INTEGRATED WATER RESOURCES MANAGEMENT

Urban water management systems face the challenge of matching growing demand with diminishing supply, as well as mitigating potentially severe negative social and economic impacts on the populations they serve. Climate change is adding to this challenge through increased climate variability and more frequent extreme weather events worldwide. Cities are particularly vulnerable to climate change impacts as their infrastructures are generally designed to handle average historic weather patterns rather than extreme events. As a result, climate change will require adjustments in water management infrastructures around the world. Unfortunately, these adaptation measures could go underfunded in developing countries, consequently placing their populations under severe health risks.

Colombia is no exception to this situation. Climate change has impacted cities across the territory, resulting in wide-ranging conditions such as extreme droughts that expose communities to water shortages as well as severe rains that put lives and properties at risk. To address these critical issues, the Empresa de Acueducto y Alcantarillado de Bogotá (EAAB) has over the past two decades proactively implemented an Integrated Water Resources Management Program (Program) that today can guarantee water supply during drought periods and minimize the consequences of severe rainy season events.

As the water and sewage service provider for a population of 8 million inhabitants, EAAB's first step in this Program was to build the necessary infrastructure to deliver efficient water and sewage services. Through a gradual increase in coverage across the Company's service area, EAAB was able to eventually reach 100 percent of all customers. In order to do this, however, and pursuant to the Public Utilities Law, EAAB designed a rate structure that allows the recovery of all operational costs, as well as the financing of investment plans. This sound financial management strategy enables ongoing profit generation, which is then reinvested in the financing of projects not included in the rate structure, thereby contributing towards building social equity in Bogotá.

Because of this financing strategy, investments have been made in projects throughout the entire water value chain, ranging from conservation efforts focused on *paramos* (high

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mountain ecosystems); water infrastructure for collecting, treating, storing, and distributing potable water; infrastructure for collecting, transporting, and treating raw water; and for collecting and transporting rainwater that falls on roofs, parks, and roads. This infrastructure was planned and designed considering projected population growth and a water allowance based on historic growth trends. To further improve the system, during the latter part of the 1990s, EAAB introduced a series of measures aimed at increasing the efficiency of water use in the city. Water tariffs were increased, new technologies for controlling water pressure were implemented, low consumption devices were installed, and a massive general public education program was undertaken involving different water users. These efforts resulted in water consumption reduction in the city from around 200 liters to 110 liters per person and allowed EAAB to postpone capacity upgrade investments and instead focus resources on social priorities, conservation, and rational use initiatives throughout the water cycle as part of an overall integrated water resources management strategy. Elements of the Program include:

- ***Conservation and restoration of paramos and basins to ensure natural water provision and long-term water security.***

  The Program's main environmental conservation corridor involves Chingaza Paramo (from which 70 percent of Bogotá's water supply comes from), Bogotá's eastern mountains (where more than 100 streams that irrigate the city originate), and Sumapaz and Guerrero Paramos. Conservation initiatives focus on building partnerships with environmental non-governmental organizations (NGOs), national and local government authorities, private sector entities, and the community. Such partnerships have allowed the implementation of plans for microbasins environmental zoning, springs protection, river and stream margins protection, and endemic flora and fauna protection. Communities are involved in workshops where agricultural and herding best practices are taught (crop diversification, sustainable herbicides, and organic agriculture, among others) as a mean to promote sustainable land use within protected areas.

- ***Clean Development Mechanism (CDM) projects based on clean energy production from height differences in aqueduct pipes.***

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The Santa Ana Hydroelectric Plant was developed under the CDM concept. This plant generates around 47 GWh per annum, which represents 50 percent of EAAB's electricity consumption, offsetting more than 200.000 tons of CO_2 emission over 10 years. It also allowed EAAB to enter the environmental services market, certifying the reduction of 79.000 tons of CO_2 in four years of operation and transferring 11096 certified emission reductions to Kyoto agreement countries. Following an agreement signed with the National Park System in Colombia (UESPNN), proceeds from the sale of certified emissions reductions fund strategic investments in the restoration and conservation of the Chingaza Paramo. With two additional CDM projects currently planned, EAAB plans to produce enough energy to meet its entire electrical consumption needs.

- ***Wetlands (humedales) ecological and participative restoration and integration with urban stormwater drainage systems.***

  Wetlands restoration and protection initiatives involve repairing wetlands' ecological attributes and their ability to provide environmental services, leading toward improved quality of life in surrounding communities, including the more than 83 neighborhoods in Bogotá and the adjacent Cota and Soacha municipalities. The results of these initiatives also provide an amenity to residents, remove buildings and other infrastructure from floodplains, reduce the urban heat island effect, help control downstream flooding, and provide habitat for animals. Recovered wetlands are now managed through participative schemes involving environmental NGOs and local communities.

- ***Bogotá River Clean-up Program***

  Through an association involving the environmental authority, as well as local, provincial, and national governments, EAAB has invested more than USD $300 million in building channels, sewers, and rainwater trunks to manage raw sewage and rainwater properly, thereby avoiding pollution in streams and wetlands within the city. Currently, EAAB operates Wastewater Treatment Plant (WWTP) Salitre, which provides primary treatment for 30 percent of Bogotá's raw sewage, while a second treatment

plant, WWTP Canoas, is undergoing detailed engineering and, once built, will treat the rest of Bogotá's and Soacha's wastewater.

To build long-term sustainability for these efforts, EAAB strives to create common ground for participation and learning among communities as a way to build a sense of ownership for the projects and the important role everyone plays in the water resources cycle. Building spaces for community participation and learning has been a critical success factor. Future advocates of the program, particularly children and teenagers, are targeted participants for learning about the water cycle, its importance to all living beings, and the available mechanisms for protecting and conserving water sources. This education campaign utilizes environmental promoters (EAAB's employees and trained citizens on environmental issues), environmental classrooms built within EAAB's headquarters, and instructional material, which is used during educational sessions and distributed around schools. The campaign also includes "Water Guardians" that perform ecological tours around the main ecosystems under EAAB's protection.

EAAB's proactive efforts to do more than just supply and treat water under the traditional infrastructure mechanisms serve as an outstanding example to water management operators across the world of how implementing a comprehensive integrated water resources management strategy can meet water needs and help adapt to climate change challenges, all while adding environmental value to current and future generations.

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