Ex-Post Project Evaluation 2020:
Package III-2 (Rwanda, Uganda, Tanzania)

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JAPAN INTERNATIONAL COOPERATION AGENCY

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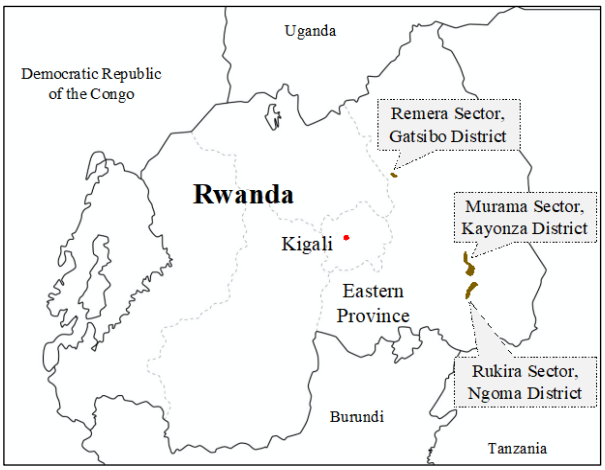
FY2020 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

External Evaluator: Takako Haraguchi, i2i Communication, Ltd. (January 2022)
Duration of the Study: December 2020–January 2022
Duration of the Field Study: 16–22 March 2021, 15–24 April 2021[1]

Country Name	The Project for Rural Water Supply (Phase III)
Republic of Rwanda	



Location of the Project site

Public water tap (Murama Sector, Kayonza District)

I. Project Outline

Background

In Rwanda, many of the people live in hilly areas where water sources are scarce. Water sources for rural water supply were mainly springs, lakes, and rivers. However, the poor quality of water and the time required to fetch water from distant areas presented additional obstacles to rural development. In its national development plan, "Vision 2020" (formulated in 2000), the Rwandan government set a goal of achieving 100% access to safe water by 2020. However, as of 2011, the national rate of access to safe water (the percentage of population served) was only 74.2%, with the Eastern Province having a particularly low rate of 66.6%.

The Japan International Cooperation Agency (JICA) has assisted in rural water supply since the early 2000s, mainly in the Eastern Province. The Rwandan government requested cooperation for sites that were not covered by the two grant aid projects, the "Project for Rural Water Supply" (Exchange of Notes (E/N) signed in 2006) and the "Project for Rural Water Supply (Phase II)" (E/N signed in 2010), and this project was implemented in response to that request.

Objectives of the Project

To improve access to safe water and the percentage of population served in the target areas of the Eastern Province by developing water supply schemes and enhancing maintenance capacity, thereby contributing to the improvement of the living conditions of people in terms of water and sanitation.

Contents of the Project

1. Project Sites: A total of four sites in Rukira Sector, Ngoma District[2] (two sites, Rukira East and Rukira West), Murama Sector, Kayonza District (one site), and Remera Sector, Gatsibo District (one site) in the Eastern Province
2. Japanese side:
   1) Civil works, procurement of equipment, etc. (The table shows actual results, with some changes in quantity from the plan.)

Facility		Site				Total
		Rukira East	Rukira West	Murama	Remera	
Intake Facility	Spring Intake Facility	1 unit	1 unit	2 units	-[a]	4 units
	Borehole Pit	-	-	-	3 units	3 units
	Conveyance Pipeline	-	0.1 km	0.1 km	-	0.2 km
Transmission Facility	Receiving Tank	1 unit	1 unit	1 unit	1 unit	4 units
	Control House	1 unit	1 unit	3 units	4 units	9 units
	Balancing Tank	-	-	2 units	2 units	4 units
	Transmission Pipeline	0.8 km	0.4 km	3.7 km	4.6 km	9.5 km
	Chlorination Room	1 unit	1 unit	-[b]	1 unit	3 units
Distribution Facility	Distribution Tank	1 unit	1 unit	1 unit	1 unit	4 units
	Distribution Pipeline	5.5 km	9.6 km	28.1 km	14.4 km	57.6 km
	Monitoring Room	-	-	1 unit	1 unit	2 units
	Break Pressure Tank	1 unit	-	5 units	2 units	8 units
Water Service Facility	Public Water Tap	7 units	16 units	25 units	27 units	75 units

[a] Distribution pipelines from the existing spring water were connected to the receiving tank.

[1] Due to the new coronavirus pandemic, the fieldwork was conducted remotely from Japan. Specifically, under the direction of the ex-post evaluator, a local assistant located in Kigali conducted interviews with the executing agency and related organizations and made site visits.
[2] Rwanda's local administrative divisions are province, district, sector, cell, and village.

	[b] A chlorine injector was installed in the Control House. 2) Consulting service / soft component: Bidding assistance and implementation supervision for the works described above, assistance for the installation of Water Service Providers (hereinafter referred to as "WSPs") and Water User Committees (hereinafter referred to as "WUCs"), and sanitation awareness activities, etc. 3. Rwandan side: Securing lands for planned water supply facilities, explaining to and obtaining consents from water source users, supplying safe drinking water to the users of existing water source facilities during construction, and selecting, executing contracts, managing WSPs at the target sites, etc. by the districts.

Implementation Schedule	E/N Date	March 5, 2015	Completion Date	July 20, 2017 (start of operation)
	G/A Date	March 5, 2015		
Project Cost	E/N Grant Limit / G/A Grant Limit: 1,013 million yen, Actual Grant Amount: 1,008 million yen			
Executing Agency	Water and Sanitation Corporation (WASAC)			
Contracted Agencies	Main Contractor: Tone Engineering Corporation Main Consultant: Nihon Techno Co., Ltd.			

II. Result of the Evaluation

Summary

The relevance is high, as the project objective was consistent with Rwanda's development plan and development needs and Japan's ODA policy at the time of the ex-ante evaluation. The outcome "to improve access to safe water and the percentage of population served" was achieved, as both the amount of water supply and the population served in the target areas exceeded the targets. The intended impact, "improvement of the living conditions of people in terms of water and sanitation," also seems to have been achieved based on the responses from the executing agency, although data were not available. Therefore, the effectiveness and impact are high. Efficiency is fair, as the project period exceeded the plan. Sustainability is high. The institutional/organizational, technical, and financial aspects of operation and maintenance have been established. Although some minor problems were observed in the current status of operation and maintenance and there was flooding near some of the facilities, these issues affected only a small part of the entire project. Thus, it was judged that the sustainability of the project effects in the future would not be undermined.

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

Overall Rating[3]	A	Relevance	③[4]	Effectiveness & Impact	③	Efficiency	②	Sustainability	③

<Special Perspectives Considered in the Ex-Post Evaluation>

- The project objective was stated in the ex-ante evaluation sheet as "to develop water supply schemes and enhance maintenance capacity in the Eastern Province, thereby contributing to the improvement in access to safe water and the percentage of population served in the province." However, based on the logic of the project, "to develop water supply schemes and enhance maintenance capacity" was classified as an output, while an "improvement in access to safe water and the percentage of population served" was classified as a direct outcome. With respect to the impact (indirect outcome), the qualitative effects "reduction in the burden of fetching water" and "reduction in waterborne diseases" stated in the ex-ante evaluation sheet are appropriate in light of the details of the project. These are also considered to be synonymous with "improvement of the living conditions of people in terms of water and sanitation," which was set as an impact in the ex-post evaluation (2016) of the "Project for Rural Water Supply/Project for Rural Water Supply (Phase II)," and this wording was used in this project as well.
- The quantitative effects were judged primarily based on the achievement level of the two indicators, "the amount of water supply in the target areas" and "the population served in the target areas," which were set at the time of the ex-ante evaluation. In addition, "the percentage of population served" and "safe water" (water quality), which are mentioned in the project objective above, were also examined as supplemental information.

1 Relevance

<Consistency with the Development Policy of Rwanda at the Time of Ex-Ante Evaluation>

This project was consistent with the development plan at the time of the ex-ante evaluation. In addition to the "Vision 2020" stated in the "Background" section above, the water sector was regarded as one of the national priorities in the "Second Economic Development and Poverty Reduction Strategy" (2013–2018). "The National Policy and Strategy for Water Supply and Sanitation Services" (2010) also defined the fundamental components of Rwanda's water policy, including the definition of the safe water access rate (the percentage of population served) (as the percentage of people who can access improved drinking water supply points (piped water supply schemes, protected wells, protected springs, and rainwater harvesting facilities, which meet the World Health Organization (WHO) Guidelines for Drinking Water Quality) located within 200 meters in urban areas and 500 meters in rural areas).

<Consistency with the Development Needs of Rwanda at the Time of Ex-Ante Evaluation>

As stated in the "Background" section above, this project was consistent with the need for access to safe water in the Eastern Province at the time of the ex-ante evaluation.

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

This project was consistent with Japan's ODA policy at the time of the ex-ante evaluation. "The Country Assistance Policy for the Republic of Rwanda" (April 2012) designated "Social Service Improvement (Safe Water Supply)" as a priority area and provided comprehensive

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

[4] ③: High, ②: Fair, ①: Low

assistance by combining various schemes, focusing on the Eastern Province where the percentage of population served was lower than other provinces.[5] The project is also consistent with the Japanese government's announcement at the Fifth Tokyo International Conference on African Development (TICAD V) (2013) that it would support an "improvement in access to safe water and sanitary conditions for 10 million people."

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact

<Effectiveness>

The quantitative and qualitative effects have been realized as expected. Therefore, the direct outcome, "improvement in access to safe water and the percentage of population served," has been achieved at the time of the ex-post evaluation.

(1) Quantitative Effects

The project facilities were confirmed to be in operation at all sites during the field inspection. Quantitative indicators, the amount of water supply in the target areas (Indicator 1) and the population served in the target areas (Indicator 2), both exceeded their target values (Table 1). The actual amount of water supply is estimated by WASAC, the executing agency, based on the population served and water supply hours and is not necessarily the actual amount of water supplied. It still is a reasonable calculation to show "the access to safe water and the percentage of population served." On the other hand, as actual measurements based on meter reading, the data on the amount of water supply (nonpublic information) for some facilities were obtained from the WSP, which is entrusted with the operation and maintenance of water supply facilities by each district. The values were lower than the data provided by WASAC above.[6] WASAC believes that WSP data are potentially underreported and is conducting a fact-finding survey at the time of the ex-post evaluation.

The reason why both the amount of water supply and the population served exceeded the plan can be attributed to the fact that water was supplied to more areas than initially targeted in order to improve the percentage of population served (Table 2). In particular, in the Remera site, the district extended the water distribution pipelines and added three public water taps in 2000 with support from NGOs.[7] As a result, the percentage of the population served in the target sectors, by calculation, became 94.6%.

Factors affecting water consumption include the use of existing water sources and the level of water pricing. As for existing water sources, water from springs and rivers is still used, and there exists an existing piped water supply scheme at the Remera site with lower rates than the project facilities.[8] The water tariff for public water taps (per 20 liters) is set uniformly throughout the country according to the power source of the facility: 8 Rwandan Francs (RWF) for gravity flow type (electricity not used), 20 RWF with the use of commercial power supply, and 25 RWF with the use of generators. At the time of the ex-ante evaluation, none of the project sites had been electrified, and the community survey estimated that the affordable price for the residents of the target areas was 22 RWF, which was less than 25 RWF. For this reason, JICA recommended to the Rwandan side to electrify the target areas as soon as possible. The water tariff was 25 RWF for all sites immediately after the completion of the project. Then, the Rukira East, Rukira West, and Murama sites were electrified in 2018, and the tariffs were reduced to 20 RWF. The Remera site is not yet electrified, and the tariff remains at 25 RWF. In addition to the high tariffs, another issue in using generators is that WSPs sometimes do not provide sufficient water supply because they refrain from running their pumps to save fuel costs for generators. However, according to WASAC, the situation has improved in sites where water tariffs have been reduced. At the time of the ex-post evaluation, WASAC is conducting a study on the revision of water tariffs for rural water supply (e.g., setting different tariffs for different income groups).

The quality of supplied water is good. The recent measured values available meet the Rwandan water quality standards (in accordance with the WHO Guidelines for Drinking Water Quality) (Table 3). Measurement data for other sites were not available, but according to the respective WSPs, all measurements at the end of 2020 were within standards.[9]

(2) Qualitative Effects

Since the WSP selection system and WUCs installed through the soft component are functioning (see also "4 Sustainability"), it can be said that qualitative effects have manifested. This was also helped by the technical cooperation project, the "Project for strengthening operation and maintenance of rural water supply systems in Rwanda" (2015–2019), which established operation and maintenance systems

[5] JICA assistance projects other than this project: "Project for Rural Water Supply" (grant aid, 2006), "Project for Rural Water Supply (Phase II)" (grant aid, 2010), "Study for the Improvement of the Rural Water Supply in Rwanda" (development study, 2008), "Improvement of Water Supply and Sanitation in the South Part of Eastern Province" (technical cooperation project, 2007–2010), "Project for strengthening operation and maintenance of rural water supply systems in Rwanda" (technical cooperation project, 2015–2019), and Japan Overseas Cooperation Volunteers (Water Security Action Team (W-SAT)). "The Project for Rural Water Supply Services and Infrastructure Management Development" (technical cooperation project, 2021–2026) is also under preparation as of September 2021.

[6] For example, the amount of water supplied in the Remera site in 2020 is 20,262 m^3/year according to the WSP data, which equals to 56 m^3/day if divided by 365 days.

[7] The World Vision and Movimento Lotta Fame Mundo (MLFM).

[8] The existing springs and rivers at the Rukira West site (the project facilities are located near these) and the irrigation reservoir at Nyakanazi cell in the Murama site were identified during the fieldwork, and the water from all of these sources is free of charge. In addition, at the Remera site, there is a gravity flow type facility (one public water tap) installed by the district before the project implementation, which, unlike the project facility, does not use an electric pump, so water is available at a low cost (8 RWF). During the fieldwork, it was also pointed out that the usage of the project's public water taps installed near this public water tap was low.

[9] The water quality of one of the three boreholes installed at the Remera site should be noted as an issue. The water quality of this source was within the WHO Guidelines for Drinking Water Quality at the time of the ex-ante evaluation and detailed design. However, a water quality test was conducted because there were some changes in the smell and color of the water immediately after pumping just before the completion of construction. In the test, some items exceeded the Rwandan water quality standards (as for the cause, the report from the consultant of this project to JICA cites potential infiltration from other aquifers). However, after discussions during the defect inspection (2019), it was confirmed that the water could be used after mixing it with water from other sources to ensure safety. According to WASAC, the smell and color of this water source still exist at the time of the ex-post evaluation, but the test items that exceeded the water quality standards in quantitative tests are now within the standards, so if demand increases further in the future, the water will be mixed with water from other sources as explained above.

for WASAC, districts, and WSPs and strengthened their capacities.

<Impact>

The intended impact (indirect outcome) of the "improvement of the living conditions of people in terms of water and sanitation" has been achieved. The burden of fetching water has been reduced. According to WASAC and the target districts, although no data are available, the time and effort required to fetch water have been reduced since the water supply points became closer than before the project. With water available within minutes of their homes, women, who are primarily responsible for fetching water, can now spend more time on agricultural activities and income-generating activities (i.e., small businesses). Children no longer have to spend time fetching water before school. Waterborne diseases are also considered to have been reduced. Although data are unavailable again,[10] WASAC believes that access to safe water has reduced diarrhea, which in turn alleviated malnutrition.

No negative impact on the natural environment was observed.[11] WASAC and relevant local organizations responded that "no negative impact has occurred," and, given the nature of the project, it is unlikely that any negative impact would have occurred. There was no resettlement.[12]

In addition, WASAC and the local stakeholders reported that the water intake in this project was not detrimental to the users of the existing water sources other than the target residents. As a countermeasure, the design of this project ensures that there is enough water for use by nearby residents and discharge downstream.

<Evaluation Result>

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

Quantitative Effects

Table 1 Actual Results of Performance Indicators

Indicators		Baseline 2012 Baseline Year	Target 2020 3 Years after Completion	Actual 2019 2 Years after Completion	Actual 2020 3 Years after Completion
Indicator 1 Amount of Water Supply in the Target Area (m^3/day)	**Sector as a whole**	**954**	**1,618**	**1,810**	**2,044**
	Rukira	339	501	573	597
	Murama	266	479	459	492
	Remera	349	638	778	955
	Project facility only	**0**	**664**	**665**	**1,036**
	Rukira East	0	162	78	93
	Rukira West			90	142
	Murama	0	213	214	256
	Remera	0	289	283	545
Indicator 2 Population Served in the Target Area (person)	**Sector as a whole**	**47,693**	**80,894**	**NA**	**96,631**
	Rukira	16,948	25,035	NA	27,309
	Murama	13,307	23,970	NA	24,649
	Remera	17,438	31,889	NA	44,673
	Project facility only	**0**	**32,901**	**NA**	**48,938**
	Rukira East	0	8,087	NA	3,269
	Rukira West			NA	7,092
	Murama	0	10,663	NA	11,342
	Remera	0	14,151	NA	27,235
(Supplemental Information) Percentage of Population Served (%)	Sector as a whole (Total of 3 sectors)	66.6 (2011)	88.2	NA	94.6

Source: Ex-ante Evaluation Sheet, Preparatory Survey Report, data provided by WASAC

Note: Based on the contents of the indicators, Indicators 1 and 2 can be classified as operation indicators, and the percentage of population served can be classified as an effect indicator. Each indicator was calculated in the following way:

- Indicator 1: Target value = baseline value + planned amount of water supply. Planned amount of water supply = planned amount of water intake x (100% - 10% of unaccounted-for water). Planned amount of water intake (in case of a spring) = feasible water yield (spring water volume) (m^3/hour) x 24 hours x (100% - 25% for discharge to nearby residents and downstream of the intake point). Planned amount of water intake (in case of a borehole) = feasible water yield (pumping volume) (m^3/hour) x 12 hours x (100% - 25% for discharge to nearby residents and downstream of the intake point). Three of the four water sources in the Remera Sector are boreholes, and all other sites are springs. Actual values were estimated by

[10] The district health offices, which may have had data, could not be interviewed due to the constraints of the fieldwork.

[11] The guideline for environmental and social considerations applied to this project is "JICA guidelines for environmental and social considerations" (2010), and the environmental category is C.

[12] At the time of the ex-ante evaluation, it was confirmed in the fieldwork in the presence of the respective district, sector, and village experts that the locations of storage tanks, including intake facilities, control houses, public water taps, etc., were on lands owned by the target villages. They agreed on the use of the land and confirmed that no resettlement would occur. During the implementation of the project, there were some changes in the construction location of some of the facilities, but these changes were made for technical reasons such as the results of test drilling in the detailed design, as well as in response to the requests of the sector offices, village mayors and residents. Such changes were decided and implemented after re-consultation with these stakeholders.

WASAC based on the population served (Indicator 2) and water supply hours.

- Indicator 2: Target value = baseline value + planned population served of the project (amount of water supply / water supply rate of 20 liter/capita/day). Actual value = baseline value + population of the area covered by the project (aggregated at the village level).
- Percentage of the population served: 2012 data are the percentage of population served in the Eastern Province in 2011, according to the third Integrated Household Living Conditions Survey. Target value = target value of population served / target area population estimate. Actual value = actual value of population served (Indicator 2) / target area population.

Table 2 Areas Covered by the Project

Site	Plan	Result (March 2021)
Rukira East	Nyaruvumu Cell and Kibatsi Cell in Rukira Sector, Ngoma District	In addition to two cells on the left, Rubimba Cell in Kabare Sector, Kayonza District
Rukira West		Nyaruvumu Cell in Rukira Sector, and Gatonde Cell in Kibungo Sector in Ngoma District
Murama	Nyakanazi Cell, Muko Cell, Rusave Cell in Murama Sector, Kayonza District	As planned
Remera	Nyagakombe Cell, Kigabiro Cell, Butiruka Cell in Remera Sector, Gatsibo District	In addition to the left, Matare Cell and Remera Cell in Rugarama Sector, Nyagisozi Cell in Kageyo Sector, Cyabusheshe Cell in Gitoki Sector, Gatsibo District

Source: Preparatory Survey Report, WASAC, districts/WSPs

Table 3 Select Water Quality Measurements at a Water Supply Point in the Remera Site

Measurement Date	pH	Turbidity	Coliform (*E. Coli*)
	Standard: 6.5<pH<8.5	Standard: <5 NTU	Standard: 0 CFU/100 ml
September 25, 2019	6.6	2.81	0
December 22, 2020	6.5	2.58	0

Source: Documents provided by WSP

3 Efficiency

The outputs of this project were as described in "I. Project Outline - Details of the Project" above, and they were mostly produced as planned, although there were some design changes and additional construction works on the Japanese side. As for design changes, construction locations and the quantity of some facilities were changed due to condition changes during construction. The additional construction works, which were the protection works on the cut-earth surface of more than two meters (six places), were carried out as additional outputs covered by the grant aid. This was due to the fact that the scale of preparation works (securing lands for planned water supply facilities), which were carried out at the Rwandan side's expense, was larger than expected. The additional construction was carried out based on the consensus among stakeholders that protection works were necessary for the cut-earth surface and by considering the maintenance of the project facilities in the future. JICA determined that all of the changes and works above were appropriate. No particular problems were observed in this evaluation.

As for the inputs, the planned and actual project costs for the Japanese side were 1,013 million yen and 1,008 million yen, respectively. The actual cost, even including the additional construction works, was as planned (100% against the plan). The planned and actual project costs for the Rwandan side were one million yen and 22 million yen, respectively, according to available information. However, most of the actual cost was for taxes related to the purchase of materials, which were not included in the planned cost, while the actual cost of the notification fees for the Authorization to Pay (A/P) and the bank arrangement fees, which were included in the planned cost, were unavailable. Thus, no comparison could be made between planned and actual costs.

While the planned project period was 25 months from March 2015 to March 2017,[13] the actual project period was 29 months from March 2015 to July 2017 (excluding the period for the additional construction), exceeding the plan (116% against the plan). This was due to the fact that the process from bidding to the execution of the contract took longer than planned.[14]

In light of the above, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional/Organizational Aspect>

The operation and maintenance system and staff assignment for this project have not changed from the plan made at the time of the ex-ante evaluation, and an adequate system has been established. The owners of the constructed water supply schemes are now districts, which supervise and oversee the water supply operations with technical support from the WASAC Rural Water and Sanitation Services. Water supply operations are conducted by WSPs (also known as Private Operators (POs) since they are currently outsourced to private companies), which are commissioned through a bidding process in each district, and users pay for water on a metered basis. The provision of water supply services and collection of fees at each water supply point is conducted by the tap manager, who is subcontracted by the WSP. In addition, the Water Users Committee (WUC), an organization representing the users of each water supply point, monitors the operation and maintenance of the water supply point and collects requests from users. The Rukira East site is located on the Ngoma District side of the border between Ngoma and Kayonza Districts, but because the water supply points are used mostly by villages in Kayonza District, the site is operated and maintained by the WSP contracted by Kayonza District. At the national level, WASAC deployed District Support Engineers

[13] While the planned project period was stated as 24 months in the Ex-ante Evaluation Sheet, the period was recalculated by including both the first and last months.

[14] The project completion date was defined as the start of operation in accordance with the framework of JICA ex-post evaluation. As of July 2017, the additional construction (protection works on the cut-earth surface) remained to be completed, but the construction of water supply schemes had already been completed. The water supply was commenced by conducting the water supply ceremony before the completion of the additional construction in response to the request from the Rwandan government. The completion date of the entire construction, including the additional scope, was October 31, 2017, which was 128% against the plan when this date is considered as the project completion date.

(DSEs) in 27 districts across the country, hiring 21 DSEs in May 2018 and six in May 2019. At the time of the ex-post evaluation, a DSE has also been assigned to each of the three target districts of the project.

Table 4 Staff Assignment for Operation and Maintenance of this Project (as of March 2021)

National level	・One person as the Head of the Operation and Maintenance Unit, WASAC Rural Water and Sanitation Services, and three DSEs (one per district)
District, Sector	・District: one person as the Water and Sanitation (WATSAN) officer ・Sector: one person as the Land Manager
Each site	・WSP: one person as the Branch Manager, one person as the Head of the Technical Team, one plumber, two pump operators, one billing officer, one tap manager (subcontracted) at each public water tap ・WUC: one group at each public water tap

Source: Documents provided by WASAC and each WSP

<Technical Aspect>

Technical skills required for the operation and maintenance of the project facilities have been established. According to WASAC, the skills required at each level are water engineering skills at the district level, civil engineering skills at the sector level, and administrative, technical (inspection, parts replacement), and financial skills at the WSP level (no specific skills required for WUC (residents)). As these are the requirements for personnel selection and deployment at all sites, it can be said that the necessary skills are in place. The technical cooperation project, "Project for strengthening operation and maintenance of rural water supply systems in Rwanda," mentioned above also supported the training of DSEs, developed guidelines, manuals, and training modules for the operation and maintenance of rural water supply facilities, and provided training to DSEs, districts, and WSPs.

As a mechanism to maintain operation and maintenance skills, for the central level (WASAC) staff, a capacity assessment is conducted annually, and training plans are developed and implemented according to the identified capacity gaps. At the district/sector level and WSPs, there are opportunities to participate in training at the central level each year. In addition, training is sometimes provided by Development partners. At the individual facility level, WASAC is planning to conduct training for WSPs and WUCs on service delivery and infrastructure maintenance.

<Financial Aspect>

Finances required for the operation and maintenance of the project facilities have been secured. It was assumed at the time of the ex-ante evaluation that WSPs' responsibility set forth in their contracts with the respective districts would be daily operations and minor maintenance and that the costs for major and medium-scale repairs and renewal of facilities would be supported by the respective districts and the central government. In addition, each WSP was to contribute a portion of its sales to the district's Water Account as royalties. At the time of the ex-post evaluation, these mechanisms were functioning. For major and medium-scale repairs and renewal of facilities, WASAC has developed and updated an inventory of rural water supply facilities. The project has also established a mechanism for the central government to secure the budget required for repairing and renewing facilities that have become obsolete or been damaged due to natural disasters, etc. (the mechanism for royalties and the inventory of rural water supply facilities were established with the support of the JICA technical cooperation project mentioned above).

While the revenue and expenditure data of WSPs could not be obtained due to restrictions on third-party disclosure, each WSP reported that they were able to recover their operation and maintenance costs from the water tariff revenue. No issues were found, as this was also confirmed by some of the disclosed data. In addition, 10% of the revenue was contributed by each WSP as royalties to the respective district. While WSPs reported that they were generally able to collect water tariffs from residents, as noted in "2 Effectiveness/Impact," if the records for the amount of water supply were under-reported by WSPs, the reported amount of fees collected and the amount of royalties paid would be less than the actual amount. For this reason, we need to wait until WASAC completes its investigation on this point (since the required amount has been secured, the rating will not be lowered due to this).

<Current Status of Operation and Maintenance>

The condition and operation/maintenance status of the project facilities is generally good. During the fieldwork, some problems were found, as shown in the table below. However, except for the problem of flooding at the Murama site, they are minor and can be addressed in the short term. As the flooding is not affecting the water supply at the time of the ex-post evaluation, this issue is not considered to be of such a magnitude as to impair the sustainability of the project effects in the future. Thus, the rating was not lowered due to this issue, although this is noted as an issue that needs to be addressed.

Regular maintenance (monthly) and routine maintenance (daily) are conducted at all sites. Spare parts are all readily available, and there is no difficulty in procuring them.

Table 5 Status of the Project Facilities (as of March 2021)

Rukira East	Good. The water tap on the plastic tank next to the receiving tank was damaged and leaking, but the operation is unaffected.
Rukira West	Generally good. Four out of the 16 public water taps are not cleaned well and have a risk of contamination. Some facilities are insufficiently protected and may be damaged by sedimentation.
Murama	Generally good. However, the adjacent facilities have the following problems. 1) They are flooded during the rainy season due to unexpected heavy rainfall due to climate change, which may cause damage to the control house in the future. 2) The padlock on the cover at the top of the intake facility has been damaged, and children are throwing stones and grass inside.
Remera	Generally good. Fences have been installed around the facility, but they are insufficient, sometimes allowing livestock to enter.

Source: Fieldwork

<Evaluation Result>

No major problems have been observed in the institutional/organizational, technical, financial aspects and current status of the operation

and maintenance system. Therefore, the sustainability of the project effect is high.

III. Recommendations & Lessons Learned

Recommendations to Executing Agency:

1) There is a possibility of under-reporting of the actual amount of water supply by WSPs. WASAC is recommended to complete the fact-finding being conducted at the time of the ex-post evaluation as quickly as possible to ascertain the exact amount of water supply.
2) As the Remera site is not electrified, water tariffs have not been reduced from the rate charged for using generators as the power source. It is recommended that WASAC explore the possibility of reducing tariffs through electrification and conduct a review of water tariffs for rural water supply as soon as possible based on the study being conducted at the time of the ex-post evaluation.
3) It is recommended that district governments manage the Water Account properly and that, in the event that the project facilities require repairs in the future, they make arrangements to ensure that the Account will be used as intended. In addition, in the event that repairs are required on a scale that districts cannot accommodate, WASAC is recommended to make arrangements to ensure that funds from the central government will be used as intended.
4) Issues were found in the maintenance status of some facilities. It is recommended that each district take the following actions as soon as possible.
   - Improving the drainage at the Murama site. Environmental authorities should take countermeasures against climate change, such as planting more trees.
   - Removing the sediment accumulated on the cover of the underground facilities at the Rukira West site.
   - Ensuring the cleaning of public water taps at the Rukira West site.
   - Replacing the padlocks on the intake facility covers and ensuring safety management at the Murama site.
   - Strengthening the fences of the intake facility and ensuring safety management at the Remera site.

Lessons Learned for JICA:

Points to consider when setting quantitative indicators

By considering the basis of its calculation, the target value of the indicator "amount of water supply" set in the ex-ante evaluation sheet appeared to represent the water supply capacity of the project facilities, which is more of an "output." It was not possible to read from the ex-ante evaluation sheet whether it was intended to define the effectiveness (outcome) goal as the full use of the entire capacity. In a project designed to improve facilities and equipment, there are typically two possible outcome indicators: (1) facility-based targets (the project facilities are completed and capable of performing their functions as planned) and (2) utilization-basis targets (the facilities are actually used at the expected level), but it was not possible to determine which of these two types of targets was intended for the indicator "amount of water supply" for this project. This evaluation attempted to verify the results based on the second type of target (however, since accurate measured values were not available, the results were verified based on estimated values). However, the past ex-post evaluations of JICA's rural water supply projects show that not many projects used "amount of water supply" as an indicator (many evaluations, including the ex-post evaluation of the current project's preceding project, used "population served" and "percentage of population served.").

When setting quantitative indicators for grant aid projects, JICA should distinguish between (1) facility-based indicators (facility capacity, maximum capacity, etc.) and (2) utilization-based indicators and set (2) as outcome indicators when (1) can only be considered as "output" indicators. In circumstances where the indicator "amount of water supply" in rural water supply projects can still measure the outcome of "ensuring access to safe water" through (1), it would be better to name the indicator as "water supply capacity" or something similar to distinguish it from (2).

Spring intake facility (left), receiving tank (right), transmission pipeline (foreground)
(Rukira Sector, Ngoma District (Rukira East))

Public water tap installed by the district by extending the distribution pipeline from the project facility
(Remera Sector, Gatsibo District)

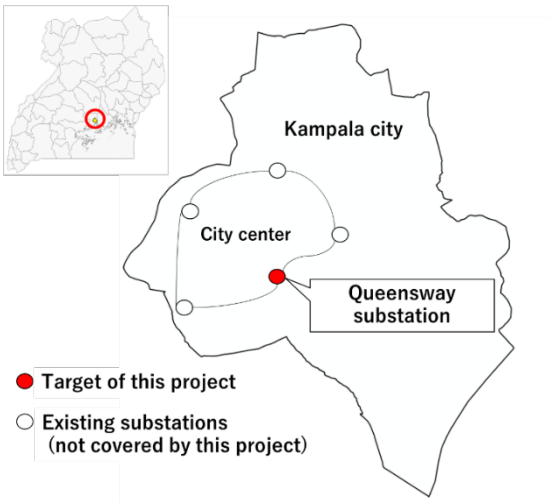
FY2020 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

External Evaluator: Juri Ishimoto, Metrics Work Consultants, Inc.

Duration of the Study: December 2020–January 2022

Duration of the Field Study: March 2021–April 2021 (conducted remotely)

Country name	Project for improvement of Queensway substation
Republic of Uganda	



Location of the project site

Outdoor 132 kV gas insulated switchgears

Indoor 33 kV gas insulated switchgears

I. Project Outline

Background	Owing to the increase in demand for electricity resulting from high economic growth in recent years, the Government of Uganda has made the increase in power generation capacity a top priority, and plans are underway to build power plants using hydroelectric, thermal, geothermal, and other technologies. However, the development of power transmission and distribution facilities has been delayed. In particular, the existing facility capacity of the 132/33 kV substation in the capital city of Kampala is approximately 400 MW, and it is operating at a maximum capacity of 320 MW or less (load factor of 80%), while the electricity demand in the city was projected to be 297 MW in 2012 and 407 MW in 2017. It was pointed out that unless the facility capacity were increased through this project, it would not be possible to meet the city's electricity demand.			
Objectives of the Project	The objective of this project was to improve the power supply to the central area of Kampala by installing new 132/33 kV substation equipment in Queensway substation, thereby contributing to improving economic development and people's lives in Kampala.			
Contents of the Project	1. Project Site: Kampala City (population: approximately 1.50 million as of 2014[1]) 2. Japanese side: 1) Civil works: control building (total floor area: 680 m^2), substation foundation (total floor area: 312 m^2); 2) Procured equipment: substation equipment (132/33 kV transformers (40 MVA, 3 units), 132 kV gas insulated switchgears (8 units), 33 kV gas insulated switchgears (14 units), 132 kV control and protection panels (9 units)), 132 kV overhead lines (including two steel towers, approximately 50 m long), and 132 kV underground cables (approximately 350 m long) ; 3) Consulting services: Detailed design, bidding assistance, construction supervision, etc. 3. Uganda side: 1) Securing land for the project site, 2) Provision of water on the site, 3) Implementation of tax exemption and customs clearance procedures, 4) Acquisition of necessary permits and approvals, such as EIA, , 5) Provision of electricity meters, 6) Procurement and installation of equipment for SCADA system[2], etc.			
Implementation Schedule	E/N Date	November 25, 2014		
	G/A Date	November 25, 2014	Completion Date	October 10, 2017 (completion date)
Project Cost	G/A Grant Limit: 3,070 million yen		Actual Grant Amount: 2,415 million yen	
Executing Agency	Uganda Electricity Transmission Company Limited (UETCL)			
Contracted Agencies	Main Contractor: Nishizawa Limited, Kinden Corporation Main Consultant: Yachiyo Engineering Co.			

II. Result of the Evaluation

Summary

The purpose of this project was to improve the power supply capacity to the central area of Kampala (Kampala metropolitan area), the capital of Uganda, by enhancing the 132/33 kV substation facilities of the Queensway substation, which is located in the center of the city. The objective is consistent with Uganda's development policy, development needs, and Japan's aid policy. Therefore, its relevance is high. Among

[1] Kampala Capital City Authority, *Statistical Abstract for Kampala City 2019*, p.23

[2] SCADA (Supervisory Control and Data Acquisition) refers to a system that collects, monitors, and controls information obtained from the equipment and facilities that make up a facility or infrastructure in a single location via a network. In Uganda, data management is conducted using a SCADA system, and this system was also introduced at the Queensway Substation, which is the subject of this project.

the effectiveness indicators, the substation facility capacity and voltage drop ratio of the power receiving end[3] have not been achieved, and the expected outcome (improvement of electricity supply to the Kampala metropolitan area) is considered to be limited. Although some of the effectiveness indicators have not been achieved, small-scale consumers in Kampala city have indicated that voltage fluctuations have reduced and the quality of service has improved since the project has been completed. In addition, the amount of nighttime light and the number of enterprises in the city are on the rise, suggesting that economic activity in Kampala is improving. The number of streetlights using electricity is also increasing, which is considered an improvement in the people's lives in terms of safety. Therefore, the effectiveness and impact of the project is judged to be fair. Although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair. As there are no problems with the institutional/organizational, technical, and financial aspects, and the current status of the operation and maintenance system. Therefore, the sustainability of the project is high.

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

Overall Rating[4]	**B**	**Relevance**	③[5]	**Effectiveness and Impact**	②	**Efficiency**	②	**Sustainability**	③

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

- Implementation of remote survey: Because of the COVID-19 pandemic, the field information necessary for the evaluation was collected via remote survey from Japan. All field surveys of the facilities developed under the project and interviews with project personnel and others were conducted by local consultants under the direction of the External Evaluator.
- Adoption of supplementary indicator (improvement of planned outage hours): During the project planning stage, planned outages were mainly caused by distribution lines overloading, and it was expected that the project would improve the planned outage hours in Kampala (1776.7 hours in 2013) by reducing the overload conditions of existing facilities. Since this project was expected to make a direct contribution, "outage hours in Kampala metropolitan area" was adopted as a supplementary indicator of effectiveness in this evaluation. However, since it is difficult to predict the increase in electricity demand in the target area, a target value was not set for this indicator. Additionally, since it is not possible to judge the degree of achievement by comparing target values with actual values, the indicator has been used only as reference information in judging the effectiveness of this project.
- Utilization of satellite data: In order to verify the qualitative effect of this project in "contributing to the economic activity of Kampala city," satellite data (nighttime light), which has been recognized to have a high correlation with economic activity, was utilized, and the secular change in the amount of nighttime light in Kampala city was confirmed.

1 Relevance

<Consistency with the Development Policy of Uganda at the Time of Ex-Ante Evaluation>

At the time of the ex-ante evaluation, *Uganda's National Development Plan* (2010/11 to 2014/15) and *Grid Development Plan* (2012 to 2028) listed the development of economic and social infrastructure as a priority issue, and it was necessary to improve the power supply capacity in Kampala. This project aimed to improve the power supply capacity of Kampala city by enhancing the facilities of the Queensway substation, which is located in the center of the city, and constructing a new transmission line. This is consistent with the development policy of the country.

<Consistency with the Development Needs of Uganda at the Time of Ex-Ante Evaluation>

At the time of the ex-ante evaluation, it was pointed out that the power supply capacity was insufficient to meet the rapidly increasing power demand in Kampala city, and frequent power outages were observed. Since this project aimed to stabilize power supply by enhancing the power distribution facilities, it is recognized to be consistent with the development needs of the country.

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

In *Japan's Country Assistance Policy for Uganda* (2012), Japan identified contributing to the stable supply of energy resources by supporting the development of electricity infrastructure as one of the priority issues in order to support sustainable economic growth in the country. Therefore, this project is recognized to be consistent with Japan's ODA policy.

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact

<The logic behind the project to the realization of impact>

The project aimed to improve the power supply capacity to the Kampala metropolitan area (Outcome) by enhancing the 132/33 kV substation facilities at the Queensway substation (Output). Furthermore, it aimed to improve economic activities and people's lives in Kampala city (Impact). Figure 1 shows the logic from the implementation of the project to the realization of the impact.

The expansion of the Queensway substation will increase the substation facility capacity, which will contribute to the increase in the substation facility capacity in the entire Kampala metropolitan area. In addition, the reinforcement of the substation facilities is expected to improve the voltage drop ratio of the power receiving end of the substation. Moreover, transmission and distribution losses occurred because of the lack of high-voltage transmission lines before the project[6], and the construction of the 132 kV transmission line is expected to reduce the transmission and distribution losses in the Kampala metropolitan area. The improvement of the power supply capacity to the Kampala metropolitan area will improve the situation with the overload and aging of the existing transmission and distribution facilities, reduce the

[3] The voltage drop (transmission end voltage - receiving end voltage) that occurs during transmission as a percentage of the receiving voltage.

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

[5] ③: High, ②: Fair, ①: Low

[6] At the time of the ex-ante evaluation, the Queensway substation was receiving power from existing substations in Kampala using low-voltage rather than high-voltage transmission lines. Since some of the power is lost as heat when it flows through the transmission line, it is necessary to reduce the current flowing through the transmission line (increase the voltage and transmit the electricity). However, the low voltage transmission caused line power loss.

need for periodic maintenance of the facilities, and improve the duration of planned power outages in the metropolitan area. Furthermore, it is assumed that stable power supply to the city will be realized, which will lead to the improvement of the economic activities of factories and companies and the people's lives.

Based on the aforementioned logic, regarding effectiveness, this evaluation verifies whether the power supply capacity to the Kampala metropolitan area has been improved by confirming the improvement status of the substation facility capacity, voltage drop ratio, transmission and distribution losses, and power outage time. As for the impact, the improvement of the economic activities and people's lives in the city is verified based on the results of interviews and the secular change in the amount of nighttime light.

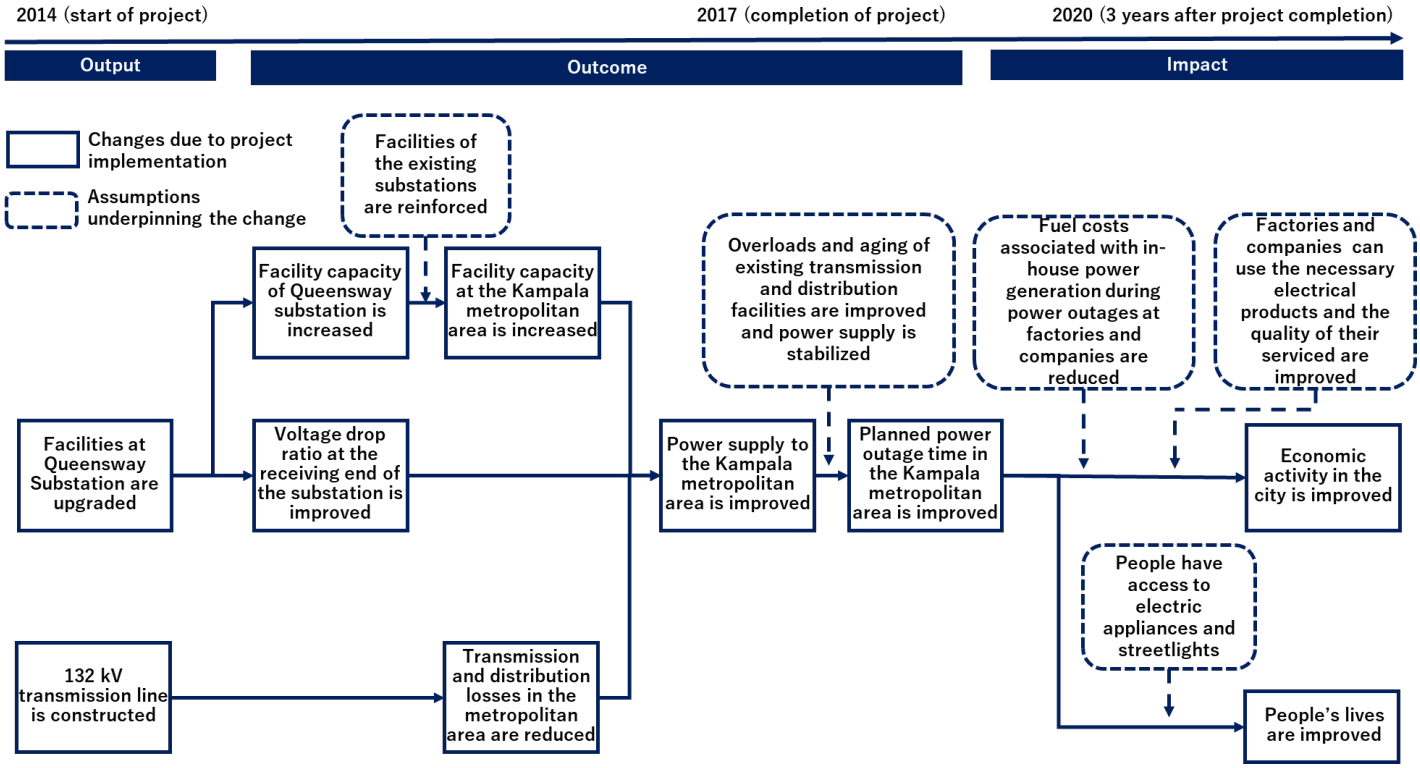


Figure 1: Logic of the project

<Effectiveness>

(1) Substation facility capacity (MVA) at Kampala metropolitan area

The actual value is 540 MVA against the target value of 700 MVA, which is far below the target. Since the actual value is 80 (540–460) against the assumed increase of 240 (700–460), the degree of achievement of the target is about 33%. Hence, this target is judged to be not achieved.

This indicator includes not only the facility capacity of the Queensway substation but also that of other substations in the Kampala metropolitan area. Therefore, the reinforcement of other UETCL substations was also required to achieve the indicator. However, because of the delay in the reinforcement of existing substations, this indicator has not been achieved. In particular, the facility capacity of the existing substation (Mutundwe substation), which is not covered by the project, was planned to be increased from 120 MVA to 240 MVA by 2020, but owing to delays in the plan, its capacity will be increased after 2022.

If only the facility capacity of the Queensway substation is compared, the actual capacity is 80 compared to the planned 120 (target achievement: approximately 67%). The reason for the underachievement is that one transformer at the Queensway substation failed in 2019 and is currently under repair (see "4 Sustainability" below). In view of the fact that without the expansion of this substation, the supply would be even lower than the target, the project is considered to have contributed to the expansion of the substation facility capacity within Kampala city. However, the target is considered to have not been achieved because the planned target of 120 has not been achieved.

(2) Voltage drop ratio of the power receiving end at Queensway substation (%)

The actual result was 6.97% against the target of 4.02%. Hence, this target has not been achieved. The main reasons are the failure of a transformer at the Queensway substation developed under the project and delays in the maintenance of surrounding substations which were not targeted by the project. Because of the failure of one transformer at the Queensway substation, the other transformers were overloaded and the overall voltage drop ratio was high. In addition, the completion of the existing substations (Karma power station, Ayago power station, and the transmission line between Karma and Kawanda) has been delayed, and not enough reactive power[7] is being delivered to the transmission grid (and Queensway substation) as envisaged at ex-ante evaluation, hence resulting in lower transmission grid voltages and a high voltage drop ratio.

(3) Transmission and distribution losses at Kampala metropolitan area (MW)

The target value was 22.1, while the actual value was 22.0. Hence, the target has been achieved.

[7] Normally, in order to prevent voltage rise due to resistance of transmission lines, etc., power (reactive power) that does not create a load and cancels out the voltage rise is fed in.

Table 1: Ex-ante and ex-post comparison of effectiveness indicators

	Baseline 2014 Baseline Year	Target 2020 3 years after Completion	Actual 2017 Completion Year	Actual 2018 1 Year after Completion	Actual 2019 2 Years after Completion	Actual 2020 3 Years after Completion
Substation facility capacity (MVA)*1	460	700	560	560	540	540
Voltage drop ratio of the power receiving end (%)*2	4.43	4.02	NA	6.67	7.87	6.97
Power transmission and distribution loss (MW)*3	17.3	22.1	NA	30.9	16.1	22.0

Source: Questionnaire responses and interviews with UETCL

*1: Total facility capacity (132 kV transformers) of the Queensway substation and existing substations not covered by the project (Lugogo, Kampala North, Mutundwe, and Kawaala).

*2: Actual values are calculated by simulation.

*3: (Power generation in Kampala metropolitan area + received power at Kampala metropolitan area) - (Total demand in Kampala metropolitan area and surrounding areas). The target value is higher than the baseline value because during project planning, it was stated, "the increase in the amount of electricity supply would lead to an increase in transmission and distribution losses, and it would be possible to reduce the increase in losses compared with the case wherein the project was not implemented (24.8)."

(4) Power outage hours in Kampala metropolitan area (Reference Information)

As indicated in the previous section <Special Perspectives Considered in the Ex-Post Evaluation/Constraints of the Ex-post Evaluation>, the above supplementary indicators have been adopted in this evaluation and used as reference information in judging the effectiveness of the project. Data regarding the number of power outage hours provided by UETCL is shown in Table 2. It should be noted that at the time of planning, only the planned outage hours were confirmed, but the actual values could not be collected separately for planned and forced (accidental) outages. Therefore, Table 2 shows the total hours for both planned and accidental outages.

The number of power outage hours has decreased significantly to 2157 hours in 2019 compared to 5640 hours in 2014. According to UETCL, the main reason for planned outages both before and after the implementation of the project is the scheduled maintenance of substations. It was noted that the reinforcement of the 132/33 kV substation facilities at Queensway substation through the project has created substantial grid flexibility and minimized the need for outages during routine maintenance, leading to a reduction in the number of planned outage hours. It should be noted that power outage hours have increased from 2018 to 2019. According to UETCL, it is attributed to emergency loadshedding that was carried out at the end of 2019 due to outage of the Owen Falls – Lugogo 1 and 2 transmission lines and towers collapsed as a result of vandalism.

Table 2: Power outage hours of each substation in Kampala city

Substation	2014	2015	2016	2017	2018	2019
Lugogo	665	1220	649	1014	481	528
Kampala North	1874	877	489	591	639	761
Mutundwe	1901	1930	774	576	220	264
Kawaala	232	276	93	119	65	320
Queensway	968	354	173	452	71	285
Total	5640	4658	2178	2752	1476	2157

<Impact>

(1) Improvement of economic activities in Kampala

Interviews with small-scale consumers

With cooperation from the Uganda Small Scale Industries Association (USSIA), interviews were conducted with small-scale consumers belonging to the association[8]. From the interviews, it was confirmed that the quality and quantity of electricity had improved after the completion of the project. At the time of the ex-post evaluation, some consumers said that they were able to provide stable service, which led to customer acquisition and increased revenue. The main power-related problems during project planning were voltage fluctuations caused by aging transmission and distribution facilities and overloads. 25 of the 30 companies responded that electrical products failed because of high voltage and that they could not be used because of low voltage. After the completion of the project, most of the companies responded that there were no problems with voltage fluctuations. Although two companies pointed out at the ex-post evaluation that voltage fluctuations were still observed, it was also reported that the fluctuations are not as frequent as they previously were and that they are improving. A beverage company had experienced significant losses because of oxidized milk caused by low voltage and insufficient power. However, after the project was completed, there were no problems with both voltage and power supply, and the company's profit margin has stabilized. In addition, a welding company had lost customers when its operations were halted because of power shortages, but the company said that it is now operating at all times.

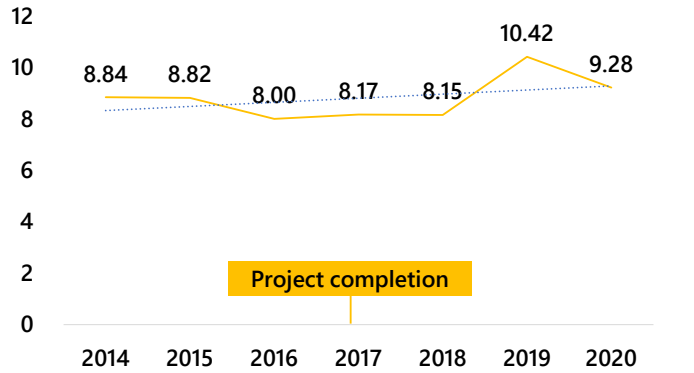
Secular change in the amount of nighttime light

It was observed that the amount of nighttime light in Kampala city increased between 2014 and 2020 (Figure 2 (blue dotted line approximates the orange broken line to see the overall trend)). If the amount of nighttime light have increased after the project's completion (2017), it is estimated that the project would be contributing to improved economic activity in Kampala city. Figure 2 shows that the amount

[8] Responses were collected from 30 companies in Kampala, including construction, manufacturing, and lifestyle-related services (laundry and hairdressing).

of light increased and decreased between 2014 and 2017 with no specific trend, but there was an overall increasing trend and a significant increase after 2019. While nighttime light is an indicator of ground brightness at night and it has been found to be highly correlated with gross economic product, it is difficult to gauge the extent of economic activity based on nighttime light levels alone. Therefore, in order to comprehend the scale of economic activity in Uganda, the average amount of nighttime light was calculated in other countries over the period 2017–2020. It was found that the amount was 2.0 in Kigali, the capital of neighboring Rwanda, and 10.0 in Nairobi, a major African city. Kampala's average amount of nighttime light over the same period was 9.3, suggesting that the city has been experiencing the same level of economic activity as Nairobi is.

In addition, the average change in nighttime light within Kampala city is shown in Figure 3, where the increase in amount of nighttime light between 2017 and 2020 is shown in order of magnitude as blue, green, yellow-green, yellow, orange, and red. From the figure, it can be seen that the amount of nighttime light has increased throughout the city, and the increase is particularly noticeable around the Queensway substation, which is located at the center of Kampala city. Since no other power transmission and distribution networks were constructed before and after the implementation of the project, it is assumed that the project has contributed to the increase in the amount of nighttime light (activation of economic activities) in Kampala city.



Source: Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines, VIIRS Nighttime Day/Night Band Composites Version 1

Figure 2: Secular change in the amount of nighttime light

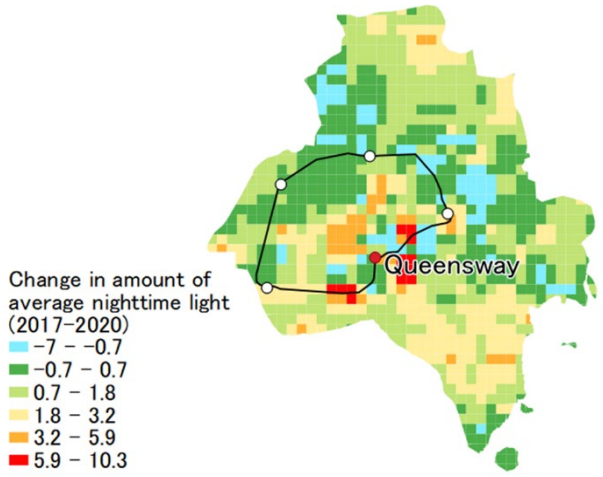


Figure 3: Change in the amount of average nighttime light in Kampala city[9] (2017–2020)

As other reference information, we collected the number of annual trade permits[10] issued by Kampala city (Table 3). Since almost all legitimate enterprises are required to obtain a permit, the number of permits issued can be viewed as the number of enterprises. Since the number of permits issued increased between 2014 and 2018, the number of enterprises is also expected to be on the rise.

Table 3: Annual number of trade permits issued in Kampala

2014	2015	2016	2017	2018	2019
46,493	97,013	63,636	60,536	63,594	NA

Source: Kampala City Statistical Abstract 2019, p. 100

(2) Improving the living environment of residents

The number of streetlights in the living environment of the residents, which may be particularly related to electricity, was identified (Table 4). Streetlights are an important element in ensuring that residents live safely, especially at night. The number of streetlights has increased after the implementation of the project (2019) compared with before its implementation (2014).

Table 4: Number of street lights in Kampala city

Source of supply	2014	2019
Electricity (connected to the hydroelectric power plant system)	NA	3,698
Solar battery	NA	1,738
Total amount	3,449	5,436

Source: KCCA Strategic Plan 2014/15-2018/2019, KCCA Statistical abstract 2019

During the aforementioned interviews with small-scale consumers, the changes in living environment were also confirmed. They answered that before the completion of the project, power outages occurred at night and theft occurred owing to the lack of streetlights, but at the time of the ex-post evaluation, such problems had not been occurring.

<Other positive and negative impacts>

(1) Impact on the natural environment

During the planning stage, the project was classified as Category C under *JICA's Guidelines for Environmental and Social Considerations* (2010) as it was determined that the project would have minimal undesirable impacts on the environment. The installation of the 132 kV underground cable and construction of the substation required an Environmental and Social Impact Assessment (ESIA), and it was approved by the National Environment Management Authority (NEMA) in February 2016. The ESIA required environmental mitigation measures during construction, such as delivering goods and equipment during low traffic hours and transplanting trees outside the substation site. According to UETCL, whether the mitigation measures outlined in the ESIA were implemented had been monitored regularly by officials of the Kampala Metropolitan Authority and the National Environmental Management Authority. The project implementation consultant also responded that no impact occurred on the natural environment during construction. The site visits also confirmed that the trees around the substation had not been cut down in excess. No complaints were reported from the residents.

[9] The area within the black line indicates the Kampala Metropolitan Area.
[10] It is valid for one year from the date of issue.

(2) Impact on the social environment (land acquisition, resettlement)

The land for the substation was owned by the Pan African Movement, a non-governmental organization chaired by the Ugandan Minister of Justice, and it was planned that UETCL would pay compensation to the organization based on its assessment. According to UETCL and the project implementation consultant, the payment was made as planned and the site was acquired before construction without any problems. Regarding the land for the 132 kV transmission line, permission for use of the road had also been obtained from the relevant authorities without any problems before construction. No resettlement has occurred.

<Evaluation Result>

As described above, the implementation of the project has increased the substation facility capacity of the Queensway substation, which has contributed to the increase in the facility capacity of the entire Kampala metropolitan area. It was also confirmed that the transmission loss and outage time in the metropolitan area were reduced. However, owing to the delay in the implementation of other projects and the failure of one transformer at the substation, the substation facility capacity has not reached the target level for the entire region, and the target voltage drop ratio of the power receiving end has not been met. Therefore, the expression of the expected outcome (improvement of power supply capacity to the Kampala metropolitan area) is judged to be limited. Although not achieved, small-scale consumers in Kampala city responded that the voltage fluctuation situation has improved and the quality of service has improved compared with their situation before the completion of the project. In addition, economic activities in Kampala are considered to have improved, as the amount of nighttime light and the number of enterprises in the city have increased. The number of streetlights that use electricity is also increasing. This may indicate that people's lives are also improving in terms of safety. No negative impacts on the natural environment or cases of resettlement were identified. Therefore, the effectiveness and impact of the project are fair.

3 Efficiency

<Output>

This project involved the reinforcement of 132/33 kV substation facilities and the construction of a 132 kV transmission line at the Queensway substation located in the center of Kampala city. The items to be borne by the Japanese side (see "I. Project Outline: Contents of the Project" above) were generally implemented as planned. Regarding the control building and the foundations for the equipment and the 33 kV gas insulated switchgear, some discrepancies were observed in the project completion report. However, this was mainly due to differences in the way the reports were written. In addition, through interviews with the project implementation consultant and site inspections, it was confirmed that the project had been implemented as planned. It was also confirmed that all the items to be borne by the Ugandan side were implemented as planned.

<Project cost>

The total project cost of this project was 2,415 million yen against the planned amount of 3,070 million yen, which was within the plan (79% of the plan). The reason the project cost was lower than the amount planned was that the contract was concluded at a lower amount than the original planned price.

<Project period>

The actual duration of the project was 36 months, while the planned duration was 27 months. Hence, the duration exceeded the plan (133% of the plan). The reasons for exceeding the planned duration were the presidential elections, torrential rains, and failure of the installed equipment. During the implementation of the project, the presidential election and torrential rains (November 2015 and April 2016) delayed the construction of the project and consequently, the completion date was extended from January 2017 to June 2017. Further, during the handover test conducted in June 2017, the 132 kV Busbar B gas insulated switchgear for the Incoming Lugogo Line failed. Therefore, these replacement activities also caused the extension of the completion date of the works from June 2017 to October 2017.

<Evaluation Result>

As described above, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional/Organizational Aspect>

At the time of ex-post evaluation, the Operation and Maintenance Department (257 employees) of UETCL was responsible for the operation and maintenance of the transmission lines developed under the project as per the plan. The Operation and Maintenance Substation Unit (57 employees) of the Department is responsible for the maintenance of the Queensway substation. The daily operation of the substation is remotely monitored and controlled 24 hours a day by the Control Unit of the Department (19 employees) through the SCADA system. According to UETCL, the operation and maintenance of the Queensway substation is remotely monitored by the SCADA system, and there has been no major failure or accident due to shortage of staff.

As described above, the scope of responsibility for the daily operation and maintenance of each facility and the equipment developed under the project is clear, and no serious accident or breakdown caused by insufficient personnel has occurred so far. Therefore, it is considered that there are no problems with the institutional and organizational aspect.

<Technical Aspect>

The staff responsible for the operation and maintenance of the substations and transmission lines developed under the project is qualified at the Engineer level (Bachelor's degree in Electrical Engineering) or Technician level (completion of a Diploma course in Electrical Engineering). The staff is also registered with the Uganda Institute of Professional Engineers (UIPE) (Engineering) and the Engineers Registration Board (ERB). Dealing with power outages caused by transmission lines requires skills in designing and constructing transmission lines, locating faults, assembling towers, etc. For substations, the staff needs skills in assembling, installing, maintaining, and commissioning equipment. The staff is equipped with these skills. In addition, any power outages due to poor maintenance skills of the staff were not reported by UETCL.

During the implementation of the project, the UETCL staff was trained on the installation and operation of the equipment developed under

the project and they were provided with operation and maintenance manuals of the major equipment. According to UETCL, the training helped them understand the substation equipment better and improve their maintenance skills to deal with the problems that occurred in the substation. The manuals are also utilized for the proper operation and maintenance of substation facilities and for the management of abnormalities.

In addition, UETCL provides technical training on transformer assembly, commissioning, and software utilization. Additionally, on-the-job training on equipment operation and troubleshooting in case of failure is provided. Labor management training in communication, leadership, management, project management, etc., is also provided.

As described above, the staff members in charge of operation and maintenance have knowledge and qualifications of electrical engineering, and are equipped with the necessary skills in case of power failure. A system to maintain the technical level by the provision of training and the use of manuals has been established. Therefore, it is considered that there are no problems with the technical aspect.

<Financial Aspect>

UETCL's operating sales are growing, and a certain amount is set aside each year for maintenance (Table 5). In 2018, the exchange rate of the Ugandan shilling against the US dollar remained at a high level, resulting in a foreign exchange loss. Although other operating losses have been incurred because of high selling costs resulting from the increase in the purchase price of power plants, UETCL's financial status improved in 2019.

Table 5: Profit and loss statement of UETCL

(Unit: million Ugandan shillings)

Item	2014 (Ex-ante evaluation)	2017 (Completion Year)	2018 (1 year after Completion)	2019 (2 years after Completion)
Revenue	750,328	599,037	1,091,150	1,115,766
Cost of sales	-611,752	-445,367	-975,691	-944,323
Operating cost	-59,330	-22,137	-49,274	-45,178
Other operating income	54,994	17,531	29,500	122,963
Total income	**134,240**	**149,064**	**95,685**	**249,248**
Maintenance expenses	-5,465	-2,788	-7,159	-7,806
Administrative expenses	-81,686	-58,211	-113,649	-145,934
Financial costs (foreign exchange losses, etc.)	-25,017	-	-81,513	-
Total cost	**-112,168**	**-60,999**	**-202,321**	**-153,740**
Operating profit	**22,072**	**88,065**	**-106,636**	**95,508**
Finance costs	-2,214	-212	-588	-
Income tax expenses	-3,262	-25,599	31,698	-30,869
Annual Profit	**16,596**	**62,254**	**-75,526**	**64,339**

Source: UETCL Annual Report for 2015, p. 51, Annual Report and Financial Statements for 2018, p. 13, 2019, p. 10

With regard to the maintenance of the facilities developed under the project, the budget for cleaning, replacing lights, and purchasing equipment for the Queensway substation has been maintained annually (Table 6). In 2020, the maintenance budget was increased to repair one transformer that failed in 2019 and to strengthen the preventive maintenance and protection of other transformers. At the project planning stage, it was estimated that US$300,000 (approximately 1,115 million Ugandan shillings) would be required annually for the procurement of spare parts to ensure the continued operation of the substation. According to UETCL, the budget at the time of the ex-post evaluation was much lower than expected, as there was no need to purchase spare parts every year and stocks were maintained.

Table 6: Maintenance budget for the Queensway substation

(Unit: million Ugandan shillings)

2017	2018	2019	2020
NA*1	25	27	3,929

Source: UETCL responses on questionnaires

*1: The Queensway substation was completed in 2017. The budget for the substation equipment developed under this project was generated since the following year (2018).

As described above, it is considered that there are no problems with the financial aspect, as the financial status is generally good and the necessary budget for maintenance and management has been secured.

<Current Status of Operation and Maintenance>

After routine maintenance in March 2019, unknown person entered the Queensway substation and vandalized the substation grounding copper wire. The transformers were left disconnected to the grounding system and this subsequently led to failure of Transformer No.3 (TX 3) when it was exposed to fault. According to the post-incident investigation by the manufacturer conducted in February 2020, the other two transformers (Transformer No.1 (TX 1) and 2 (TX 2)) had sustained mild damage during the incident; and were still in operation at the time of ex-post evaluation. UETCL believes that in addition to non-earthed substation operating condition due to theft of earthing conductor, the reason why the transformers got damaged is the weak design of the tertiary winding of the transformers. The damaged TX 3 is currently in the process of being repaired and UETCL has scheduled to embark on reinforcement for the tertiary winding of TX 1 and 2 as recommended by the manufacturer, upon completion of repairs of the already damaged TX 3. The reason for the time taken to repair TX 3after the discovery of the malfunction is as follows. After the malfunction was confirmed, the transformer could not be opened on site, and it took time to assess the degree of damage. It also took time to locate a contractor who could handle the problem, as malfunctions of this sort do not occur frequently. Since the parts needed for the repair were not available in Uganda, UETCL contacted the manufacturer in Japan, estimated the cost of the repair, and applied for a budget. However, after approval was granted, it was found that the spare materials were taxable, yet the tax was not included in the budget estimates; and consequently, UETCL needed to reapply for the budget. In addition, after the procurement funds were secured, the manufacturer was unable to send engineers to repair the transformer because of the travel ban imposed owing to the COVID-19 pandemic. For this reason, UETCL is currently importing the parts and the transformer repairs are scheduled to commence by the Japanese supplier in January 2022 at a company that specializes in repairing substation equipment. It should be additionally noted that on 2nd November 2021, while awaiting reinforcement of its tertiary winding, TX 1 malfunctioned and is currently pending repair. The repairs for TX

1 are expected to be completed by the end of March 2022.

UETCL has strengthened security at the substation and is checking the operation of the substation more regularly. In the near future, permanent staff members are to be appointed at the substation office. UETCL also stated that preventive measures would be taken to prevent theft and destruction, such as using copper clad steel instead of pure copper. As the process of applying for and securing funds for the repairs would take some time, UETCL said it was also considering credit agreements with providers of replacement parts.

For the maintenance of substation equipment, substation staff visually inspects the condition of the equipment daily. In addition, the Operations and Maintenance Department tests the operation of the substation equipment and performs routine maintenance on transformers, switchgear, and other equipment twice a year. Cleaning inside the Queensway substation is carried out daily by staff, while cleaning outside the substation is outsourced to a private company and carried out on a regular basis. The site visit confirmed that spare parts were stored at the substation. According to UETCL, the inventory is managed through the system and a record book, and a sufficient number of spare parts is available.

As described above, at the time of the ex-post evaluation, it was found that one of the transformers developed under the project had a problem and was out of service. The necessary parts have been arranged and repairs are scheduled to be completed at the end of FY2021. Since preventive measures are being taken, it is judged that there is no serious concern about the status of operation and maintenance. The operational status of other facilities and equipment is good, daily inspections and regular preventive maintenance are conducted, and spare parts are systematically procured. Therefore, it is considered that there are no problems with the current status of the operation and maintenance system.

<Evaluation Result>

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

III. Recommendations and Lessons Learned

Recommendations to Executing Agency:

One transformer developed under the project has been out of service since March 2019 and is currently under repair. In addition to external factors such as the COVID-19 pandemic, the reasons it has taken time to repair the transformer are the procurement of parts that are unavailable in Uganda repair measures, and the complexity of the procurement process. When reinforcing substation facilities in the future, as well as the prompt repair of transformers, it is desirable to confirm that the parts are available in Uganda and to check thoroughly that there are no mistakes in the procurement procedures if the parts are difficult to obtain and must be procured from overseas.

Recommendations to JICA:

None.

Lessons Learned for JICA:

(1) Setting indicators

"Substation facility capacity," which is an effectiveness indicator of the project, included not only the facility capacity of the Queensway substation constructed under the project, but also the capacity of other substations located in Kampala city. However, the reinforcement of the facilities of other substations was delayed more than planned and the target value was not met. Indicators should be set to verify the direct effects of the project, especially in terms of effectiveness. In cases of supporting a part of a power supply network, such as from power generation to transmission, it is necessary to determine the extent to which the project is directly related to the project objectives, and to set appropriate quantitative indicators to measure the effectiveness of the project. For example, in order to verify the effect of this project itself, it is considered that an indicator should have been set for only the facility capacity of the Queensway substation.

With regard to the "Voltage drop ratio of the power receiving end," when asking UETCL for the actual values, the response was that the voltage drop ratio always fluctuates and that all the data on voltage drop ratio is not stored indefinitely by the SCADA system.. For example, the realistic measure would be to calculate the voltage drop ratio by taking the voltage value for the day of the month with the highest electricity consumption of the year and the period with the highest electricity consumption during the day into consideration. However, for the indicators set in the project, the actual (baseline) and target values were calculated by simulation, and there was no prior decision on how to collect specific data, as described above. Since difficulty is expected in checking the data retrospectively, it is important for JICA to agree with the implementing agency on the definition of the set indicators and the specific calculation method at the project planning stage or at the latest, by project completion.

(2) Materials and equipment to be procured for the project

As mentioned above, one of the reasons it took so long to repair the transformers developed under this project was that spare parts for the substation equipment were not available in Uganda and had to be imported from overseas. The impact of the COVID-19 pandemic has also made it even more time-consuming to procure these parts than it would have been in previous years. Given that there will be similar restrictions on travel and transportation in the future, it is even more important to consider whether it is possible to carry out repairs in Uganda at the time of project formation.

Control building

Control panel

Grounding part of transformer

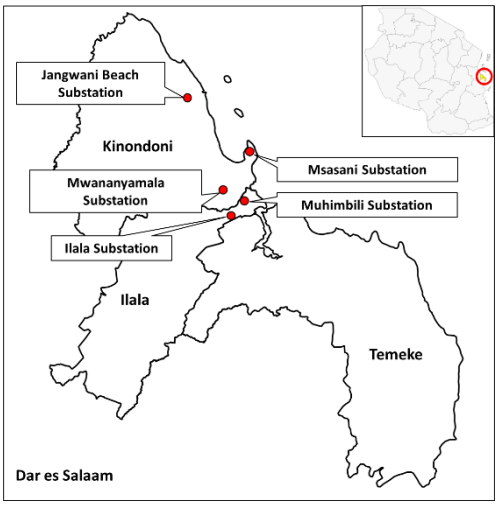
Transformer under repair

FY2020 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

External Evaluator: Juri Ishimoto, Metrics Work Consultants Inc. (January 2022)

Duration of the Study: December 2020 - January 2022
Duration of the Field Study: February 15, 2021 - February 25, 2021

Country Name	The Project for Reinforcement of Power Distribution in Dar es Salaam
United Republic of Tanzania	



Project site

33/11kV Transformer (Msasani substation)

I. Project Outline

Background	Tanzania's electricity demand growth rate was expected to expand at an average rate of 8.5% until 2035 because of increased economic activity. However, from the time the privatization of the Power Development Corporation was attempted in 1992 until it was stopped in 2006, public support from the government and donors stagnated. There was no expansion of facilities or maintenance of existing facilities to meet the growing demand. Therefore, the facilities became decrepit and were chronically overloaded to cope with the increasing demand, and inadequate maintenance caused equipment breakdowns and frequent power outages, which became a major obstacle to various socioeconomic activities. In particular, in Dar es Salaam, although the electricity demand had increased, the existing power transmission and distribution facilities remained insufficient; and the aging of the facilities added to the unstable power supply situation, making the situation even more serious.			
Objectives of the Project	The objective of this project was to improve the supply capacity of the transmission and distribution network by developing new transmission and distribution lines as well as expanding and updating substations in Dar es Salaam, thereby contributing to the improvement of the quantity and quality of power supply to residents of the area and the social and public facilities.			
Contents of the Project	1. Project Site: Dar es Salaam (Population about 4.36 million) 2. Japan: 1) Civil works and equipment procurement: Transmission line reinforcement (132kV/7.5km transmission line), construction of three new distribution substations, reinforcement of two existing distribution substations, construction of new distribution lines (approximately 17.2km), installation of the SCADA system in each substation; 2) Consulting services: Detailed design, bidding assistance, construction supervision 3. Tanzania: 1) Compensation for the resettlement plan; 2) Provision of storage space for materials and equipment; 3) Ensuring security for construction workers; 4) Response and compensation to customers and others for power outages required during construction; 5) Publicity and communication of power outage plans to customers during construction; 6) Removal of waste materials from the site; 7) 132kV transmission line and 33kV distribution line, securing access roads and work sites for construction work, and acquiring permission for their use; 8) Implementation of customs clearance and tax exemption measures; 9) Implementation of environmental monitoring; 10) Connection of SCADA communication equipment at the Distribution Control Center (DCC) with the SCADA system to be installed at each substation under the project, etc.			
Implementation Schedule	E/N Date	Detailed Design: January 17, 2014 Main: July 24, 2014		
	G/A Date	Detailed Design: January 17, 2014 Main: July 24, 2014	Completion Date	April 11, 2017 (Extradition Day)
Project Cost	G/A Grant Limit: Detailed Design 32 million yen, Main 4,410 million yen Actual Grant Amount: Detailed Design 31 million yen, Main 4,054 million yen			
Executing Agency	Tanzania Electric Supply Company Limited (TANESCO)			
Contracted Agencies	Main Contractors: Mitsubishi Corporation. /Iwata Chizaki Inc./Takaoka Engineering Co., Ltd. (JV) Main Consultants: Yachiyo Engineering Co., Ltd./West Japan Engineering Consultants, Inc. (JV)			

II. Result of the Evaluation

Summary
This project upgraded the existing substation facilities in addition to constructing new substations as well as transmission and distribution

lines to improve the supply capacity of the transmission and distribution network in Dar es Salaam in Tanzania. The purpose of the project was consistent with Tanzania's development policy and development needs as well as Japan's ODA policy; therefore, the relevance is high. Although the project cost was within the plan, the project period was longer than planned; thus, the efficiency of the project is fair. The implementation of the project has improved the supply capacity of the transmission and distribution network, such as reducing the time of power outages, stabilizing the voltage, and reducing the power loss, which were expected during the planning; it has realized a stable power supply. Consequently, medical institutions, public facilities, and hotels have been able to reduce their own power generation costs and use the electrical equipment necessary to provide services, leading to increased profits. Further, households operating small stores such as kiosks and repair shops have been able to continue to use electrical appliances, which has led to an increase in customers and income. No negative impacts on the natural environment or resettlement were identified. Therefore, the effectiveness and impact are high. However, although there have been no major accidents or failures at this point, there are still concerns about the sustainable operation and maintenance of the facilities due to the lack of remote control and monitoring of the unstaffed substations developed under this project. Therefore, the sustainability of the project effects is fair.

Considering the above, this project is evaluated to be satisfactory.

Overall Rating[1]	**B**	**Relevance**	**③**[2]	**Effectiveness & Impact**	**③**	**Efficiency**	**②**	**Sustainability**	**②**

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

To verify the qualitative effects of the project, "the project enables stable operation of public, industrial/tourist, and religious facilities, etc. and contributes to the revitalization of medical and educational services as well as economic and social activities in Dar es Salaam," the status of economic activities in Dar es Salaam before and after the project implementation was verified using satellite nighttime light data, which has a high correlation with rural electrification and economic activities, as well as interviews with the facilities.

1 Relevance

<Consistency with the Development Policy of Tanzania at the Time of Ex-Ante Evaluation >

At the time of the ex-ante evaluation, *Tanzania's Third Poverty Reduction Strategy Paper* (2010–2015), *National Energy Policy* (2003), and *Power System Master Plan* (2012) identified economic growth and poverty reduction as key issues. Further, the need for a stable electricity supply was pointed out to achieve these goals. This project aims to realize a stable electricity supply to Dar es Salaam, which has a high electricity demand, by enhancing the transmission and distribution facilities. Therefore, the project is consistent with Tanzania's development policy.

<Consistency with the Development Needs of Tanzania at the Time of Ex-Ante Evaluation >

At the time of the ex-ante evaluation, Dar es Salaam's capacity of the existing transmission and distribution system was insufficient, and the power supply situation was extremely unstable. As this project aims to provide a stable electricity supply to Dar es Salaam by enhancing the electricity distribution facilities, the project is consistent with Tanzania's development needs.

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

In the *Japan's Country Assistance Policy for the United Republic of Tanzania* (2012), Japan identified the development of electricity infrastructure as one of the priority areas to support sustainable economic growth and poverty reduction in Tanzania. Therefore, the project is consistent with Japan's ODA Policy.

<Evaluation Result>

Considering the above, the relevance of the project is high.

2 Effectiveness/Impact

<The Logic Behind the Project to the Realization of Impact>

The project developed the substations as well as transmission and distribution lines in the target districts in Dar es Salaam (Kinondoni and Ilala districts) (Outputs), aiming to improve the supply capacity of the transmission and distribution network in the same district (Outcome) and the quantity and quality of electricity supply to the city (Impact). Figure 1 shows the logic from the implementation of the project to the realization of the impact, which was assumed at the time of planning.

It was assumed that the capacity of substations located in the target districts (Kinondoni and Ilala districts) would be increased by constructing and reinforcing substations as well as improving transmission and distribution lines. Subsequently, the power outages, voltage drop, and power losses in the target districts that had been caused by overloads and the aging of existing substation facilities would be improved. Further, the power supply area would be expanded (the amount of power supply would be improved) by extending transmission and distribution lines in addition to increasing substation capacity through the project. It was assumed that the quality and quantity of electricity in these target districts and the supply capacity of the transmission and distribution network would be improved. This would further lead to the stable supply of electricity to public facilities and residents in Dar es Salaam (improvement in the quantity and quality of electricity supply). Consequently, it was expected that the quality of medical and educational services would be improved by enabling the use of medical equipment and electrical appliances that require a certain voltage to be maintained. It was also expected to stimulate economic and social activities by enhancing business and public services that require electricity and improve the living environment of residents by promoting the use of electrical appliances such as refrigerators and air conditioners.

In this evaluation, based on the logic shown in Figure 1, whether the power quality has improved is verified by confirming changes in the outage time, voltage drop rate, and power loss in terms of effectiveness. Further, whether the power supply in the target districts has improved is checked, and whether the supply capacity of the power transmission and distribution network has improved owing to these changes is verified. Regarding the impact, whether the quantity and quality of electricity supply to the city has improved is verified from the perspective

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

[2] ③: High, ②: Fair, ①: Low

of “improvement of medical and educational services,” “activation of economic and social activities,” and “improvement of the living environment of residents,” which were mentioned at the project planning phase.

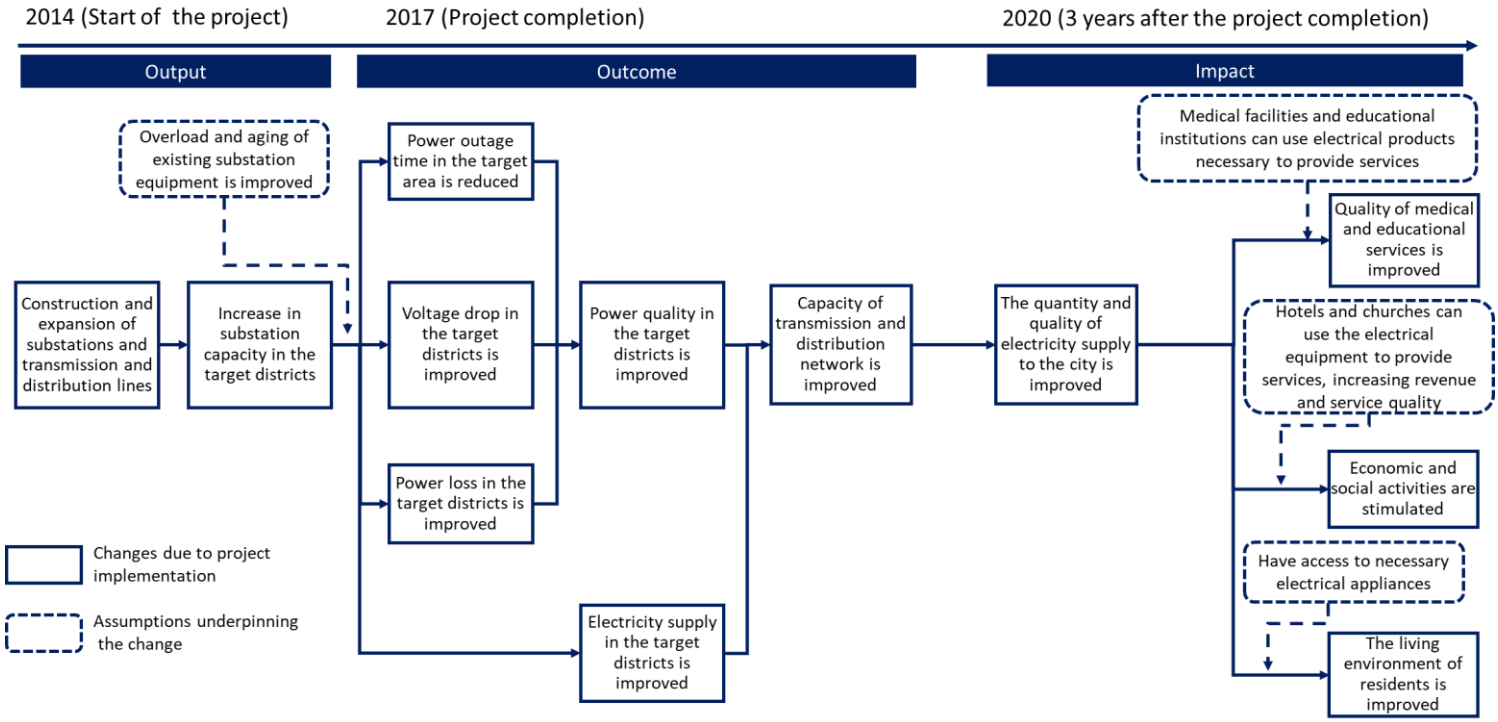


Figure 1. Logic of the project

<Effectiveness>

(1) Power outage time

The main causes of accidental outages before the project implementation were equipment failure and overload of the existing substation facilities, lightning, and birds. Planned outages were caused by equipment replacement due to aging and overload. It was assumed that the aging and overload conditions would be improved by the project, and the accidental and planned outage times would be improved.

The average outage time of all substations developed under the project has improved significantly compared to the time before the project was implemented (26.3 hours; 2012). Comparing the target value of 23.7 hours in 2020 (the target year), the actual value was 21.2 hours in 2020, which reached the target. The number of accidental outage hours in 2017 is much lower than that in 2018 because the data of the Ilala substation, which has more outages than other substations, are missing. The increase in the number of accidental outage hours in 2020 is because the existing distribution line at the Msasani substation (not covered by the project) could not be connected to the breaker developed under the project due to its aging, causing a malfunction. The increase in planned outage hours in 2020 is because of the increase in maintenance associated with the aging of the transmission and distribution network, which is not covered by the project. According to TANESCO, in the ex-post evaluation, power outages still occur due to the aging of distribution lines, birds, and fallen poles. However, the overload condition of the existing substation facilities has improved through the project, and the power outage time has also improved.

(2) Voltage drop rate

The voltage drop rate at all substations has improved significantly compared to the rate before the project was implemented (4.8%, 2012). While the target value was 4.3%, the actual value was 1.6%, which reached the target. Public facilities and residents said that before the project, they could not use electrical appliances and equipment due to low voltage. However, after the project was completed, the voltage stabilized, and they could use electrical appliances and equipment daily.

(3) Power loss

Power losses have improved significantly compared to the pre-project level (15.65%, 2012). In 2020, the target year, it was 9.7% compared to the target average of 11.95% in both districts, reaching the target. Although in 2019 and 2020, it has increased compared to 2017 and 2018, TANESCO said that the power loss has increased due to defective power meters and electricity theft.

(4) Number of electrified households

During planning, it was assumed that the number of electrified households in Kinondoni and Ilala districts would increase from 383,000 to 430,000 (an increase of 47,000 households, 12% increase). TANESCO does not collect actual data on the number of electrified households but collects that on the number of electricity contracts, which indicates access to electricity. The number of contracted units before and after the project implementation increased by approximately 139,869—from 204,508 in 2012 to 344,377 in 2020 (68% increase). Although the number of electrified households and that of contracts do not necessarily match because multiple households may access one contract, the increase in the number of contracts is extremely large (139,869) compared to the target increase of 47,000 electrified households set during the project planning. Residents living around the substations said that they were satisfied with TANESCO’s services and felt that the power quality had improved, with fewer power outages and more stable power voltage after the project completion. On the demand side, the improvement in the quality of electricity through this project is also considered to have contributed to the increase in the number of households who wish to sign a contract with TANESCO (the number of contracted households).

Table 1: Before and after comparison of quantitative effectiveness indicators

	Baseline 2012 Baseline Year	Target 2020 3 years after project completion	Actual 2017 Completion year	Actual 2018 1 year after completion	Actual 2019 2 years after completion	Actual 2020 3 years after completion
Power outage time (hours/month) * [1]	**26.3**	**23.7**	**7.7**	**15.3**	**15.2**	**21.2**
Planned	NA	NA	3.0	2.9	2.6	4.3
Accidental	NA	NA	4.7	12.4	12.6	16.9
Voltage drops (%) * [2]	4.8	4.3	1.5	1.7	1.6	1.6
Power loss (%) * [3]	15.65	11.95	7.2	7.6	10.3	9.7
Number of electrified households	383,000 * [4]	430,000	NA	NA	NA	NA
Number of contracts	204,508	NA	287,057	306,321	324,031	344,377

Source: Questionnaire responses and interviews with TANESCO

1: The baseline value is the average monthly power outage time of the 33kV system at the Ilala substation, and the target value is a 10% reduction from the baseline value. At the ex-post evaluation, average values were calculated for the 33kV systems at all substations (Ilala, Msasani, Muhimbili, Jangwani Beach, and Mwananyamala) developed under the project and compared with the target value. The outage duration by cause was not recorded and was not available.

2: The baseline value is the value measured for the 33kV system at the Ilala substation. The target value is a 10% reduction from the baseline value. At the ex-post evaluation, the average value was calculated from 33kV systems at all substations and compared with the target value.

*3: Average values for Kinondoni and Ilala. Target values were calculated with reference to the *Power System Master Plan* (2012 update) and the *Annual Report 2011*.

*4: Baseline value = (population of the target districts (Kinondoni and Ilala) x electrification rate: 51%)/4 (assuming 4 persons per household); target value = Baseline value + number of new consumers to be newly electrified by the project (number of connected units)

<Impact>

(1) Improvement of medical and educational services

The Muhimbili National Hospital in Dar es Salaam, the target site of this project, is the largest medical institution in Tanzania and receives electricity from the Muhimbili substation developed under the project. Before the project implementation, the problem in the hospital in terms of electricity was that it had to interrupt the provision of medical services due to frequent power outages and malfunctions of medical equipment caused by voltage fluctuations[3]. As a countermeasure, the hospital had to incur fuel costs for operating its own power generation system. After the project completion, the number of accidental power outages caused by Muhimbili substation was reduced, and the voltage was stabilized. Therefore, medical equipment no longer breaks down and can be used at all times, allowing for the continued provision of medical services. Additionally, in 2017, the annual fuel cost was approximately 93 million Tanzanian shillings (about 5.5 million yen); in 2018, it was around 10 million Tanzanian shillings (about 600,000 yen), a significant cost reduction of approximately 83 million Tanzanian shillings (about 4.9 million yen) per year.

At Muhimbili University of Health and Allied Sciences, which is adjacent to the hospital, the problems before the project were that classes could not be held because electrical equipment could not be used due to power outages and voltage drops and high fuel costs for the in-house power generation equipment. After the project completion, electric power has supplied stably, and the voltage has also stable; therefore, classes has been able to be held without any breakdown of electrical equipment.

(2) Stimulation of economic and social activities

<Interviews with Tourist, Industrial and Religious Facilities>

Interviews were conducted with hotels near the Jangwani Beach and Msasani substations and a church near the Mwananyamala substation, which were developed under the project. The problems related to electricity at the planning period around all the substations were frequent power outages, voltage fluctuations, and fuel costs due to the operation of private power generation facilities as a countermeasure. According to the hotel, since the completion of the project, there have been no accidental power outages, and the voltage has been stable, eliminating the need for private power generation and leading to significant cost savings. Additionally, the stable power supply has improved the service, which has led to customer acquisition and increased profits.

The church, which receives electricity from the Mwananyamala substation, used to experience frequent power outages before the project was completed. However, now there are no accidental power outages and only planned power outages that are notified by TANESCO in advance. The stable power supply enables the church to play musical instruments using electricity, and the number of visitors to the church is increasing.

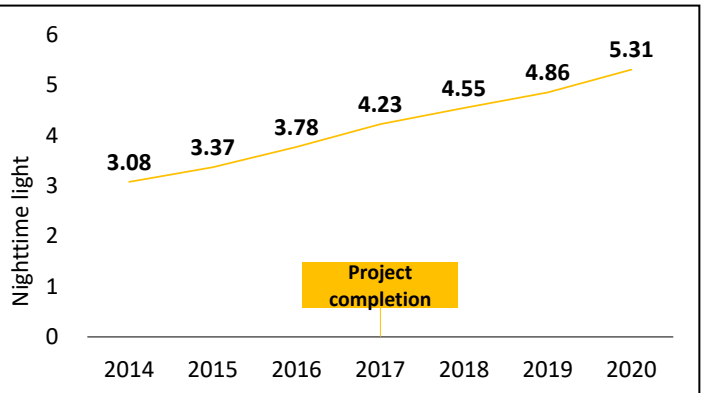
<Longitudinal Analysis of the Amount of Nighttime Light>

Complementing the results of the above interviews, this evaluation analyzed the amount of night light in Dar es Salaam over the period 2014–2020 and found that the amount of nighttime light is on the rise (Figure 2a). While nighttime light is an indicator of the brightness of the ground at night and is highly correlated with electrification and gross domestic product, it is difficult to understand the scale of the economy based on the amount of nighttime light alone. Therefore, the average amount of nighttime light was calculated in other countries between project implementation and ex-post evaluation (2017–2020). It was found that it was 2.0 in Kigali, the capital of neighboring Rwanda, and 10.0 in Nairobi, a large African city. As the average night light in Dar es Salaam during the same period was 4.7, it can be assumed that economic activities are more active at night than in Kigali, although not as active as in Nairobi.

Figure 2b shows the night light images before and after the project implementation. The higher the amount of nighttime light, the whiter the image becomes. It is visually evident that the nighttime light increases in the target districts, and the economic activities are activated because

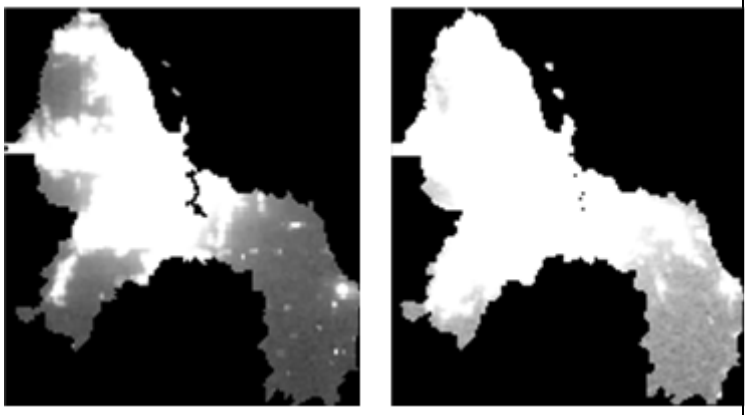
[3] Before the project completion, the voltage was unstable and could not be maintained in a voltage range suitable for medical equipment, resulting in equipment failure.

it becomes mostly white at the time of the ex-post evaluation compared to the time before the project.



Source: Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines, VIIRS Nighttime Day/Night Band Composites Version 1

Figure 2a. Longitudinal change in the amount of nighttime light



2014 (before project implementation)

2020 (at the time of ex-post evaluation)

Figure 2b. Nighttime light images before and after project implementation

Figure 3 also shows the change in the amount of night light before and after the project implementation by region. The greater the increase in night light between 2014 and 2020, the darker the color is. Although there are some areas where the average value of nighttime light has decreased, the figure on the right also visually shows that the average value of nighttime light has increased overall in the Kinondoni and Ilala districts, where the substations developed under the project are located.

Considering the above, as a result of the interviews with the hotels and churches, it was confirmed that stable electricity supply has been realized after the project implementation, leading to the reduction of private power generation cost and increased profit in the hotels, and the improvement of services in the churches. Additionally, the amount of nighttime light is increasing, and it is assumed that the economic and social activities in Dar es Salaam have been activated.

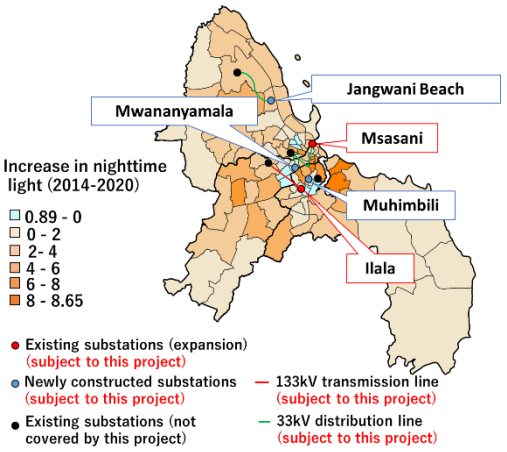


Figure 3. Changes in nighttime light levels by region

(3) Improving the living environment of residents

Three residents living near the Ilala substation were interviewed, and all of them answered that stable electricity was supplied after the project completion. Before the project completion, there were power outages about twice a week and no power supply after 2:00 pm. Additionally, there were many voltage fluctuations, which caused electrical appliances to break down or become unusable. At the time of the ex-post evaluation, there were still planned power outages, but they were not as frequent as before, and the voltage was stable; therefore, there were no more such breakdowns. Owing to the stable power supply, poultry farmers have been able to hatch more eggs than before the project was completed, which has led to an increase in their income. The owner of a guesthouse responded that the number of guests has increased because they can currently use refrigerators and fans.

Five residents living in the vicinity of the Mwananyamala substation also responded that before the project completion, there were power outages about three times a week, and electrical appliances broke down due to voltage fluctuations. However, now the power supply is stable, and there are no such breakdowns. A man who undertakes the repair of electrical appliances said that he used to have to suspend his work due to frequent power outages because the electrical appliances he used for repair were not available. Nevertheless, he can now undertake many repairs, and his income has improved. A man who runs a door manufacturing business responded that frequent voltage fluctuations caused the breakdown of electrical equipment, which delayed production. Thereafter, he can deliver products on time, which has led to the acquisition of customers and an increase in income. A woman who runs a shop said that she can now sell beverages and ice cream chilled in the refrigerator, which has led to increased sales and higher income.

<Other Positive and Negative Impacts>

(1) Impact on the natural environment

The project was classified as Category B under *JICA Environmental and Social Consideration Guideline (2010)* because the project would not fall under the large scale of power transmission and distribution sector, and the undesirable impact on the environment would not be significant.

Before the project was implemented, the following measures were required to be taken to deal with noise, waste, soil, and water pollution during construction. According to TANESCO, all the measures were taken as planned and no negative impact on the natural environment occurred during the construction. The monitoring during the construction was also carried out as planned[4]. The residents and public facilities around the substations also responded that there was no particular negative impact on the natural environment.

[4] A report of the implementation status could not be collected.

Table 2: Plans and actual results of environmental mitigation measures

Item	Plan	Results
Noise	In terms of noise generated during construction work, a distance will be maintained from residences, and soundproof walls will be installed.	Implemented as planned
Waste	The transformers to be disposed of under the project, especially if hazardous waste is generated, will be disposed of, and stored in accordance with Tanzanian laws and regulations and TANESCO guidelines.	Implemented as planned
Soil and water pollution	As contamination may occur if insulating oil used in transformers leaks, install oil-proof pits and oil-water separation tanks and ensure that personnel in charge properly dispose of insulating oil so that it does not leak when it is replaced.	Implemented as planned

Source: Documents provided by JICA

(2) Impact on the social environment (land acquisition, resettlement)

As the construction of Mwananyamala substation would result in the resettlement of 21 households (62 persons), and the construction of Muhimbili substation would result in the resettlement of 1 household (5 persons), there was a plan to prepare a simplified Abbreviated Resettlement Action Plan (ARAP) and implement the resettlement in accordance with the plan.

According to TANESCO, when the project was planned, the households were supposed to be relocated to acquire land for the road for power distribution lines. However, as the plan was changed to construct an overhead power distribution line on the sidewalk, the final number of households to be relocated was only two households[5] living in the area where the Mwananyamala substation was to be constructed. After signing a Memorandum of Understanding (MOU) between the owner and TANESCO regarding the compensation details, the relocation of the target households proceeded, and the compensation cost was paid to the two target households before the construction started. Information on the compensation cost was not available, but there were no complaints from the relocated households regarding the compensation.

As a result of the relocation, the two target households had moved to distant places, and face-to-face interviews with them during the field survey were not possible. According to the interview with the local leader who participated in the discussion with TANESCO at that time, TANESCO explained the relocation to the target households in advance; the target households agreed to the compensation before relocating. The payment from TANESCO to the relocated persons was made promptly, and there was sufficient time for relocation, approximately one year. With the compensation, the target persons built houses at the relocation site. They could also purchase two small buses and one car. They have not been negatively affected by the relocation.

<Evaluation Result>

As a result of the implementation of this project, the amount of electricity supplied in the target districts has increased, which was assumed at the time of the plan. The quality of electricity has improved in terms of reduced power outage times, stabilized voltage, and improved power loss. These improvements in the supply capacity of the power transmission and distribution network and the stable supply of electricity have enabled medical facilities and educational institutions to use electrical products stably, leading to the continuous provision of services. The stable power supply at hotels and churches has improved their profits and quality of service, and the amount of nighttime light, which is highly correlated with economic vitalization, has been increasing. Therefore, it can be considered that the project revitalized the city's economic and social activities. Additionally, households operating small shops such as kiosks and repair businesses have been able to continue using electrical appliances, which has led to customer acquisition and increased income. No negative impacts on the natural environment or resettlement were identified. Therefore, the effectiveness/impact of the project is high.

3 Efficiency

<Output>

The project involved the strengthening of existing substations (Ilala and Msasani substations), construction of new substations (Muhimbili, Jangwani Beach, and Mwananyamala substations), and procurement and installation of 132kV transmission lines and 33kV distribution lines in Kinondoni and Ilala districts, the central districts of Dar es Salaam. The parts to be borne by the Japanese side were implemented as planned, except for some minor changes such as design changes to the 132kV transmission line gantry, the shape of the sound barrier for transformers in the Muhimbili substation, and changes in the 33kV distribution line route. No technical assistance (soft components) was included in the project.

The project also planned to install a SCADA system[6] at each substation to monitor and control the substations remotely from the Distribution Control Center (DCC). The parts to be borne by the Japanese side were to procure and install SCADA systems for each substation, while that to be borne by the Tanzanian side was to connect the SCADA systems at each substation to the DCC (including changing the system for connection and procuring necessary communication equipment). However, at the time of the ex-post evaluation, it was confirmed that some of the parts to be borne by the Tanzanian side had not been completed. According to an interview with the DCC, the plan was to outsource the procurement of the necessary communication equipment and the connection. However, the bidder offered 2.8 billion Tanzanian shillings (130 million yen), and it was difficult to secure funds within TANESCO as well as obtain government subsidies and loans from financial institutions, which made it difficult to connect immediately. Therefore, TANESCO decided to procure the communication equipment by itself and is planning to proceed with the connection work in cooperation with the manufacturers of the SCADA equipment installed in this project at the time of ex-post evaluation[7].

[5] Number of household members could not be collected.

[6] A SCADA system transmits information obtained from substation equipment and facilities to a monitoring and control server in the substation and displays and manages the information collectively on panels and PC monitors. In this project, it was planned to connect the SCADA system of each substation to the DCC via communication equipment and remotely monitor and control the system at the DCC.

[7] According to DCC, the connection work has been started in phases from the Muhimbili Substation. The communication equipment required for the connection has already been procured, but the connection requires specialized skills and knowledge that necessitates a cooperative installation from the manufacturer of the SCADA system (Germany).

<Project Expenses>
The Japanese share was 4,054 million yen compared with the initial plan of 4,410 million yen, which was within the plan (92% of the plan). The reason for the lower-than-planned amount was that the contract was concluded at a price lower than the originally planned price as a result of bidding.

Although the Tanzanian share of the project was 195 million yen, according to the response from TANESCO, the actual amount was 2,000 million Tanzanian shillings (approximately 112 million yen[8]). However, the breakdown did not include the cost of relocating the cemetery and that of the 132kV transmission line, which were assumed at the planning stage, and these costs are unknown. Therefore, as it is difficult to compare with the contents of the original plan, the evaluation judgment was made based on the Japanese portion only.

<Project Period>
The project period was 40 months (105% of the plan), which exceeded the original plan of 38 months. The reasons for exceeding the plan were delays in clearing the land for the Ilala substation, obtaining construction permits, and shipping procurement materials.

Considering the above, the project cost was within the plan, but the project period exceeded the plan. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional/Organizational Aspect>
The operation and maintenance system of each facility at the time of the ex-post evaluation is shown in Table 3. The operation and daily inspection of the Ilala substation—the main substation in Dar es Salaam—are conducted by the staff stationed at the substation. The existing substation (the Msasani substation) and new substations (the Muhimbili, Jangwani Beach, and Mwananyamala substations) are operated unstaffed; the District Office operators visit the sites for maintenance and operation. However, as the newly established substations are not connected to the DCC, it is not possible to instantly know when power is interrupted. After customer complaints are reported to the District Office, the staff goes to the substations and investigates the cause.

In the event of a failure of substation equipment, the Department in charge of operations first reports the problem to the Headquarters (Transmission Department), and a maintenance team dispatched from the Department repairs the equipment. Depending on the nature of the problem, repairs can take several hours to days. Temporary measures are taken to restore power if it takes long to repair. Maintenance of 132kV transmission lines is handled by the Transmission Department, while that of 33kV distribution lines is managed by the District Office.

As described above, the scope of responsibility for the operation and maintenance of each facility is clear at the time of the ex-post evaluation, and there have been no accidents or failures caused by insufficient personnel. However, as the remote monitoring and control of the newly built substations is not functioning, there is still a concern about the prompt restoration work.

Table 3: Operation and maintenance system at the time of ex-post evaluation

Department/Office	In charge	Number of staff
Ilala substation	・ Operation and daily inspection of Ilala substation	9 people (1 manager, 8 technicians)
Kinondoni North District Office	・ Operation and maintenance of the Jangwani Beach, Mwananyamala and Msasani substations ・ Maintenance of 33kV distribution lines (the Tegeta substation to the Jangwani Beach substation, the Makumbusho substation to the Msasani substation, the Makumbusho substation to the Mwananyamala substation)	8 people (1 engineer, 7 technicians)
Ilala District Office	・ Maintenance of a 33kV distribution line (the New City Centre substation to the Muhimbili substation) ・ Operation and maintenance of the Muhimbili substation	4 people (1 engineer, 3 technicians)
Transmission Department	・ Maintenance of a 132kV transmission line (the Ubungo substation to the Ilala substation) ・ Repair of all substations	40 people (40 engineers)

Source: Questionnaire responses from TANESCO

<Technical Aspect>
The personnel in charge of the operation and maintenance of each facility developed under the project is qualified at the Technician level (4 years post high school graduation with a diploma in electrical engineering) or Engineer level (4 years with a bachelor's degree in electrical engineering). According to TANESCO, the maintenance team at the Headquarters, which is in charge of maintenance, has the necessary skills to deal with power outages without any problems, while there have been power outages due to the aging of the distribution network and birds.

TANESCO provides its staff with on-the-job training and training opportunities on the operation and maintenance of substations so that they can continue to acquire the necessary skills. Newly appointed employees undergo training on operation and maintenance at TANESCO Technical Training School; subsequently, they are assigned to each substation. The operation and maintenance manuals for each substation prepared in this project are organized and stored at the Ilala substation, and repairs are conducted in accordance with the manuals in the case of failure or malfunction. According to TANESCO, JICA's technical cooperation project ("The Project for Capacity Development of Efficient Distribution and Transmission Systems (2009-2016)"), which was implemented simultaneously as this project, has led to the reduction of the time required for the maintenance of power transmission and distribution facilities and the reduction of accidents during maintenance.

As described above, there is no technical problem because the staff in charge of operation and maintenance of the substations as well as

[8] Calculated using the average IFS rate during the project implementation period (2014–2017): 1 Tanzanian shilling = 0.06 yen.

the transmission and distribution network developed in this project have the necessary skills, and there are the mechanisms for acquiring and maintaining those skills.

<Financial Aspect>

From 2016 to 2018, TANESCO continued to incur operating losses because while sales increased year on year, the cost of sales also increased (Table 4). The main reasons for this were electricity tariffs being set in a way that did not reflect the use and costs of the rented power plants[9], the completion of various major projects, and higher depreciation costs, which are part of the cost of sales. Operating expenses have decreased as a result of the cessation of use of the rental power plants and grid expansion, and the financial situation of TANESCO has further improved in 2019 as a result of new customer acquisitions. Although the budget and actual expenditures for maintenance and procurement of spare parts for the facilities maintained under the project were not available, a certain amount is spent each year for repairs and maintenance. During the site visit, it was also confirmed that each substation was operating without any problems and that spare parts were stored.

As described above, the financial situation is improving, a certain amount of money is secured every year for repair and maintenance, and each substation is operating without any problems with sufficient spare parts. Therefore, there is no financial problem regarding the continuous operation of the substations and transmission and distribution network developed in this project.

Table 4: Profit and Loss Statement of TANESCO

(Unit: million Tsh)

(data) item	2016*1	2017 (Completion year)	2018 (1 year after completion)	2019 (2 years after completion)
Revenue	1,379,740	1,415,314	1,436,153	1,535,040
Cost of sales*2	-1,469,103	-1,537,037	-1,459,921	-1,525,729
Gross profit	**-89,363**	**-121,723**	**-23,768**	**9,311**
Operating expenses*3	-271,667	-164,446	-197,683	-166,572
Other income*4	163,230	140,526	202,148	228,020
Operating profit	**-197,800**	**-145,642**	**-19,303**	**48,683**
Interest income	1,139	904	551	397
Finance costs, etc.	-158,669	-121,008	-96,060	-81,267
Net finance costs	**-157,530**	**-120,104**	**-95,509**	**-80,870**
Income before taxes	**-355,330**	**-265,746**	**-114,811**	**-32,187**
Corporate tax, etc.	8,932	5,170	5,940	3,600
Current period net benefits	**-346,398**	**-260,576**	**-108,871**	**28,587**

Source: TANESCO Annual Report 2016/2017 p.5, TANESCO Annual Report 2017/2018 p.7

*1: The accounting period of each fiscal year is from July 1 to June 30 of the following year.

*2: Power purchase costs from power plants, costs of transmission and distribution, etc.

*3: Staff salaries, operation and maintenance expenses, depreciation, expenses on advertising and promotion, etc.

*4: Gas sales revenue, interest cost on electricity tariff arrears, financial donation from other donors, etc.

<Current Status of Operation and Maintenance>

Through the field inspection, it was confirmed that the substation facilities maintained in the project are operating without any problems. However, the connection between the SCADA system of the newly constructed substations and the DCC, which was the responsibility of Tanzania, has not been established. The existing substation is connected to the DCC, but there is a communication problem caused by the gateway device[10]; data from the Ilala substation is reported to the DCC with a delay of three hours, and the gateway device stops working. At the Msasani substation, if the gateway device stops due to a power failure or other reasons, it does not restart automatically and cannot be operated remotely until the DCC staff manually restart it.

Cleaning of the inside of the Ilala substation is conducted daily by the staff, while cleaning of the outside of the station is outsourced to the private sector and conducted regularly. During the site visit, it was confirmed that the site was tidy and well cleaned.

Substation maintenance is conducted systematically by checking the operation once a month and preventive maintenance twice a year. In the preventive maintenance, deterioration and defects of the substation equipment are checked, and repairs and replacement of parts are carried out. At the Ilala substation, daily patrols and inspections are also conducted by resident staff to check for abnormal sounds and conditions of the equipment.

During the site visit, it was confirmed that spare parts are stored at each substation. For the procurement of spare parts, the Transmission Department prepares an annual procurement plan in consideration of the service life as well as condition and applies to the Procurement Department of the Headquarters.

As described above, the operational status of the facilities and equipment is good at the time of the ex-post evaluation. Daily inspections and preventive maintenance are conducted regularly, and spare parts are procured systematically. However, there are still concerns about the rapid restoration work in the case of failure or power outage in the future because there are communication problems between the substation and DCC, and the remote control and management are not functioning.

[9] The power plant owned by Independent Power Tanzania Limited (IPTL); TANESCO needed to purchase power from IPTL because the power generation facilities owned by TANESCO alone could not meet the demand.

[10] A communication device that converts communication protocols to make them compatible between different systems; it is part of the SCADA system and is required to connect substation equipment to the DCC.

<Evaluation Result>
Considering the above, it is considered that there are no problems in technical and financial aspects. However, there are still concerns about the sustainable operation and maintenance of the facilities. This is because the unstaffed substations developed under the project are not remotely controlled and monitored, although they have not given rise to major accidents or failures currently. Therefore, the sustainability of the project effect is fair.

III. Recommendations & Lessons Learned

Recommendations to Executing Agency:

(1) Importance of early connection between new substations and the DCC

In the project, it was planned to install a SCADA system in each substation to monitor and control the substations remotely at the DCC. However, during the ex-post evaluation, the newly built substations (the Muhimbili, Jangwani Beach, and Mwananyamala substations) were not connected to the DCC. Although they have not developed into serious accidents or breakdowns to date, it has not been possible to instantly realize when power is interrupted; the employees have been investigating and repairing substations after receiving reports from customers. It is desirable that TANESCO will connect the SCADA system of the newly constructed substations with the DCC as soon as possible for quick restoration of power and sustainable maintenance of the substations in the future.

(2) Necessity of strengthening response to reduce power outage times

The average outage time of all substations developed under the project has improved significantly compared to before the project was implemented but has been increasing since 2017. As the number of contracted units is on the rise, electricity demand is expected to continue to increase. As accidental outages account for a particularly large proportion of planned and accidental outage hours, it is desirable that TANESCO will strengthen measures to reduce accidental outage hours. The main reasons for the occurrence of accidental power outages are the aging of facilities and equipment in addition to the collapse of power poles. Therefore, it is necessary for TANESCO to detect aging facility equipment at an early stage through regular inspections as well as prioritize and systematically allocate budget for new construction and replacement. It is also important to replace collapsed poles as early as possible and use concrete poles instead of wooden poles, which are prone to collapse when constructing or replacing electric lines. Furthermore, it is desirable to connect the DCC to newly constructed substations and solve communication problems with existing substations as soon as possible. This is because the connection with the DCC enables immediate identification of abnormalities and immediate responses such as switching to another system remotely even if the power supply is interrupted.

Recommendations to JICA:

In this project, it was planned that a SCADA system would be installed at each substation and connected to the DCC by the Tanzanian side. However, the equipment introduced is a German product that TANESCO has never handled before, and TANESCO does not know the configuration, operation, and maintenance of the product; therefore, the connection has not been completed. JICA should continue to monitor the Tanzanian side to ensure that the abovementioned solutions are steadily implemented. Additionally, if it is difficult for the DCC to do so on its own, it is desirable for JICA to consider other support including technical cooperation for the operation and maintenance of SCADA equipment.

Lessons Learned for JICA:

(1) Setting of Indicators

During the ex-ante evaluation, the number of electrified households was set as one of the indicators to verify the effectiveness of the project. However, the baseline and target values were estimates based on population and household surveys as well as the electrification rate, therefore actual values were not calculated. At the time of the ex-post evaluation, the implementing agency did not collect the actual number of electrified households, and no population and household survey had been conducted since the ex-ante evaluation. Therefore, it was difficult to collect the actual number of households with the same target and standard values. When planning a project, it is important to set indicators after confirming whether they are possible to be collected. It is desirable to make maximum use of existing data regularly recorded and collected by the implementing agency. However, if there is a need for additional surveys and data collection, the purpose and timing of collection should be fully explained to the implementing agency and agreed upon from the planning stage.

(2) Introduction of an automated network unfamiliar to the implementing agency

In the project, it was planned to install a SCADA system at each substation and connect it to the DCC by the Tanzania side. However, the gateway equipment installed was a German product, and the DCC staff did not know how to configure, operate, and maintain the system because they had never used it before. In the project, the manufacturer provided training during the implementation period, but the content was limited to basic initial operations for some staff. If it is difficult to include the connection between the systems in the project scope, and it is to be borne by the executing agency, it should be carefully confirmed beforehand whether the agency has sufficient knowledge, skills and experience in operating the equipment to be introduced. If it is judged that the agency does not have sufficient technical skills, it is desirable to include the initial operation of the equipment and the system configuration, operation, and maintenance methods in the components of OJT and soft components of the project. However, if there are numerous facilities and equipment to be developed in the project, it may be difficult to allocate sufficient days for the OJT and the soft component in the grant aid to teach the operation and maintenance of a specific system and equipment. In such a case, it is important to enhance the synergistic effect of the project by collaborating among multiple projects and programs, for example, by providing guidance through technical cooperation projects and/or dispatching experts.

(3) Ensuring the implementation of matters to be borne by the recipient in grant aid projects

The connection of the SCADA system at each substation to the DCC was a responsibility of the Tanzanian side, but it was not completed at the time of the ex-post evaluation. Initially, the procurement and connection of the necessary communication equipment was planned to be outsourced, but the bidders offered a higher cost than expected. The SCADA system was not a high priority within TANESCO, and it was difficult to secure immediate funding. Therefore, TANESCO has not been able to procure and connect them. To prevent this sort of situation

from having happened, the importance of the SCADA system should have been recognized in TANESCO during the project planning, and it should have been confirmed in advance that the procurement funds would be secured. JICA should confirm the importance of the equipment and materials to be introduced, including those to be paid by the recipient, with the implementing agency and carefully check the distribution of the budget within the implementing agency to ensure that items to be borne by the recipient are implemented.

Control building (Ilala substation)

132kV Transmission line gantry (Ilala substation)

33kV Distribution line