Aspiring Engineers Learn from the Experience of Fellow Island Nation Japan

– Project for Capacity Enhancement of Groundwater Management in the Republic of Cuba

Engineers from Empresa de Investigaciones, Proyectos Hidráulicos Habana (EIPH-Habana) and Japanese experts (Mr. Kihara is third from the right). (Photo: EIPH-Habana)

As an island country in the Caribbean Sea, the Republic of Cuba depends on groundwater for most of its water supply. The major water source for Cuba's capital Havana is Cuenca Sur, a groundwater aquifer that spans the neighboring provinces of Mayabeque and Artemisa. Havana, however, faces a serious water shortage, as supply covers only approximately 60% of the water demand. In fact, the volume of water intake from the Cuenca Sur aquifer dropped by half in the period between 2000 and 2010.

What is causing this decrease in the volume of water intake? In coastal areas, saltwater intrudes into the groundwater system. Because saltwater has higher density, it stays beneath freshwater in coastal aquifers. Rising sea levels, however, push the saltwater layer in the groundwater system higher.

Furthermore, when the level of fresh groundwater drops by 1 cm as a result of excessive groundwater extraction, the pressure balance is disrupted and the saltwater layer rises by approximately 40 cm due to the pressure from the ocean. The combined effect of rising sea levels and excessive groundwater extraction results in intrusion of saltwater in groundwater and increased salinity concentration, which in turn render groundwater unusable not only as drinking water but also for agricultural purposes. This leads to the dramatic drop in the water intake. In order to improve this situation, it is necessary to implement proper management of groundwater extraction with consideration of the impact on urban water intake and agriculture.

The Government of the Republic of Cuba requested technical cooperation from Japan in order to solve this grave issue. In response to this request, the Project for Capacity Enhancement of Groundwater and Seawater Intrusion Management was launched in February 2013. The project targets Mayabeque Province and Artemisa Province, which are the major suppliers of water to Havana. Japan International Cooperation Agency (JICA) expert Mr. Shigeki Kihara serves as the project leader. He is a specialist with extensive experience in numerous international cooperation projects for development of water resources in Asia and Africa.

The first step in the implementation of the project is the building of a "groundwater model" that will clarify the state of water quality, levels, and currents in the Cuenca Sur aquifer. Equipment to survey water levels and quality will be installed in test wells, data will be collected on a continuous basis, and the acquired information will be organized and stored in a database.

Engineers of EIPH-Habana receive training on methods for measurement of water quality at different depths of the measurement wells using multi-parameter water quality analyzers. (Photo: Hirokatsu Utagawa)

The information contained in the database will be analyzed using specialized simulation software to formulate predictions about changes in the groundwater levels and saltwater intrusion. Cuban engineers are receiving training from JICA experts to learn technologies for correct implementation of data collection and analysis.

According to Mr. Kihara, "As a socialist country, in the past Cuba received assistance from the Soviet Union in the implementation of groundwater management. Engineers who have been working in this field since those years sustain a high level of technical expertise. After the collapse of the Soviet Union, however, it became impossible to maintain groundwater measurement equipment. There is also the economic embargo, so imports of equipment are restricted. Yet, even in these circumstances, Cuban engineers are eagerly striving to acquire new information. They are also highly motivated to make up for any material deficiencies with inventiveness and ingenuity. I truly admire their attitude."

Training was also provided in Japan as part of the project. Japan is an island nation as well, and has experienced ground subsidence resulting from excessive groundwater extraction in the postwar period. Japanese experts possess knowledge and information obtained in the process of overcoming the issue of saltwater intrusion in groundwater aquifers, particularly on remote islands, an issue that is similar to the problems faced by Cuba today. Training conducted on the main island of Okinawa and on Miyakojima island included a study tour of underground dams. Underground dams are structures that are built to prevent intrusion of saltwater by installing underground walls, and they increase the volume of groundwater by facilitating permeation of rainwater.

"Since we knew that construction of underground dams in the areas where this project was implemented in Cuba was unfeasible because of the local geological conditions, we had explained this to the engineers. They, however, had to see the actual facilities during their training in Japan before they finally become convinced. Cuban engineers believe that even if something cannot be done right away, a day will definitely come when they will be able to do it, so it is imperative to relentlessly prepare for this day and continue studying.

They have apparently begun exploring the possibilities for construction of underground dams in other areas, where the geological conditions are better suited for such facilities. This eagerness to apply what they have learned into practice is truly wonderful."

As fellow island nations, Japan and Cuba face common challenges in the field of groundwater management, and highly motivated engineers are beginning to apply the experience and knowledge that they gained in Japan to Cuba.

The project is scheduled to end in February 2017. Currently, the building of a groundwater model is underway, and, going forward, experts and engineers will conduct a series of simulations based on this model and frame proposals for facilities that will raise groundwater levels by facilitating permeation of rainwater. Parallel to these efforts, they will formulate management plans to maximize the efficiency of the utilization of groundwater resources.