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

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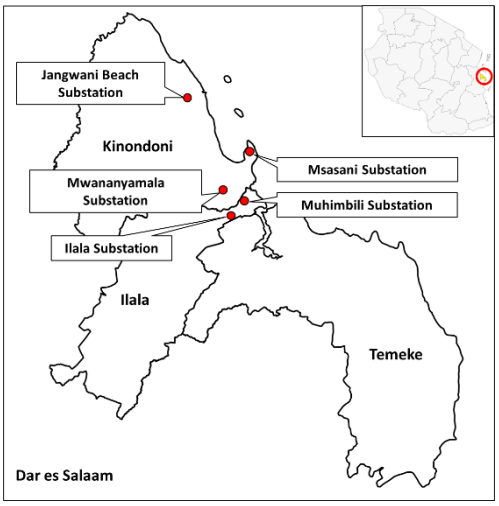
Duration of the Study: December 2020 - January 2022
Duration of the Field Study: February 15, 2021 - February 25, 2021

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.

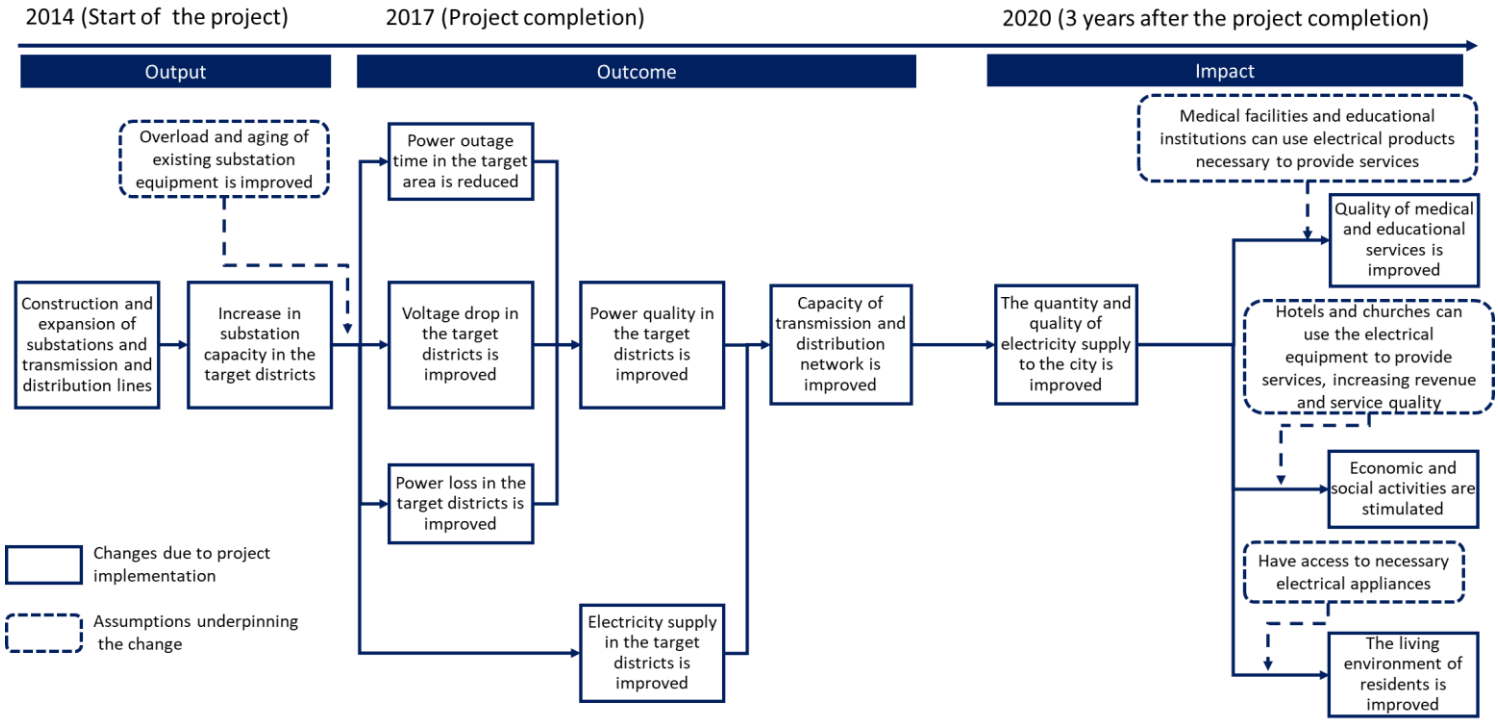


Figure 1. Logic of the project

<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.

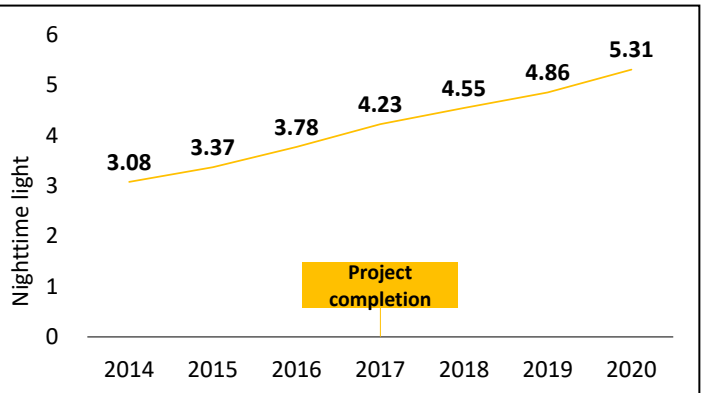
<Longitudinal Analysis of the Amount of Nighttime Light>

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

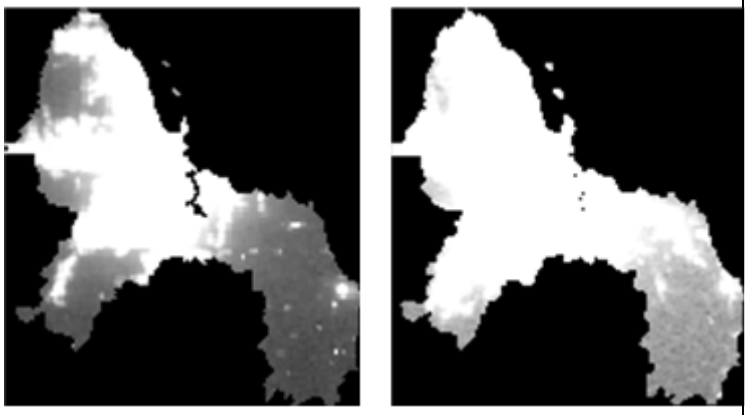
[3] Before the project completion, the voltage was unstable and could not be maintained in a voltage range suitable for medical equipment, resulting in equipment failure.

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.

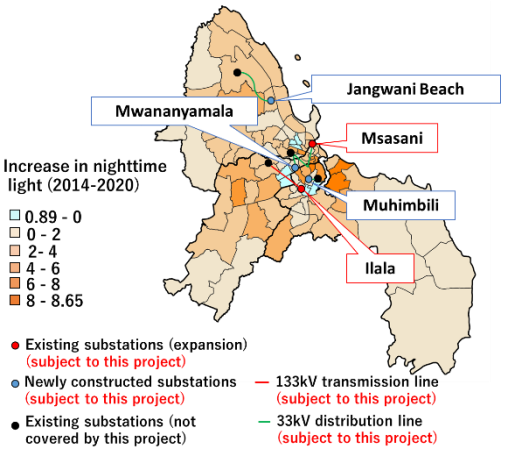


Figure 3. Changes in nighttime light levels by region

(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