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Rainwater harvesting

for sustainable water supply

Building rainwater harvesting capacity in Mexico

Current and returned Peace Corps México volunteers **Jason Berner**, **Elena Neibaur**, and **Gregory Lohrke** report on three projects that helped to build local capacity for rainwater harvesting in the Mexican state of Puebla. Volunteers successfully improved water supply resiliency and drove local engagement through training and installation in rural, underserved, and university communities.

Since 2009, Peace Corps México has worked with the United States Agency for International Development (USAID) to effectively and strategically use small grants funding to support community development projects that are consistent with the Peace Corps approach. This approach emphasizes building the capacity of community organizations, service providers, and individuals. It also promotes sustainable behavior and systems changes in communities where Peace Corps works. For instance, volunteers in Mexico work closely with their host-country agencies and community partners to build local capacity in environmental education and to promote green practices and the implementation of new applied technologies. In Mexico, this has included building and facilitating community adoption of rainwater harvesting (RWH) systems in rural and urban areas.

From October 2013 to September 2014, five of the 25 Small Project Assistance (SPA) grants funded by USAID have gone to support four communities in central Mexico: Zacatlan de las Manzanas, San Jose Xacxamayo, San Diego La Mesa Tochimiltzingo in the Mexican state of Puebla, and El Rosario in the state of Tlaxcala. These five grants were funded to help these communities adapt to harsher climates and confront local water scarcity by implementing RWH systems. The following RWH projects are examples of collaborations between Peace Corps Volunteers and host-country counterparts that have increased the knowledge and technical capacity of over 330 individual project participants.

RWH education for a university community

In the municipality of Zacatlan, Puebla, the municipal drinking water utility is concerned with the trend of annual decreases in rainfall volumes being captured and treated. This is largely attributed to deforestation from timber harvesting and mining activities within the drinking watershed in Zacatlan. Also of concern is the growing population of Zacatlan, which will require new ways of meeting increasing potable water demands. One way to bridge the gap between supply and demand is to reduce the consumption of potable water from existing sources by increasing rainwater use for domestic activities. However, although rainfall is abundant in Zacatlan, it is rarely collected by large institutions for non-potable uses. Due to the changing realities of the area's available water resources, some businesses and institutions in Zacatlan are reevaluating the utility of captured rainwater. In particular, the Instituto Tecnológico Superior de la Sierra Norte (ITSSNP), the Zacatlan university where Returned Peace Corps Volunteer Jason Berner served from 2013 to 2014, maintains a great interest in harvesting rainwater for non-potable uses because it consumes large volumes of municipal water. Due to this prevailing interest, Berner focused on training ITSSNP students, faculty, maintenance staff, and community members in various aspects of integrating RWH systems into campus operations.

With Peace Corps leadership and USAID SPA grant funding, Berner facilitated the planning and execution of a RWH workshop in February 2014. Workshop participation included representatives from the university staff, student body, municipal water utility, local rotary club chapter, local businesses, nongovernmental organizations, and Peace Corps México. During the multi-day workshop, participants designed and built the first RWH cistern constructed for an ITSSNP campus building and learned maintenance procedures for its future operation. The project is ultimately designed to help ITSSNP meet international environmental management standards for reducing potable water consumption. The project will also help reduce costs associated with purchased water through rainwater collection and water-saving technologies. The pilot system is monitored daily and expected to harvest 200,000 liters of rainfall annually. It is estimated that annual baseline potable water use for the building will be reduced by 75 percent.

With additional USAID funding and community resources, Berner also facilitated a RWH and water conservation business and research seminar – hosted by ITSSNP and the local rotary club in the spring of 2014. Expert speakers from non-governmental organizations, including Isla Urbana and Sarar

RAINFALL IS ABUNDANT IN ZACATLAN, BUT IT IS RARELY COLLECTED BY LARGE INSTITUTIONS FOR NON-POTABLE USES.

Xacxamayo community members as young as six years old are responsible for collecting water from distant wells. Image credit: Diego Rodrigo

RAINWATER HARVESTING PROJECTS HAVE HELPED XACXAMAYO ACHIEVE A MORE ENVIRONMENTALLY, SOCIALLY, AND ECONOMICALLY SUSTAINABLE AND RELIABLE WATER SOURCE – PROVIDING RESILIENCE AGAINST THE RAINFALL FLUCTUATIONS THE COMMUNITY IS EXPECTED TO ENCOUNTER DUE TO REGIONAL CLIMATE CHANGE.

Left: In San Jose Xacxamayo, Mexico, during the second day of constructing the rainwater harvesting tanks, beneficiaries work alongside local skilled workers. Image by Elena Neibaur.

Transformación, as well as the Universidad Nacional Autónoma de México were invited to speak at the seminar on various RWH topics. Speaker panels addressed local opportunities for RWH businesses, implementing affordable decentralized wastewater treatment facilities, university landscape water conservation practices, and reusing wastewater nutrients for landscaping. A student team from ITSSNP presented on the previously installed RWH system, giving a tour of the pilot system for community members interested in similar designs. The student team also outlined a proposal for retrofitting two existing cisterns on the university campus for rainwater capture. Rotary club members discussed annual potable water savings for a typical residential RWH system in the community. The seminar also initiated discussion among attendees for plans to implement new RWH and water conservation projects throughout the municipality by 2015.

Post-project monitoring and evaluation results from community participants identified the availability of financial resources, technical knowledge, and skilled workers as the most important requirements for successfully implementing RWH and water conservation projects in Zacatlan. Encouraging and facilitating community partnerships between ITSSNP, community organizations, and national experts also contributed to the success of Berner's projects.

Household RWH in a small, rural community

San Jose Xacxamayo, a community located in the expansive municipality of Puebla, is separated from the bulk of the municipality's population and services by a large reservoir, Lake Valsequillo. This rural town of about 800 residents experiences water shortages due to its semi-arid climate, remote location, and the high cost of water transportation. The scarce water that is available comes from distant wells or must be purchased from water tankers arriving from other communities. Residents of Xacxamayo have used RWH for more than 10 years as a supplemental measure to meet their daily water needs. However, some households do not have the means to construct their own rainwater tanks, or tanks are not adequately sized to meet a family's annual water demands. Existing storage systems have been adequate for the six-month rainy season when annual precipitation averages about 700 millimeters, but during the later stages of the dry season, this capacity often falls short of household water needs.

To address the community's water needs, Returned Peace Corps Volunteer Elena Neibaur was able to secure a USAID SPA grant and other local and international funding to initiate several rooftop RWH collection projects from November 2012 to October 2014. These projects included the implementation of 82 household RWH tanks of 10,000-liter capacity and the installation of 70 ceramic filters for treating captured rainwater to produce potable water. Using stone masonry, the RWH cisterns were built underground to increase structural stability and conserve valuable above-ground space. Each cistern was constructed over an average of five days by a local skilled worker with labor assistance from project beneficiaries. Typically these cisterns have an average lifespan of 30 years. However, if a cistern of this design is well maintained by the user, it can last even longer. The 70 installed filters – products of a local capacity-building organization, CATIS-Mexico – are of a low-maintenance, ceramic design with a colloidal silver coating that removes 99.99 percent of bacteria and pathogens. Each filter costs US$30 and can produce about 24 liters of clean water per day. The filters have a lifespan of two to three years with regular cleanings, and a replacement filter will cost the beneficiary less than $10.

Neibaur's projects also focused on capacity building, including workshops covering the technical and practical aspects of RWH and filtration. Additional efforts focused on establishing a water quality monitoring committee, which received additional training on how to periodically test post-filtration water quality to ensure proper user maintenance and optimal filter condition.

These RWH projects have helped Xacxamayo achieve a more environmentally, socially, and economically sustainable and reliable water source – providing resilience against the rainfall fluctuations the community is expected to encounter due to regional climate change. More than 40 percent of community residents benefitted from the combined projects, and the majority of residents now have an adequate water supply for household demands throughout the year. The augmented water supply for these community members also has eliminated the need to purchase water from tanker trucks in many cases, saving an average of $50 per household annually. Finally, RWH has reduced the number of time-consuming trips taken to retrieve water at local wells – trips that are primarily taken by the women and children of each household.

Neibaur's projects were implemented successfully due to three factors. The first factor was that the community self-identified the issue they wanted to address: having more readily available potable water. Secondly, they worked together to develop a solution, establishing that RWH tanks would be the most beneficial additional potable water source. Third, the community was involved in the project from start to finish, contributing their time and money to construct cisterns and attend capacity building events. Assigning high importance to community participation and buy-in was key to the sustainability of the RWH cisterns.

Sustainable water sources in underserved communities

La Soledad Tepehuaxtitla is a small community within the municipality of San Diego La Mesa Tochimiltzingo in the Mexican state of Puebla. Recent Secretary of Social Development data from 2010 show that 68.7 percent of households in the municipality are considered impoverished due to a lack of access to basic services. A large component of this deficit is the 38.9 percent of surveyed households that are not connected to the municipal potable water network. The uneven social and geographic distribution of access to a centralized water network has led to an unequal economic burden for inhabitants of the municipality's smaller communities. Many residents of towns like La Soledad experience shortages in water supply during the drought months of the region's dry-wet seasonal cycle. Presently, RWH as a solution to these shortages must confront two principal barriers: a lack of formal training in the installation and maintenance of roof-mounted rainwater capture and filtration systems as well as a long-term storage capacity deficit at the household level due to insufficient capital for infrastructure development. Overcoming these principal barriers to water security has directed the focus of Peace Corps Volunteer Gregory Lohrke's current project.

Working closely with municipal authorities and local assistance, Lohrke first designed and administered a community-wide household survey concerning water sources, storage capacity, and use. He then used survey results to categorize and assess the specific strengths and needs of each of the 40 households in La Soledad with regard to water resources. Following the survey, proper RWH design and installation was chosen as the principal focus of capacity building exercises. Project funds were used to contract professional plumbers to train a group of local day-laborers in RWH system installation and basic maintenance through a focused, three-day practicum. These newly trained local plumbers were then contracted using USAID grant funds to install RWH systems. Sites for the systems were selected based on survey results and input from local collaborators to be most beneficial for community members and families with particular water needs. In total, grant funding allowed the local plumbers to install 10 professionally designed systems for improved harvesting and primary filtration of rainwater. A primary school, community clinic, and two other public buildings, as well as six previously underserved households now have increased capacity to confront future domestic and operational-needs water shortages through efficient rainwater capture. The survey information also will aid municipal authorities in the planning and execution of similar projects in the future.

Lohrke emphasized the importance of community diagnostics in assessing the knowledge, skills, and abilities of potential beneficiaries. He placed as much or greater focus on determining appropriate capacity-building areas as on delivering the more tangible aspects of the program. Understanding and building on the existing strengths of the community will yield a more sustainable development for the beneficiaries and town as a whole than one-time gifts ever could. Ideally, project participants will continue improving the skills garnered from this program and further advance water security goals through sustainable, applied technologies.

Lessons learned from these completed RWH projects will be applied to ongoing activities, as well as in future volunteer initiatives, to produce the most effective use of USAID grant funding for local capacity building projects in Mexico. For example, two ongoing RWH projects in the municipality of San Diego La Mesa Tochimiltzingo in the state of Puebla and the community of El Rosario in the state of Tlaxcala are expected to train an additional 475 people in RWH practices. Additionally, it is expected that long after volunteers return to the United States, beneficiaries of past projects will maintain effective management of natural resources and continue toward more sustainable development under their own initiatives.

As exemplified by the projects in Puebla, Peace Corps México facilitates these continued community initiatives by emphasizing the recruitment of local financial and technical assistance and the importance of local participation in all stages of volunteer-facilitated projects. For instance, after collaborating with Berner, administrators and students at ITSSNP are actively seeking finances for integrating RWH into the operations of a second campus building. Following the successful improvements initiated by Neibaur and her counterparts, the town of Xacxamayo also is preparing another project to increase the number of community members with improved rainwater capture and storage systems. And it is hoped the town of La Soledad will also use its newly trained installation professionals and the suggestions produced by Lohrke's community survey to continue providing families with sustainable water supply solutions.

Authors' Note

Jason Berner is an environmental protection specialist and landscape architect with the US Environmental Protection Agency's (EPA) Office of Water in Washington, DC. For more than seven years, he has focused on urban stormwater, green infrastructure, and watershed management.

Elena Neibaur is a teacher's assistant and graduate student at Florida International University in Miami, Florida, United States. She is completing her Master of Science in Environmental Studies, focusing on rainwater harvesting as a sustainable method for domestic household uses in water-scarce, rural areas.

Gregory Lohrke is pursuing his Master of Science in Environmental Science and Master of Public Affairs degrees at the School of Public and Environmental Affairs at Indiana University-Bloomington, in the US state of Indiana, while serving in the Peace Corps. His work in Mexico has focused on environmental education and adoption of environmentally sustainable practices at the household level.

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