--- Habitat for Humanity / Mexico ---

Affordable Water Harvesting for Low-Income Households in Urban Areas

Abstract: *(Viewable by general public)*

Everyone has the right to access sanitized water for personal and domestic consumption in a sufficient, healthy, acceptable and affordable way. On the planet, more than 768 million people do not have access to drinking water, since only 0.007% of the existing water on Earth is drinkable, and that amount is reduced year after year due to pollution. Therefore, Habitat for Humanity is looking for affordable water harvesting solutions for use in urban areas, with a particular focus on approaches applicable to low-income households in Mexico where more than a third of homes suffer from water shortages.

This is a Reduction-to-Practice Challenge that requires written documentation and proof-of-concept demonstration data if available.

Overview: *(Viewable by general public)*

In Mexico, 67% of the territory is classified as an arid or semi-arid area. The lowest annual availability of water is found in the Valley of Mexico (Mexico City and its metropolitan area) with barely 186 m^3 per inhabitant. Even though 98.7% of homes in Mexico City have piped water, 36% of its homes suffer from water shortages and each year more homes are experiencing supply cuts. However, the crisis in the Valley of Mexico is not due to a real lack of water. In Mexico City there is a natural abundance of water, but it is poorly managed. For several months out of the year, torrential rains fall on the city, saturating the drainage and flooding entire neighborhoods. What if this water could be collected, stored, and used? Habitat for Humanity is seeking low-cost solutions to harvest rain and remove impurities, so that the water (once boiled) is suitable for human consumption.

The submission to the Challenge should include the following:

1. A **detailed description** of the proposed Solution and how it addresses each **Technical Requirement** presented in the Detailed Description of the Challenge. This description should be accompanied by a well-substantiated rationale for the design, annotated drawings, and cost estimates.
2. **Proof-of-concept demonstration data**, if available, showing implementation of the proposed solution.

The Challenge award is contingent upon theoretical evaluation and field demonstration or validation of the submitted Solutions by the Seeker.

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To receive an award, the Solvers will not have to transfer their exclusive Intellectual Property (IP) rights to the Seeker. Instead, Solvers will grant to Habitat for Humanity a *non-exclusive license* to practice their solutions and the right to share awarded solutions with other nonprofit and for profit organizations worldwide. **Habitat for Humanity will make awarded solutions freely available to other nonprofit and for profit organizations to help improve the state of low-income housing worldwide.**

Submissions to this Challenge must be received by 11:59 PM (US Eastern Time) on July 5, 2021.
Late submissions will not be considered.

ELIGIBILITY

Employees and interns of Habitat for Humanity International (HFHI), as well as their immediate family members (spouse, parent, child, sibling, and their respective spouses) or persons living in the same household, whether related or not, are eligible to enter the Challenge; provided that they **will not be eligible to receive an award** if their Solution is chosen. In addition, the Solutions of employees and interns of HFHI will fall under HFHI's employment policies and be considered work product of HFHI. **Please note**, employees and interns of Habitat for Humanity Affiliates and independent National Organizations are eligible to enter and receive an award if their Solution is chosen.

Habitat for Humanity®
Terwilliger Center for Innovation in Shelter

ABOUT THE SEEKER

Habitat for Humanity International

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Through the Terwilliger Center for Innovation in Shelter (TCIS), Habitat for Humanity facilitates more efficient and inclusive housing market systems, making affordable housing possible for millions more families.

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SEA FREIGHT LABS
Innovate Better

Affordable Water Harvesting for Low-Income Households in Urban Areas

Habitat is supported in this project by SeaFreight Labs (www.seafreightlabs.com), an open-innovation consultancy using global challenges to cost-effectively deliver breakthrough innovation. Participation in this project is a direct result of the recent SeaFreight Labs decision to join the Pledge 1% movement.

Detailed Description and Requirements:

(Viewable by Solvers who signed user agreement for your Challenge. This and the Project Deliverables section appear on a different webpage from the Abstract and Overview, which is the reason for some duplication of content, for instance, background and award/IP details.)

BACKGROUND

According to the World Health Organization, half of the world's population will be living in water-stressed areas by 2025. About 70% of the people in Mexico City have less than 12 hours of water available per day. In the areas of greatest scarcity, 18% of the population must wait several days for an hour or two supply. In periods of drought, the situation worsens considerably. 26% of the inhabitants do not receive enough water, and 15% do not have daily service. The supply of drinking water in many areas is provided by water trucks; this situation occurs in 10 of the 32 municipalities of the city. The population supplied through water trucks is approximately 1.8 million inhabitants, most of whom receive water, but not daily (273,000 of them lack piped water in their homes).

Without a massive intervention, the long-term trends are frankly worrying, because according to the Mexico City Water System, in 40 or 50 years there will be great problems with extracting the water from below ground. The situation will worsen every year between now and then. Each year the city registers a subsidence of between 8 and 12 centimeters due to the excessive extraction of water from the aquifers, with catastrophic effects on urban infrastructure, since in the last 10 years this sinking reached one meter and during the last century it totaled 10 meters.

According to international criteria, low-income families should not pay more than 5% of their family income for water supply; however, in Mexico City there are families that do not receive piped water and pay up to 20% of their income for water from tanker trucks for their homes.

Faced with this situation, different types of solutions arise: one of them, the collection of rainwater as a safe water alternative where a family, in Mexico City, can have between 5 to 8 months of independence. This model gains acceptance in areas where the supply is not constant or is of poor quality. However, there are some difficulties with these systems, the main ones are:

1. The limited offer of products on the market designed to guarantee access to safe water (drinkable water) because some of these systems are made with inadequate designs, improvised technologies, poor quality materials and lack of equipment to make the water drinkable.
2. It's hard to adapt and install these systems, because some of these systems require special conditions that the homes must meet, in some cases related to the size, slope and materials of the roofs, the existence of a cistern or water tank of a certain capacity, which sometimes is not possible due to the reduced free space in some homes in the city.
3. Systems that can guarantee water quality are too expensive for a low-income family (with a monthly family income from $550 to $2,000) because the cost of acquiring and installing a solution could exceed $1,500 USD plus a $50 annual fee for maintenance, while in the country the average monthly income per capita is $320, which can translate into an average monthly family income of $640.

Rainwater in Mexico City is not suitable for direct human consumption. As described here, the rainfall contains pollutants, heavy metals, and microorganisms that cause headaches, fever, and diarrhea when ingested. Thus, a suitable rain collection system must include a method to remove these contaminants. The roof is an ideal catchment surface, but between storms debris will accumulate, so it is important to allow the first portion of water to be diverted before collecting the rest. Most buildings have flat roofs that are usually made with concrete poured over

cinder blocks and these can be covered by tile or corrugated galvanized steel. Therefore, gutters and drain spouts are not commonly installed as is the case for homes with sloped roofs.

STRATEGY FOR A SOLUTION

The following links describe affordable solutions that do not provide drinkable water because there is no separation or filtration step.
https://www.ecohome.net/guides/2269/introduction-to-rainwater-harvesting/
https://www.hgtv.com/outdoors/gardens/planting-and-maintenance/diy-rain-barrel-system

On the other hand, this comprehensive rainwater harvesting system is effective, but too expensive.
https://www.mdpi.com/2071-1050/10/11/3890/htm

THE CHALLENGE

Habitat for Humanity is seeking designs for a low-cost water harvesting system that guarantee the availability of quality water in urban low-income households. Solutions should provide easy access to the water along with suitable storage capacity to alleviate water insecurity. Solutions can include, but are not limited to, rainwater harvesting, condensation of water from the air, *etc*.

Habitat for Humanity is primarily interested in solutions that meet the following **Technical Requirements**.

Must have:

1. Removes debris and incorporates a flushing component that removes the initial rainfall (~10 minutes, only in the case of rainwater harvesting)
2. Prevents the growth of algae and mosquito infestation
3. Provides water that is drinkable after boiling
4. Is primarily used in urban family homes (compatibility with apartment buildings would be a bonus)
5. Collects rainwater above ground in a water tank (1,000 liters) or underground in a cistern (20,000 liters)
6. Low tech and simple to install and connect with existing facilities (e.g. piping to dispense water indoors)
7. Cost
    - Materials ≤ $210
    - Installation ≤ $420
    - Maintenance ≤ $50 annually

Nice to have:

1. Provides modular water storage with the ability to increase and decrease capacity or move the system
2. Collects enough water for all household needs (e.g. cleaning, gardening)

Project Deliverables: *(Viewable by Solvers who signed user agreement for your Challenge)*

Submissions should include the following:

1. **Detailed description** of the design solution and **rationale** as to how the proposed Solution addresses each **Technical Requirement**. This should include the design philosophy along with material specifications, instructions for installation, and predicted overall performance.
2. **Detailed drawings** including, but not limited to the following:
    a. Well annotated plans, elevations, and sections if and where necessary

   b. Shop drawings for the different elements of the proposed design (e.g. catchment, conveyance, first flush, storage)
3. **Cost estimate** for the proposed design containing:
   a. Material specifications for all components to be used
   b. Material quantities and their respective costs
4. Proof-of-concept demonstration data, if available, showing implementation of the proposed solution as well as demonstrating its ability to meet the **Technical Requirements** as outlined above.

The Seeker may wish to partner with the Solver at the conclusion of the Challenge. Solver should describe their expertise and include a statement indicating their interest in this opportunity.

The proposal should not include any personal identifying information (name, username, company, address, phone, email, personal website, resume, *etc*.) or any information the Solvers may consider as their Intellectual Property they do not want to share.

The Challenge award is contingent upon theoretical evaluation and field demonstration or validation of the submitted Solutions by the Seeker. If multiple proposals meet all the **Technical Requirements**, the Seeker reserves the right to award only the solution which they believe will be the easiest to install at the lowest cost.

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