Internal Ex-Post Evaluation for Technical Cooperation Project (SATREPS[1])

conducted by India Office: February2022

Country Name	UASB-DHS Integrated System - A Sustainable Sewerage Treatment Technology
India	

I. Project Outline

Background	In India, the rapid urban growth resulted the polluting rivers. Under the National River Conservation Plan (NRCP), many sewage treatment plants (STPs) adopted the Up-flow Anaerobic Sludge Blanket (UASB) process and waste stabilization ponds as an energy-saving and low-cost sewage treatment technology. An UASB plant requires a post-treatment step to comply with the prescribed effluent discharge standards. Thus, most UASB plants were provided with a polishing pond, specifically a final polishing unit (FPU), with a one- or two-day detention period. However, the FPU requires a considerably large area of land. Furthermore, an issue developed in which a UASB-FPU system was unable to meet the effluent standards. The Down-flow Hanging Sponge (DHS) system is a technology developed at the Nagaoka University of Technology, Japan, especially for post-treatment of the effluent from UASB reactors. The key of the DHS system is use of the polyurethane sponge as a support material to retain sludge. The UASB effluent is supplied to the top of each sponge module, and it trickles down to the bottom of the module. The performance of a 1 MLD* pilot DHS plant at Karnal in Haryana, had been monitored for more than five years, and it was reported that the effluent quality was fairly good and that the plant also reduced the amount of sludge production. As the DHS system requires simple operation and maintenance (O&M) and less land, the National River Conservation Directorate (NRCD) requested Japanese Technical Cooperation to up-scale the DHS system through collaborative research and a practical scale experiment of the UASB-DHS integrated system. * MLD: Million Liters per Day
Objectives of the Project	The project aimed to develop a novel sewage treatment technology, which is appropriate from the viewpoint of less energy consumption, ease of O&M, less land requirement, and the less total cost , through (i) verification of the applicability of the UASB-DHS system in India and (ii) preparation of Design and O&M Guidelines for the UASB-DHS system and a dissemination plan for the Guidelines and Manual (Draft), thereby contributing to the dissemination of a suitable UASB-DHS system for adoption as a suitable sewage treatment technology in India. 1. Expected Overall Goal: NA 2. Project Purpose: A novel sewage treatment technology, which is appropriate from the viewpoint of energy consumption, O&M, land requirement, and total cost, is developed.
Activities of the Project	1. Project site: Agra, Uttar Pradesh State 2. Main activities: (i) Procurement of media for DHS reactor, Design and construction of a UASB-DHS system, Continuous operation of the UASB-DHS system and evaluation of the applicability for sewage treatment in India; (ii) Preparation for Design Guidelines and the O&M Guidelines for the UASB-DHS system, Provide training courses with prepared Design Guidelines and the O&M Guidelines.[2] 3. Inputs (to carry out above activities) Japanese Side 1) Experts: 19 persons (1 long-term and 18 short-term) 2) Trainees trained: 12 persons 3) Design and Construction of the 5 MLD DHS pilot plant 4) Equipment: Equipment for water analysis, measuring micro-organisms, etc. 5) Operation cost Indian Side 1) Staff allocated: 9 persons 2) Facilities: Land for the pilot plant construction, buildings for laboratory, long-term expert office accommodation including lights, electric, facility, desk and chairs, etc. 3) Operation cost
Project Period	May 2011 - May 2016	Project Cost	(ex-ante) 398 million yen, (actual) 440 million yen
Implementing Agency	National River Conservation Directorate (NRCD), Ministry of Environment, Forests and Climate Change (MoEFCC); Central Pollution Control Board (CPCB); Uttar Pradesh Jal Nigam (UPJN); Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development (MOUD); Aligarh Muslim University (AMU); Indian Institute of Technology, Roorkee (IIT Roorkee) * NRCD was reorganized to NRCD, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti after project completion. * MOUD was reorganized to Ministry of Housing and Urban Affairs (MoH&UA), after project completion.		
Cooperation Agency in Japan	Tohoku University; Nagaoka University of Technology; Kisarazu Institute of National College of Technology; Kagawa Institute of National College of Technology; Niigata University of Pharmacy and Applied Life Sciences		

II. Result of the Evaluation

<Constraints on Evaluation>

- Due to the COVID-19 pandemic, it was difficult to collect information from the implementing agencies. Therefore, this evaluation is based on the limited information provided by UPJN, which managed to cooperate with the study under difficult circumstances.

<Special Perspectives Considered in the Ex-Post Evaluation>

- This SATREPS project did not have indicators for the Project Purpose, "A novel sewage treatment technology, which is appropriate from the viewpoint of energy consumption, O&M, land requirement and total cost, is developed." This ex-post evaluation did not set new indicators but followed the way the terminal evaluation took to assess the achievement level of the Project Purpose based on the result of economic evaluation of the developed sewage treatment system.

[1] SATREPS: Science and Technology Research Partnership for Sustainable Development

[2] The project plan was to prepare an O&M manual (draft), but since the manual needs to be approved by the Indian government, it was later changed to a guideline after discussions with the Indian side.

- For this SATREPS project, the Overall Goal was not set. Considering that the terminal evaluation recommended measures to disseminate the developed technology for adoption/replication in India, this ex-post evaluation regarded "A suitable UASB-DHS system is disseminated for adoption as a suitable sewage treatment technology in India" as the Expected Overall Goal (In the case of a SATREPS project without the Overall Goal, the Expected Overall Goal (set at the ex-post evaluation) should not be considered for the sub-rating of the effectiveness/impact and the overall rating).

1 Relevance

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

This project was consistent with India's development policies, such as the Eleventh Five Year Plan (2007-2012) that set a policy goal of supplying water to the entire urban population and providing sewerage and sanitation facilities by 2012. The Plan also argued that water pollution of rivers was caused by the inflow of untreated wastewater in excess of natural purification and aimed to establish a National River Conservation Plan (NRCP) and improve the water quality of major rivers to the designated use water quality.

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

As mentioned in "Background" above, this project was consistent with the need to develop a sustainable sewage treatment technology such as the UASB-DHS system.

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

This project was consistent with Japan's Country Assistance Program for India (2006) that addressed support for sewage treatment for river purification under "Improvement of the Poverty and Environment Issues," one of its three priority areas.

<Evaluation Result>

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

2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the time of Project Completion>

The project achieved the Project Purpose at the time of its completion as the objective of bringing down the pollution norms of treated water with low cost was successfully achieved by the technology developed under this project. A 5 MLD DHS pilot plant got constructed adjacent to the 78 MLD UASB STP at Dhandhupura, Agra, and started operation and continuous monitoring in July 2014. This plant was to test a UASB-DHS system, where effluent from the existing UASB plant reactor was treated at the project's DHS pilot plant. The project's economic evaluation showed that the UASB-DHS system had the lowest life cycle cost, including initial investment cost (capital cost) compared to other treatment processes that met the prescribed wastewater treatment standards at that time.

<Continuation Status of Project Effects at the time of Ex-post Evaluation>

The project effects have continued to the time of ex-post evaluation. According to UPJN, the 5 MLD DHS pilot plant is operating, and monitoring is being done.[3] Although India's discharge standards were raised from BOD<30 mg/L to BOD<10 mg/L, effluent from the pilot plant is still better than the normal UASB plants without DHS.

The Design Guidelines for the UASB-DHS system and the O&M Guidelines for the UASB-DHS System were prepared by the project and officially approved after project completion, and the brochures were developed. However, they were not shared as no follow-up was made for dissemination.[4] No information was collected on continuation of the related research by the universities involved in this project due to difficulties in contacting them under the pandemic.

<Status of Achievement for Expected Overall Goal at the time of Ex-post Evaluation>

The Expected Overall Goal has not been achieved by the time of ex-post evaluation. In addition to above information, in the present scenario, STPs are usually being constructed on the sequencing batch reactor (SBR) technology keeping in view the latest criteria of BOD<10 mg/L. In that case, according to UPJN, this project's DHS will not be of any use, but for earlier constructed and functional UASB STPs where effluent BOD standard was BOD<30 mg/L, DHS with improved efficiency as tertiary treatment to bring down the BOD could be promoted to achieve the latest standards. UPJN also shared that where land availability is not a big issue, techno-economic studies for UASB-DHS combination and SBR could be performed to arrive at the conclusion for adopting the DHS technology. Therefore, the effectiveness of the researched technology is confirmed, but the UASB-DHS system has not been disseminated.

<Other Impacts at the time of Ex-post Evaluation>

No negative impact on the natural environment has been observed. As a positive impact, UPJN officials engaged in the project have gained knowledge about the DHS system.

<Evaluation Result>

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

Achievement of Project Purpose and Overall Goal

Aim	Indicators	Results
(Project Purpose) A novel sewage treatment technology, which is appropriate from the viewpoint of energy consumption, O&M, land requirement, and total cost, is developed.	Result of economic evaluation of the developed sewage treatment system	Status of the Achievement: achieved (continued) (Project Completion) - During a flowrate of 3 MLD in hydraulic retention time (HRT) of 2.4 hours, the UASB-DHS system was able to satisfy the BOD<30mg/L discharge standard for 416-491 days of continuous operation. - The economic evaluation revealed that the UASB-DHS system has lower costs such as installation space, power consumption, and sludge generation compared to existing treatment processes. (Ex-post Evaluation) - The 5 MLD DHS pilot plant is operating, and monitoring is being done.

[3] In addition to the DHS pilot plant, various experimental equipment for this project's research was provided to the 78 MLD STP in Agra, but we were not able to fully grasp the status of their utilization during the ex-post evaluation. According to the information available, some are still in use (voltage stabilizers, vortex shaker, UPS battery cabinet, furniture, etc.) and some are no longer in use (computers, BOD incubator, sludge sampler, etc.).

[4] It was reported that the "preparation of a dissemination plan," which was supposed to be carried out by the project, corresponded to the holding of workshops for concerned parties.

(Expected Overall Goal) A suitable UASB-DHS system is disseminated for adoption as a suitable sewage treatment technology in India.	Whether the UASB-DHS system developed under this project was spread to other STPs in India	(Ex-post Evaluation) not achieved - The effectiveness of the researched technology is established, but the UASB-DHS system has not been disseminated (the project's DHS system does not match the STP scenario and the effluent standards at the time of the ex-post evaluation. Therefore, there is no prospect of widespread use of this system as it is.).

Source: Terminal Evaluation Report; JST Final Report; questionnaire and interview with the implementing agencies

3 Efficiency

Although the project period was almost as planned (ratio against the plan: 100%), the project cost exceeded the plan (ratio against the plan: 111%). The Outputs of the project were produced as planned. Therefore, the efficiency of the project is fair.

4 Sustainability

<Policy Aspect>

The NRCP has been changed to Namami Gange, an integrated conservation programme since 2014, which does not restrict the dissemination of DHS plants.

<Institutional/Organizational Aspect>

The relevant organizations exist, but detailed information was not available. UPJN is still responsible for the 5 MLD DHS pilot plant including 78 MLD UASB STP, O&M of seven STPs in Agra is outsourced to an Indian multinational company. However, no institutional set-up for the dissemination of the DHS system has been established as, according to UPJN, they are not responsible for the dissemination of sewerage systems design and O&M guidelines, i.e., in India, such guidelines are published by CPHEEO.

<Technical Aspect>

The fact that the DHS pilot plant is operating shows that the staff involved has a certain level of skills. However, no other information was available.

<Financial Aspect>

The fact that the DHS pilot plant is operating, shows that a certain level of budget is allocated to the plant. However, no other information was available.

<Evaluation Result>

In light of the above, some problems have been observed in terms of the institutional/organizational, technical, and financial aspects of the implementing agencies, including the unavailability of enough information to judge them as in a sufficient condition. Therefore, the sustainability of the effects through the project is fair.

5 Summary of the Evaluation

The project achieved the Project Purpose as the objective of bringing down the pollution norms of treated water with low cost was successfully achieved by the UASB-DHS system developed under this project. The project's effects have continued: the pilot DHS plant is operating with continuous monitoring, and the guidelines for the dissemination of the developed technology are ready. However, the project's system does not match the STP scenario and the effluent standards at the time of the ex-post evaluation, which makes it difficult for the developed technology to be used in other STPs, especially newly constructed ones. The dissemination has not taken place, and thus the Overall Goal has not been achieved. No major problem has been found in the policy aspect regarding sustainability, but enough information was not available in the institutional/organizational, technical, and financial aspects. As for the efficiency, the project cost exceeded the plan. Considering all of the above points, this project is evaluated to be satisfactory.

III. Recommendations & Lessons Learned

Recommendations for Implementing Agency:

- CPHEEO, National Mission for Clean Ganga (NMCG), and other competent authorities including UPJN are recommended to intensify efforts to disseminate the UASB-DHS technology by involving relevant stakeholders.

Lessons Learned for JICA:

- For a project to develop a novel technology, it should include (i) sufficient time and action for its dissemination with clear responsibility of actors and (ii) measures to avoid frequent staff transfer/to correspond to transfer of staff in charge of dissemination of the developed technology at the project formulation stage. For (i), the "dissemination plan" planned in the project should have been formulated as a specific plan to be implemented by UPJN and Urban Development Department (UDD), Government of Uttar Pradesh (State government in charge of dissemination). The plan could have aimed to facilitate the continuation of research and the establishment of new DHS plants, rather than simply holding workshops to present the project results. In addition, the concerned division in JICA HQ (in-charge of the SATREP project) should have formulated mechanism of the handholding support to UPJN/UDD, Government of U P for a specific period after the project completion, in order to not only help UPJN/UDD in dissipation of the project knowledge for its replication but also periodical reporting of the DHS plant O&M performance to UDD, Govt of U P and also NRCD/MoH&UA Government of India.