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

conducted by Bolivia Office: August, 2019

Country Name	Project for the Study on the Impact of Glacier Retreat on Water Resource Availability for the Cities of La Paz and El Alto
Plurinational State of Bolivia	

I. Project Outline

Background	Bolivia, situated in the Tropical Andes with an average annual precipitation of about 500 mm, largely depends on meltwater from glaciers for its water resources. However, these glaciers in the Tropical Andes will disappear in the next 30 to 40 years due to the effects of climate change; hence, Bolivia is facing potential depletion of its water resources. Regarding the quality of water resources, the decrease in current rivers flow due to glacier retreat will cause increase in pollution load of rivers and lakes. Furthermore, soil erosion at times of heavy rainfall would have brought about sediment and reduce the water storage capacity of reservoirs, which would cause shortage of available water resources. The country, however, had inadequate number of experts who comprehensively worked on water issues, and was lacking observation networks for water quality and data management, as well as the development of scientific models to evaluate the water resources availability.		
Objectives of the Project	Through development of models (glacier melting, water balance, erosion and sediment transport, water quality under climate change scenario and evaluation of the impact on water resources under climate change) and sharing information and knowledge on water resources with decision makers , the project aimed at discussion of possible adaptation policies for climate change, thereby contributing to application of the system of modelling, scientific insight and investigation results for formulation of policies of water supply under climate change scenarios.		
	Overall Goal: The system of modelling, scientific insight and investigation results are applied to the formulation of policies of water supply under climate change scenarios. Project Purpose: Support system* is developed for the formulation of water resource management policies under climate change scenarios, in the cities of La Paz and El Alto. *Support system: System for data collection and analysis, operation of models, sharing of information and knowledge based on simulations, update and operation of such information and knowledge.		
Activities of the project	Project site: La Paz and El Alto. 1. Main activities: Development of models of glacier melting, water balance, erosion and sediment transport, water quality under climate change scenario, development of the model for the evaluation of the impact on water resources under climate change, provision of information and knowledge on water resources to decision makers, etc. 2. Inputs (to carry out above activities) Japanese Side 1) Experts from Japan: 12 persons 2) Training in Japan: 20 persons 3) Equipment: 3D laser scanning system, meteorological observation system, hydraulic observation system, etc. 4) Local cost: cost for travel expenses, hiring local consultant, communication, etc. Bolivian Side 1) Staff allocated: 18 persons 2) Land and facilities: office space, etc. 3) Local cost for travel expenses, construction of facilities, equipment, etc.		
Project Period	April 2010 to March 2015	Project Cost	(ex-ante) 350 million yen, (actual) 246 million yen
Implementing Agency	Ministry of Environment and Water (MMAyA), Major University of San Andrés (UMSA), Institute of Hydraulics and Hydrology (IHH)		
Cooperation Agency in Japan	Tohoku University, Tokyo Institute of Technology, Fukushima University and Nihon University		

II. Result of the Evaluation

[Special Perspectives Considered in the Ex-post evaluation]

- As continuation of the project effects after the project completion, the following were verified: utilization of research outputs and availability of researches related to the project research outputs and new researches. Indicator 3 of the Project Purpose was related to the institutional development for utilization of research outputs, and therefore, its continuation status at the ex-post evaluation was verified in as the institutional aspect of sustainability.
- Since no indicators were set for the Overall Goal, its achievement was verified by examining if the project experience and research outputs were utilized for formulation of policies on water resources management.

1 Relevance

<Consistency with the Development Policy of Bolivia at the time of ex-ante evaluation and project completion>

The "National Development Plan" (2006-2010) mentions securing provision and quality of water as a natural resource with consideration of the most vulnerable people. In addition, in the "Law of the Right of Mother Earth" (2010) and the "The Mother Earth Law and Integral Development to Live Well" (2014), priority is on water resource management, and thus the project objectives were relevant with these policies.

<Consistency with the Development Needs of Bolivia at the time of ex-ante evaluation and project completion>

It was predicted that the decrease in provision of water resources due to glacier retreat would severely affect people's livelihood and economic development, and it was urgent to tackle with issues of shortage of water supply. In the metropolitan area of La Paz and El Alto,

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

if no measures were taken, the high influx of people from rural areas and the increasing demand for water would have brought severe consequences in the future. Thus, the project was consistent with these needs both at the time of the ex-ante evaluation and at the project completion.

<Consistency with Japan's ODA Policy at the time of ex-ante evaluation>

Priority pillars for assistance in Bolivia at the time of the ex-ante evaluation were supporting social development for poverty reduction and support for sustainable economic development. Water and sanitation were included in social development, which was one of the priority areas[2].

<Evaluation Result>

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

2 Effectiveness/Impact

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

The Project Purpose was achieved within the project period. In the project, as a support system for formulation of water resource management policies under climate change scenarios, models of glacier melting, water balance, erosion and sediment transport, water quality under climate change scenario, evaluation of the impact on water resources were developed, and these models and utilization plans were utilized by related stakeholders (Indicator 1). For example, the sedimentation model in basins was utilized in the project "Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes Project" (PRAA) of MMAyA and the World Bank, and the map of landslide prediction was provided by the project to PRAA. In addition, the model of the evaluation of the impact on water resources was installed at IHH and was shared with related organizations (Indicator 2). Observation data collected by the project were made public by IHH and the Water Resources Platform was established for the purpose of applying to the formulation of water resources policies.

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

Research outputs of the project have been utilized as follows. The model of glacier melting has been utilized in other areas than the project target areas, and research results were summarized in journals and articles. Models of water balance, erosion and sediment transport and water demand have been referred by the International Atomic Energy Agency (IAEA) in its project for evaluation of climate change. The water quality model has been utilized by the Institute of Sanitation Engineering and Environment (IIS) of UMSA in its researches and works, and IHH has conducted trainings on the water quality model for the Public and Social Company of Water and Sanitation in La Paz (EPSAS). MMAyA and the Stockholm Environment Institute (SEI) has been applying the water management system for the development of a decision-making tool in order to prioritize projects in the Rocha River watershed in Cochabanba.

Besides, researches related to the project outputs and new researches have been conducted. IHH has received researchers from Nihon University each year to conduct joint researches for improvement of the models of glacier melting and water demand in Tuni watershed. In addition, IIS, jointly with Tohoku University, has been conducting researches, mainly on the water quality model. UMSA has implemented researches in the Charquini Glacier with support from the National Agency of Research of France and signed an agreement to sustain the project researches at the regional level.

Major equipment provided by the project has been utilized. Observation during the survey conducted in April 2019 found that equipment of IHH (3D laser scanning system, meteorological and hydraulic observation system, equipment for water quality observation, etc.) has been maintained regularly and is functioning.

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

It is judged that the Overall Goal has been achieved. In 2016, Bolivia was declared in state of emergency after the worst draught in the past 25 years. There was water shortage in seven cities out of the top 10 cities with larger population, and more than 250 thousand people were affected by draught[3]. In this situation, UMSA immediately suggested mitigation measures to minimize damages cause by the draught based on the information and experiences gathered from the project. Furthermore, IHH and IIS led the Water Committee to formulate policies on water resources in coordination with the MMAyA and other organizations. As a result, large-scale projects such as dam construction were formulated and implemented. In addition, MMAyA has implemented a weather forecast project nationwide with UMSA and other universities, with their equipment for water resources monitoring and data analysis. MMAyA has also conducted researches for formulation of water resources policies that aimed at forecasting water resources and water-related disasters based on weather forecast data.

Regarding social implementation of research outputs of the project, IHH has discussed with the MMAyA regarding the limitations of the models and application requirements, further the project experience and knowledge has been used as a space for policy making and other purposes. Specifically, as mentioned earlier, the Surface Water Balance Platform established by the MMAyA has been used for decision-making on policy formulation to tackle drought problems, based on scientific data and research outputs from the project. After the water shortage crisis, prediction on water resources as well as awareness raising to the local residents regarding the efficient use of water has been conducted every year. The Surface Water Balance Platform is also being used to update hydrogeological models, research water resource management in other parts of the country, and develop guidelines of priority watersheds management.

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

First, as impacts on gender, many of the female researchers who participated in the project have sustained their research activities even after the project completion. Before the project, there was an image that mountaineering and glacier researches were tough for women and most of the researchers were males. According to UMSA, the image on the research theme has been changed by the fact that female researchers participated in the project and have continued research activities even after the training in Japan (completion of the master and doctoral courses), and more females became interested in participating in research activities. Second, local residents have become more conscious about efficient water use. According to IHH, scientist were aware of the decrease in water resources but there was no scientific data to prove the amount. The project has provided clear evidence with numbers of this phenomenon and efforts were made to disseminate information gathered through the project in workshops and meetings.

<Evaluation Result>

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

Achievement of the Project Purpose and Overall Goal

[2] Ministry of Foreign Affairs of Japan (2011) "ODA Databook 2010."

[3] This incident led to decree of the National Emergency Declaration and dismissal and prosecution of the Minister of MMAyA and the Chief Executive Officer of EPSAS.

Aim	Indicators	Results
(Project Purpose) Support system is developed for the formulation of water resource management policies under climate change scenarios, in the cities of La Paz and El Alto	1. The outputs of project is mentioned or referred in water resources management policies under climate change scenarios, other projects, or researches	Status of achievement: Achieved (Continued) (Project Completion) - The sedimentation model in basins, one of the project outputs, was referred in PRAA Project implemented by MMAyA and the World Bank. The project provided the map of landslide prediction in La Paz under climate change scenario, based on the submitted glacier inventory. (Ex-post Evaluation) - Glacier melting model: 2 research articles and 3 academic journals were developed by IHH and MMAyA. - Models of water balance, erosion and sediment transport and water demand: They are referred to in IAEA project (evaluation of climate change impact on the quality of land, water and ecosystem in the polar region and mountainous area). - Water quality model: It has been utilized in researches and works in IIS and the Bolivian Association of Sanitary Engineering.
	2. Model for the evaluation of the impact on water resources under climate change scenarios (Support system) is installed in IHH with staff who are capable to respond to the needs (information) of water related organization	Status of achievement: Achieved (Continued) (Project Completion) - The model for the evaluation of the impact on water resources under climate change scenarios was installed in IHH, and IHH shared outputs of the research groups with related organizations through seminars. (Ex-post Evaluation) - MMAyA and IHH have conducted trainings on the model of water quality for EPSAS. - Water management system: MMAyA has utilized the system for development of the decision-making model in the Rocha River watershed in collaboration with SEI.
	3. The outputs of above model are uploaded in the website or stored in digital media and distributed to the concerned organization.	Status of achievement: Achieved (Project Completion) - Monitoring results of the project were accumulated at IHH, and the first report and second report of observation data were made public in 2014 and 2015, respectively. - The Surface Water Resources Platform was established with participation of Bolivian water-related organizations and donors, where utilization of data of projected future water resources for policy formulation on water resources was discussed. (Ex-post Evaluation) - Verified in the institutional aspect of sustainability.
(Overall Goal) The system of modelling, scientific insight and investigation results are applied to the formulation of policies of water supply under climate change scenarios.	1. The system of modelling, scientific insight and investigation results are applied to the formulation of policies of water supply under climate change scenarios.	Status of achievement: Achieved (Ex-post Evaluation) - During the drought crisis in the whole country in November 2016, it was IHH and IIS who suggested measures for mitigating damages from water shortage. After that, they worked together with the MMAyA and other organizations for policy formulation on water resources that resulted in planning and implementation of large-scale projects including dam construction in several sites in the country. - MMAyA made possible the procurement of computer resources and has implemented a weather forecast project nationwide, together with universities including UMSA. With the weather forecast data, it has conducted researches for policy formulation on water resources, for the purpose of prediction of water resources and water-related disasters.

Source: Terminal Evaluation Report, JST Completion Report, interview with IHH, IIS and MMAyA.

3 Efficiency

Both of the project period and project cost were within the plan (ratios against the plan: 70% and 100%, respectively). Outputs were produced as planned. Therefore, the project efficiency is high.

4 Sustainability

<Policy Aspect>

Water resource management policies are prioritized in the National Development Plan. In particular, after the drought crisis in 2016, high priority has given to policies and programs on water resources management, and it became a requirement by the Potable Water and Sanitation Authority to make an emergency response plan for abnormal situations every year.

<Institutional Aspect>

The MMAyA has organized the Surface Water Balance Platform for utilization of research outputs of the project, although the Water Resource Platform established by the project has not been sustained. UMSA, University of San Simon, University of Tarija and EPSAS are participating in the new platform. Researchers of IHH and IIS who participated in the project have utilized the research outputs in Japan for their current works, as they have worked at UMSA, the Special Research Unit of the Planning Department of the MMAyA, private companies of consulting and construction, etc. UMSA has sustained its collaboration agreement with EPSAS, for provision of water resource data of La Paz and El Also to UMSA. Personnel in charge of maintenance and management of the research equipment procured by the project have been continuously employed by UMSA. Management of the meteorological observation equipment installed in the project sites has been commissioned to nearby residents by UMSA, who are regularly monitoring the maintenance status at the sites.

<Technical Aspect>

At each group of snow ice, outflow, sediment and water quality of IHH, undergraduate students are continuing researches for their thesis and written academic papers. They have shared researches with the Japanese researchers of Tohoku University, Nihon University and Tokyo Institute of Technology and received technical advices as necessary to sustain and upgrade research capacities. For social implementation, the MMAyA established the Special Research Unit in the Planning Department to manage cross-departments the theme of water resources. The MMAyA has sustained and improved its literacy of science and technology by working together with other sections, departments, municipalities, EPSAS and universities including UMSA. As mentioned earlier, research equipment installed at IHH has

operated and maintained, and data have been continuously collected. This shows that IHH sustained knowledge and skills for equipment maintenance. On the other hand, IHH conducted trainings on measures against droughts occurred in the previous year for EPSAS in 2017 and acquired skills for data input. However, it has not developed a perfect command of the models developed by the project as tools for prediction of meteorological conditions, water volume or water quality.

<Financial Aspect>

Budget sources of researches based on the project outputs and related researches have been secured through the Bilateral Joint Research Program and Grants-in-Aid for Scientific Research Program of the Japan Society for the Promotion of Science. UMSA has secured 2.5 million Japanese Yens (about 22 thousand US Dollars (USD)) each year and all amounts have been disbursed. According to UMSA, these have been sufficient for research activities. Budgets for operation and maintenance of the equipment have been secured but not for renewal of equipment in the future. MMAyA has organized discussion for social implementation in the Surface Water Balance Platform, and budgets for the platform operation have come from the Inter-American Development Bank (IDB) (370 thousand USD in 2016 and 59 thousand USD in 2017) and Belgium Development Agency (120 thousand USD in 2018). Financial support from IDB is planned also for 2019.

<Evaluation Result>

In light of the above, slight problems have been observed in terms of the financial aspects of the implementing agency. Therefore, the sustainability of the effects is fair.

5 Summary of the Evaluation

The Project Purpose was achieved. As a support system for formulation of water resource management policies under climate change scenarios, models of glacier melting, water balance, erosion and sediment transport, water quality under climate change scenario, evaluation of the impact on water resources were developed, and these were utilized by the MMAyA and other related stakeholders. These models have been utilized since the project completion, and researches based on the project outputs and new researches have been conducted. During the water crisis in 2016, UMSA made efforts for policy formulation on water resources based on the project research outputs, together with the MMAyA and other organizations. As a result, projects such as dam construction have been planned and implemented, and therefore it is judged that the Overall Goal has been achieved. Regarding the project sustainability, small concerns were that budgets for equipment renewal have not been secured and that EPSAS needed further improvement for fully utilizing the developed model, while there have not been concerns in the institutional and technical aspects for researches based on the project outputs and other related researches and social implementation.

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

III. Recommendations & Lessons Learned

Recommendations for Implementing agency:

- At the time of the ex-post evaluation, research equipment procured by the project was operated and maintained, but its renewal would be necessary in the future. It is recommended to UMSA to discuss with EPSAS to secure budgets for maintenance and renewal of equipment, since it is EPSAS that should monitor water resources for provision of drinking water and conduct future prediction. For this, it is desirable to exchange written agreement with EPSAS within the fiscal year 2019.
- Engineers of EPSAS have not utilized models of prediction of water resource volume and quality to a full extent. For their capacity development, MMAyA and EPSAS should conduct trainings at least for one year.

Lessons learned for JICA:

- In the project, models of glacier melting, water balance, erosion and sediment transport, water quality under climate change scenario, evaluation of the impact on water resources were developed as a support system for formulation of water resource management policies under climate change scenarios, and these were shared with stakeholders related to policy formulation. Although the Project Purpose was achieved during the project period, if activities of technical transfer had been included for social implementation after the project completion, these models would have been utilized in a more effective way. In order to secure such time, it is important for JICA experts to have discussions at the project formulation stage or earlier in order to understand works and schedules of implementing agencies. In countries where it takes much time for getting approval of the project outputs like Bolivia, activities need to be planned after fully understanding on the approval procedure and required time in the implementing agency. In other words, activities need to be planned in consideration of the period for social implementation, approval procedure and time required by the implementing agency.

Condoriri Glacier

Meteorological and hydrological equipment procured by the project