Internal Ex-Post Evaluation for Grant Aid Project

conducted by Nepal Office: January 2018

Country Name	**The Project for Clean Energy Promotion Using Solar Photovoltaic System**
The Federal Democratic Republic of Nepal	

I. Project Outline

Background	The power supply in Nepal mostly depends on hydropower using water resources. While the power demand increased irreversibly every year, the power supply volume dropped during the dry season due to the lack of river water. This caused to fall the power supply far below the demand, resulting in a critical situation for the local people. The scheduled power cutoff was executed for 18 hours a day at the maximum level in 2009. In the country, stand-alone photovoltaic (PV) system has already been introduced for water pumping, telecommunications, airport and the solar home system has been introduced for general houses and public facilities in non-electrified areas. However, no grid-connected PV system was yet to be installed. Besides underlying needs of stable and renewable energy supply, the government of Nepal requested the government of Japan a support to gain technical knowledge and know-how through the introduction of the grid-connected PV system to Kathmandu Upatyaka Khanepani Limited (KUKL).			
Objectives of the Project	To enhance power generation capacity, diversify energy sources and increase awareness among the people of Nepal on the utilization of renewable energy by procurement and installation of grid-connected PV system as well as capacity building of engineers in KUKL, thereby contributing to demonstrating the initiatives of Japan to promote global collaborative efforts towards climate change.			
Contents of the Project	1. Project Site: Dhobighat Water Reservoir (Kathmandu) 2. Japanese side: (1) Provision of grant necessary for procurement and installation of PV system (680.4kW) Equipment of PV System: PV Module, Power Conditioner, Transformer, Low Voltage Switching Panel, Junction box, Connection box, Low voltage distribution boards, Distribution Panel, Switchgear Panel, Power Cables, Data Collecting System, Meteorological Monitoring System, Control House, Display panel, Spare parts, etc. (2) Technical Assistance (soft component of Grant Aid) Training on basic knowledge about interconnecting PV system and its operation and maintenance (O&M) including daily /periodic maintenance check-ups and data logging system/data analysis 3. Nepal side: Land preparation for construction of control house for switchgear, construction work of temporary road, Construction work of power line crossing road.			
Project Period	E/N Date	January 29, 2010	Completion Date	July 8, 2012
	G/A Date	January 29, 2010		
Project Cost	E/N Grant Limit / G/A Grant Limit: 660 million yen, Actual Grant Amount: 650 million yen			
Executing Agency	Kathmandu Valley Water Supply Management Board (KVWSMB) Kathmandu Upatyaka Khanepani Limited (KUKL)			
Contracted Agencies	Main Contractor(s): Marubeni Corporation Main Consultant(s): Nippon Koei Co., Ltd. Agent: Japan International Cooperation System			

II. Result of the Evaluation

<Special Perspectives Considered in the Ex-Post Evaluation> >

Since the target year for the ex-post evaluation is generally the 3rd years after the project completion, the target year of this project was set as the year of 2014 at the time of ex-ante evaluation. However, since the completion of the project was delayed to 2012, the target year can be the year of 2015. On the other hand, the PV system can be fully operated just after the installation. Therefore, for this ex-post evaluation, the achievement level of the project objectives was verified by the data in 2014 and 2015.

1 Relevance

<Consistency with the Development Policy of Nepal at the Time of Ex-Ante and Ex-Post Evaluation>

The project has been consistent with Nepal's development policies highlighting promotion of renewable energy resources, including a PV system, set in policy documents such as "The Rural Energy Policy 2006", "Renewable Energy Delivery Policy 2013" and "Renewable Energy Delivery Mechanism 2013". At the time of ex-post evaluation, "the 14th Three Year National Plan 2016-2019" and the "Subsidy Policy for Renewable Energy" approved in 2016 put priorities on renewable and clean energy for sustainable development.

<Consistency with the Development Needs of Nepal at the Time of Ex-Ante and Ex-Post Evaluation >

The project has been consistent with Nepal's development needs of installing a solar power system across the country to contributing generation and supply of sufficient electricity for local residents to use electricity all year round, in particular in a dry season. As there is still a necessity for mitigating a gap between the power demand and the power supply, several types of power generation systems including PV system other than hydropower generation have been promoted.

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

The project was consistent with Japan's ODA policy for Nepal prioritizing social and economic infrastructure development, including transportation, electricity, water supply, and urban environment, as one of the 3 priority areas through policy dialogues between Nepal and Japan since 2006. In addition, the project was implemented under a scheme of "Program Grant Aid for Environment and Climate Change", which the government of Japan newly introduced in 2008 in order to support developing countries with willingness to contributing to mitigation of climate change but with lack of capacity and fund to balance between their economic growth and greenhouse gas reduction."

<Evaluation Result>

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

2 Effectiveness/Impact

<Effectiveness>

The project mostly achieved its objectives at the time of ex-post evaluation. The annual power generation volume by the PV system installed by the project (Indicator 1) was 446,230 kWh/year in 2014 (93% of the target value) and achieved 570,310 kWh/year in 2015 (119% of the target value). It further increased to 571,581kWh/year in 2016. In terms of the amount of CO_2 reduction (Indicator 2), the estimated reduction of CO_2 by the power generation using the PV system installed by the project was 356,984 t/year in 2014 (93% of the target value), and it increased to 456,248 t/year in 2015 and 457,265 t/year in 2016. The annual reduction of electricity cost of KUKL (Indicator 3) was 1.23 million Nepal Rupees (NRP) in 2014 which was below the target amount (1.32 million NRP) but reached 1.34 million NPR in 2015 and further increased to 1.77 million NPR in 2016. Although KUKL can cover electricity cost by the electricity sales to NEA (Nepal Electricity Authority), energy demand has been also increased both in production and distribution due to the increase in the usage of pump machine. The project contributed to raising the awareness of Nepalese on the utilization of renewable energy. Since the PV system installed by the project is the pilot model to demonstrate a large-scale solar power generation in Nepal, students studying engineering and information technology visited the site of the PV system for learning purposes. Also, researchers of the National Academy of Science and Technology utilized the data collected from the PV system. Over 400 visitors have visited the sites from 2013 till 2016. Although KUKL itself does not organize learning events particularly for promotional purpose, whenever contacted for visitation on the PV system, KUKL welcomes them and explains about the system. On the other hand, the demonstration effect of the PV system to the public has been limited because the energy meter with instruments and the display panel installed by the project has not been functioning.

<Impact>

The project has partially contributed to demonstration of the initiatives of Japan to promote global collaborative efforts towards climate change, as Japan's commitment for promoting clean energy and reduction of CO2 emission has been realized through the project

Some positive impacts were observed at the time of ex-post evaluation. The PV system installed by the project contributed to an increase in the amount of electric power supplied via the electric power network in Kathmandu through the sales of the power generated by the PV system to NEA. The sales of the power to NEA also led the additional revenue of KUKL: 1.2 million NPR in 2014, 2.9 million NPR in 2015 and 2016. In addition, the sufficient supply of the power generated by the PV system to the Sundarighat Water Treatment Plant has enabled to supply water for 24 hours from the Plant to locals and partially contributed to the improvement of water treatment capacity of the Plant to 4.8 million litters covering 100,000 households since 2013 from 2.4 million litters covering 50,000 households in 2012. The contribution of the PV system to the total power supply of NEA in 2014 is 0.01%. Furthermore, the demonstration effect by the PV system installed by the project led NEA to be more active towards promotion of the PV system in the country under the supports by the other donors including the World Bank (WB) and the Asian Development Bank (ADB)[1]. Institutional PV systems and household PV systems have been promoted by the Alternative Energy Promotion Center (AEPC) and 106 institutional PV systems were installed in 2014.The total power generation capacity of the PV system across the whole country is expected to increase to 75MW in 2017. There was no resettlement and land acquisition caused by the project. There was no negative impact observed at the time of ex-post evaluation.

<Evaluation Result>

In light of the above, the effect of the project has been observed mostly achieved as planned. Therefore, the effectiveness/impact of the project is high.

Quantitative Effects

Indicators	Baseline 2010 Baseline Year	Target 2014 2Years after Completion	Actual 2013 1 Years after Completion	Actual 2014 2 Years after Completion	Actual 2015 3 Years after Completion	Actual 2016 Year of Ex-post Evaluation
Indicator 1: Total Power Generation (kWh/year)	0	479,000	612,710	446,230	570,310	571,581
Indicator 2: Amount of CO_2 reduction (t/year)*	0	383,000	490,168	356,984	456,248	457,265
Indicator 3: Annual Reduction of Electricity Cost of KUKL** (NPR/year)	0	1,320,000***	955,084	1,232,400	1,345,978	1,772,902

Source：Ex-Ante Evaluation Sheet (JP), Preparatory Survey Report (EN), data provided by KUKL, answers to the questionnaire surveys to and interviews with staffs of KVWSMB and KUKL,

Note 1: * The equation of the reduced amount of CO_2 (e.g. 383,000 = 479,000 kWh/year X 0.800 t-CO_2/MWh)

Note 2: ** The annual power consumption of the Sundarighat Water Treatment Plant was 203 MWh from August of 2008 to July of 2009. Since the PV system installed by the project will annually generate 479 MWh, an expected surplus power volume will be 276 MWh, which will be 1.32 million NPR.

Note 3: *** 1,320,000 NPR = 1,600,000 JPY (Applied exchange rate in 2010: NPR1.00 = JPY 1.22)

3 Efficiency

The output of the project was produced as planned. Although the project cost was within the plan (ratio against the plan: 98%), the project period exceeded the plan (ratio against the plan: 157%). The reason why the project period exceeded the plan was that of some technical issue for pre-commissioning and handover of the plant including some additional rectification work on data cable breakdown, delays in submission of the Pre-commissioning test report, in the finishing of civil works, and in connection to NEA's grid. Therefore, the efficiency of the project is fair.

4 Sustainability

<Institutional Aspect>

KUKL has been under the control of KVWSMB and responsible for operation and maintenance (O&M) of the PV system installed by

[1] WB supports the Grid Solar Energy and Energy Efficiency Project (GSEEP) to establish a 25MWp Scale Grid Tied Solar Farm. Besides that, NEA is going to implement a project to install PV systems for 50MW with support by ADB and to have Power Purchase Agreements (PPAs) with private operators for 64 MW in total.

the project. There has been no institutional change in KUKL since the project completion. KUKL has 1 monitoring officer, 1 finance officer, 1 assistant manager, 1 engineer, 7 supervisors, 2 guards and 1 foreman for O&M of the PV system, and they are sufficient to accomplish their responsibilities, in that the PV system is properly operated and maintained.

<Technical Aspect>

Although KUKL has been primarily a water utility operator and has not had regular budget and resources for training on the PV system, the O&M staffs of KUKL have sustained the necessary knowledge and skills for O&M of the PV system at an intermediate level. It is often the case that whenever a staff is transferred or a new person joins, they are asked to refer to the manual and guideline for O&M of the PV system. Sometimes their predecessor provides successors brief guidance about the PV system and tasks associated with the PV system. Despite the sufficient number of staffs assigned for the system, as aftercare trainings have not been conducted in KUKL, the staffs have not had the necessary knowledge and skills for troubleshooting and repair of the PV system. Thus, there has been a risk that hampers the O&M of the PV system in a long run.

<Financial Aspect>

Although there is no available data for the budget allocated to KUKL for the PV system, according to staffs of KVWSMB interviewed at the time of the ex-post evaluation, KVWSMB has allocated a certain amount of budget for O&M of the PV system to KUKL based on KUKL's requests. The administration budget of KUKL has been also secured at the value of 1.06milillon NPR in 2013 and constantly increased to 1.44 million NPR in 2016, resulting in keeping the sufficient number of staffs for the O&M. KUKL has secured a small amount of the budget for spare parts and consumable equipment since the project completion. In addition to the annual budget to KVWSMB from central government that is to be allocated to KUKL, the future budget of KUKL is expected to be complemented by sales of the power generated by the PV system to NEA.

<Current Status of Operation and Maintenance>

Most of the major equipment of the PV system, including PV module, a power conditioner, a transformer panel and a 11kV distribution board, have been functioning well and there has not been any problem in the supply of spare parts and procurement of consumables. However, the energy meter with instruments, display panel, meteorological monitoring system, data collecting system had not functioned since software problems have been left due to the lack of the staff's knowledge and skills for troubleshooting. Although KVWSMB has conducted inspections for the problems, it has been intermittent because of lack of adequate human resource for monitoring at KVWSMB. In addition, although a staff at the site operates and maintains the PV system on a regular basis, there has been no systematic maintenance plan for any problem. Although previously, logging analysis of power was automatically conducted through the computer system, after the computer system was broken down, trainings on the analysis for newly assigned staffs have not been conducted and the analysis stopped. Staffs that had been trained by the project were either transferred or retired. Even some trained staffs who are still in KUKL could not identify software problems.

<Evaluation Result>

In light of the above, slight problems have been observed in terms of the technical aspect of the executing agency. Therefore, the sustainability of the project effect is fair.

5 Summary of the Evaluation

The project has achieved its objective to enhance power generation capacity, diversify energy sources and increase awareness among the people of Nepal on the utilization of renewable energy. As for sustainability, there is a concern about the knowledge and skills for maintenance and troubleshooting of staffs of KUKL as a display monitor and other equipment for public relations of the PV system have not yet been repaired. However, the PV system itself has been well functioning and generating electricity without any problem. As for efficiency, the project period exceeded the plan.

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

III. Recommendations & Lessons Learned

Recommendations to Executing Agency:

- Some equipment related to data collecting system and meteorological monitoring system has not functioned. It has thus hampered data collection, data logging as well as data analysis in the accurate operation. Therefore, to sustain the self-administered PV system, the technical capacity of staff must be strengthened particularly on its troubleshooting skills. It can be realized by seeking technicians with experience and expertise in Nepal, or by seeking support of JICA to identify expert/technicians involved in the project to troubleshoot the technical problem of the equipment; and it is also important to enhance the internal knowledge transfer system among staff (esp. when they are transferred or retired) as a parallel effort of KUKL.
- Although the Project intended to spread its demonstration effect, adequate awareness raising as well as technical know-how has not been fully disseminated. The flow of visitors is decreasing and KVWSMB, as well as KUKL, does not have dissemination plan to increase awareness among people on the utilization of renewable energy by the PV system. Hence, to promote awareness among people and like-minded institutions, as per project objective, KUKL and KVWSMB need to organize dissemination programs, sharing sessions and training and KUKL and KVWSMB need to increase awareness among people on clean energy. It can be done by organizing several learning events, dissemination workshops and inviting visitors to the site. KUKL need to show demonstration effect of the project to larger mass in order to show the viability of electricity generated by the PV system. KUKL must maintain the project site clean and make all equipment and system properly function.

Lessons Learned for JICA:

- During Project formulation, some training was incorporated into the project. However, because the project was first of its kind, technical sustainability of the project was not well envisioned. Similarly, the technical and financial capacity of KUKL on operating the PV system was not adequately considered in detail. Follow-up training and OJT was not planned in the project. Even sub-contractor recruited during the project could not identify or troubleshoot the software problem. It thus reflects that novel technology was transferred without transferring comprehensive skill and knowledge to maintain the totality of the system. Hence, follow-up training should be conducted for such newly introduced technology to secure the sustainability.

PV panels at site

Solar Power Conditioner working properly