Internal Ex-Post Evaluation for Grant Aid Project

conducted by Nigeria Office: February 2021

Country Name	The Project for Introduction of Clean Energy by Solar Electricity Generation System
Federal Republic of Nigeria	

I. Project Outline

Background	Nigeria is one of the world's largest oil producing countries, however, there had been limitations on sustainable energy supply depending on fossil fuels. On the other hand, the power generation volume of the hydropower plant of the country, one of the country's major power sources, had lowered because of adverse effects by climate change such as a decrease in the flow of the Niger River system was a concern. As it became difficult to secure sustainable energy supply and energy security, there was growing interest in shifting from conventional fossil fuel-based energy policies.			
Objectives of the Project	To increase power generation capacity, diversify power sources, and raise awareness of people of Nigeria for utilization of renewable energy by procurement of photovoltaic (PV) system and related equipment in the Lower Usuman Dam Water Treatment Station as well as technical assistance for capacity building of technical personnel, thereby contributing to demonstration of Japan's initiatives for promoting collaborative efforts by both developed and developing countries against climate change.			
Contents of the Project	1. Project Site: Lower Usuman Dam Water Treatment Station 2. Japanese side 1) 975kWp PV generation system (PV module, Power conditioners, Transformers, Data management system, Display system, Weather monitoring instruments, etc.) 2) 207.76 kWp additional PV generation system (The output was added by using the residual amount of the E/N limit amount) 3) Technical assistance (soft component): Training on basic knowledge, technical characteristics, preventive inspection, operation and maintenance including emergency response of grid-connected PV system. 3. Nigerian side: Securing a disposal site for excavated earth, sewage, and waste oil during the works period			
Project Period	E/N Date	May 15, 2012	Completion Date	January 12, 2017 (Completion of installation)
	G/A Date	September 25, 2012		
Project Cost	E/N Grant Limit / G/A Grant Limit: : 980 million yen			Actual Grant Amount: 980million yen
Executing Agency	Federal Ministry of Power (FMOP)			
Contracted Agencies	Main Contractor(s): Toyota Tsusho Corporation Main Consultant(s): Yachiyo Engineering Co., Ltd Agent: Crown Agents			

II. Result of the Evaluation

< Special Perspectives Considered in the Ex-Post Evaluation >

・The target year for conducting ex-post evaluation is generally set to 3 years after the completion of the project, and the target year for this project was set to 2019 at the time of the ex-ante evaluation; however, the completion of this project was delayed to 2017, so the target year would be 2020. On the other hand, since the PV system can be operated immediately after installation, in this ex-post evaluation, the degree of achievement of the target was verified using the data of 2018 and 2019.

・As mentioned in 3 Efficiency below, the project delayed significantly (the ratio against the plan: 258%). The reasons are related to security issues and installation of additional system. Due to the deteriorating security situation in the region, the initial project site Umaru Musa Yarádua University in Katsina State in Northwest Nigeria was relocated to Usman Dam Water Treatment Plant in Abuja.

1 Relevance

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

The project was consistent with the development policy of Nigeria. Nigeria ratified the United Nations Framework Convention on Climate Change and the Kyoto Protocol, and was actively working on climate change countermeasures. The Energy Commission of Nigeria (ECN) formulated the "Renewable Energy Master Plan" in 2005 (revised in November 2012), and it aimed to diversify the country's energy sources through promotion of renewable energies such as PV, wind, small hydro and biomass based on the plan.

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

The project was consistent with the development needs of Nigeria for clean energy, as Nigeria had been dependent on fossil foil and also power generation volume of hydropower had declined, as noted above ("Background").

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

The project was consistent with Japan's ODA policy to Nigeria. Basic infrastructure development was one of the priority areas under the "Country Assistance Policy to Nigeria" (December 2012), and increasing and stabilizing the power generation volume was emphasized. . Also, the Government of Japan introduced a scheme of "Program Grant Aid for Environment and Climate Change" in 2008 aiming at support for developing countries with lack of implementation capacity and funds for balancing between reduction of CO2 emission and economic growth in order to effectively promote global efforts against climate change. The project was implemented under this scheme as a mitigation measure through introduction of clean energy.

<Evaluation Result>

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

2 Effectiveness/Impact

<Effectiveness>

The project partially achieved its objectives as the actual results of quantitative effects did not reach the targets. The net power generation

volume (indicator 1) has been less than 80% of the target after the project was completed. The project targeted to generate 1,459 MWh/year in 2019 by the original 975 kWp PV system alone, and the actual power generation volume is estimated to be 70% (2017), 82% (2018) and 70% (2019) of the target volume[1]. One of the reasons of not reaching to the target was that the grid-connected solar power generation system installed by the project needed to stop power generation due to the daytime outages, which occurred often, in the power distribution grid operated by Abuja Electricity Distribution Company (AEDC). Part of the generation data were missing from the data log as a result of failure of the data management system in parts of 2017 and 2019. The data management system was fixed twice- first time in 2017 and the second time in 2019. The system was working well at the time of ex-post evaluation. The CO2 Reduction (indicator 2), which was calculated based on the power generation volume, has not reached the target either. The conditions of the both systems have been well, as all modules (3,696 PV modules and 784 PV modules for respective system) have been functioning and the capacities of the systems have been maintained.

The project implemented the soft-component for capacity enhancement for operation and maintenance (O&M). The capacity has been maintained as the installed equipment has been properly maintained and a sufficient number of staff has been assigned.

Public awareness about the installed solar power generation systems has increased among the stakeholders including; the State Water Boards, universities, secondary schools, professional associations, investors in power generation, state ministries of power, and others. For example, students of Government Secondary School Ushafa, a neighboring community to Lower Usuma Dam, who are studying sciences were in Usman Dam to see how a solar panel and power plant operates and they were happy at the end of the day. Delegation of Sokoto and Kano State Water Board were in Usuma Dam to see the solar facilities with a view to replicating the same in their agencies. Staff of Nigeria Bulk Electricity Trading Company was in Usuma Dam to see the solar facilities and were satisfied. Students of higher institutions of learning including military schools have been coming to see the solar facilities, likewise corporate organizations and professional associations. Also, the project site received more than 1,500 visitors a year. It is therefore, important to say that with the number of visitors trooping here on daily basis to either see or make enquiries about the solar power plant, Nigerians have been more aware of solar system and awareness has been created since the project completion.

There has been an effect that the grid connected PV system brings in savings in electricity bills.

<Impact>

Although it was expected that Japan's initiative for promoting measures climate change both by developed and developing countries is publicized, it was unable to confirm a case which introduced the project as a model case at symposiums and other occasions by the time of ex-post evaluation.

According to Federal Capital Territory Water Board (FCTWB), an agency who carries out Operation and Maintenance (O&M), no negative impact on natural environment was observed. No land acquisition and resettlement occurred under this project.

<Evaluation Result>

Therefore, the effectiveness/impact of the project is fair.

Quantitative Effects

	Baseline (2014) Baseline Year	Target (2019) 3 year after Completion	Actual (2017) Year of completion	Actual (2018) 1 year after Completion	Actual (2019) 2 years after Completion
Indicator1: Power generation volume at transmission end (MWh/year) (for original 975 kWp system) * 1	0	1,459	1,027.47	1,194.70	1,023.10
Indicator 2: CO2 Reduction (ton/year) (for original 975 kWp system) *2	0	723.5	509.57	592.51	507.40

*1 Total power generation volume of both original and additional system was 1,245.615MWh (2017), 1,448.34MWh (2018) and 1,240.31MWh (2019) respectively. The volume of the original 975 kWp system is estimated based on the ratio of its capacity (975), relative to the total capacity (975+207.76). CO2 Reduction (indicator 2) is estimated in the same manner. The total CO2 reduction is 617.76 ton (2017), 718.31 ton (2018) and 615.13 ton (2019).

*2 CO2 reduction is calculated at the time of ex-ante evaluation as follows:

Offset amount of thermal generation [GJ/year] × Emission factor [tC/GJ] × 44/12

Hence, the annual reduction of greenhouse gases is calculated to be 723.5 t as follow:

14,195.7 × 0.0139 × 44/12 = 723.5 t

(Offset amount if thermal generation is calculated as follows: Power generation [MWh/year] × 3,600 [GJ/(1000MWh)] ÷ Thermal efficiency of generation)

*3 The Indicators 1(1,204.67 (MWh/y) and 2(597.38 (t/y) to be compared with Target(2019) 3 year after Completion were estimated assuming that the available actual data of the first half of the year 2020 (730.58MWh) is applied to the one of the second half and correcting the difference between the volume of the original 975 kWp system and additional system in the same manner as *1

Source : FCTWB

3 Efficiency

Although the project cost was as planned (the ratio against the plan: 100%), the project period significantly exceeded the plan (the ratio against the plan: 258%). The project period exceeded the plan partly because of installation of additional system and partly because of change in project site due to deteriorating security situation in the region after signing G/A. Outputs were produced as planned. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional/Organizational Aspect>

O&M of the facilities under the project has been carried out by FCTWB. The Electrical and Mechanical Unit of FCTWB has been responsible for the O&M of the power plant. The total number of workers attached to the power plant has been 12 members. Four members

[1] As the Federal Capital Territory Water Board (FCTWB), an O&M agency did not have the breakdown of the power generation volume for the 975 kWp original system and additional 207.76 kWp system, therefore, the power generation volume for the original system was estimated based on the ratio of capacity of each system relative to the total capacity .

each have been assigned to operation, maintenance, and cleaning. The number of staff has been sufficient.

<Technical Aspect>

The staff has had sufficient technical skills and knowledge to conduct proper O&M, as the soft component, during the project implementation, was used to transfer the necessary skills for O&M. There might be needs for the refresher training, especially for young engineers recruited, for the long-term purpose. The manuals provided by the project have been utilized.

<Financial Aspect>

According to FCTWB, the necessary budget has been secured for O&M through annual budget appropriation of the Federal Capital Territory Administration (FCTA).

O&M Budget of FCTWB

(unit: Naira)

	2017	2018	2019	2020
O&M Budget	50,000,000	50,000,000	30,500,000	30,000,000

<Current Status of Operation and Maintenance>

The installed equipment and spares have been in excellent condition. Routine maintenance activities have been carried out and some of which include; (i) Daily inspection of PV system and monitoring of power generation; (ii) Weekly inspection of Junction and Collection boxes including wiring system; (iii) Washing of PV panels every two weeks, and others.

<Evaluation Result>

No major problems have been observed in the institutional/Organizational, technical, and financial aspects. Therefore, the sustainability of the project effect is high.

5 Summary of the Evaluation

The project partially achieved its objectives as the net power generation has not reached the target due to the power outage. Nonetheless, the project strengthened the O&M capacity and raised the public awareness towards the renewable energy. As for the efficiency, although the project period significantly exceeded the plan, the project cost was as planned.

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

III. Recommendations & Lessons Learned

Recommendations to Executing Agency:

- FCTWB should work further closely with the power distribution company (Abuja Electricity Distribution Company) to increase availability of day time supply to close 100%. This will promote impact of the project and reduce C02 emissions from thermal power generation. In addition, it is desirable that FCTWB takes measures such as establishing a system for appropriate maintenance and operation of system to minimize the outage part of panels when accidents occur and to ensure quick recovery.
- FMOP should work with JICA to create awareness of renewable energy technologies and widely publicize the effects of the project.
- FCTWB is recommended to conduct capacity building workshops/trainings periodically to promote sustainability of the project.

Lessons Learned for JICA:

- For grid connected PV systems, a net meter is important to measure energy import and export to the grid. Since no net meter is installed under this project, it is difficult to measure energy import and export accurately and therefore energy exports to the grid during periods of low demands (from the water treatment plant) are unaccounted for and FCTWB is not compensated accordingly. When installing grid connected PV systems in a project, it is important to examine the necessity of a net meter.

PV modules installed under the project