Chapter 8

Catalyzing the widespread adoption of rainwater harvesting in Mexico City

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8.1 INTRODUCTION

The Isla Urbana (IU) project seeks to 'detonate' adoption of rainwater harvesting (RWH) systems by Mexican households as a response to the water crisis. By installing these systems in households, a sustainable water source is secured that directly benefits the families involved. When greater numbers of houses begin harvesting rainwater, their collective reduction in demand and greatly increased self-sufficiency builds resilience into the community and the city as it faces shortages from conventional sources.

IU designs systems that take advantage of certain idiosyncratic characteristics of Mexico City's houses that allows for very effective RWH at low costs. It has been based since its founding in a low income, water scarce area of the city and has developed much of its work there. Constant close contact with the systems and their users has provided a living research and development lab where ideas and

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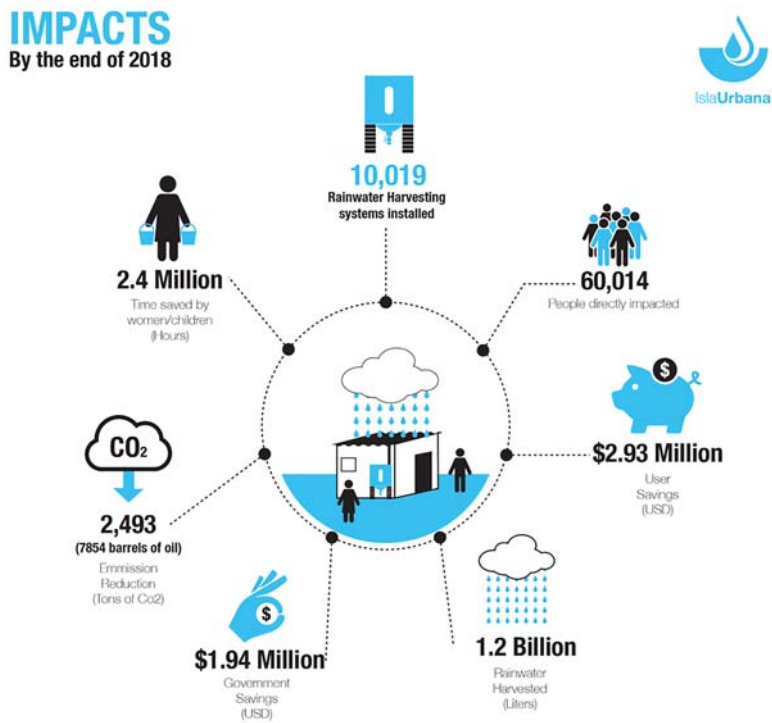

Figure 8.1 Isla Urbana's impacts in numbers from 2009–2018. (*Source*: Isla Urbana, 2018).

designs are tested, adjusted, retested, trashed or adopted based on their effectiveness in real people's lives.

IU has installed over 10,000 RWH systems in its nine years of existence (See Figure 8.1). Over the next six years, they hope to install another 100,000 systems in homes, benefiting over 700,000 people. The long-term goal, however, is the implementation of systems in most households in the city, which would benefit the entire population of 22 million people

8.2 SOCIAL AND ECOLOGICAL CHALLENGE

Mexico City was founded on a small island in the middle of lake Texcoco around 700 years ago. When Hernan Cortez first saw it, the city appeared beautifully integrated into its watery context. Man-made islands ringed the solid ground, crisscrossed with canals along which canoes carried goods from throughout the valley. Long causeways linked it to the shores, aqueducts brought drinking water from springs in Chapultepec, and the huge dyke of Nezahualcoyotl separated the

brackish waters in the east from the fresh waters in the west and held back surges in the rainy season. Much like in Venice, Mexico's inhabitants had learned to thrive in the water, and the city seemed inextricably linked to the lake it was born in.

The war with the Spanish marked the end of Aztec civilization, and with it also began a long, ongoing battle against the lake itself. The deep relationship Mexico City had with the water around it would be thoroughly destroyed. During the war, the aqueducts and dyke were wrecked to deny the besieged city clean water, and to flood out its struggling resistance. After it's palaces and temples had been dismantled and replaced with the churches and buildings of the New Spain, the city suffered chronic floods and epidemics. The Vice-Royal government struggled to establish its capital in the swamp and considered relocating to a more salubrious location. But finally, in 1607, a different course was chosen, and fateful work began on the first drainage canal, which cut an exit from the closed watershed of the Valley of Mexico and allowed the water to flow out and into the river Tula and the gulf.

With this huge project, the future course of water management in the valley was set. Instead of finding a way to live with the abundant water, as the Aztec had done, Mexico would strive to rid itself of it. From then on draining out the rains would remain an ongoing endeavor right up until the present day, in which all that's left of the once great lakes are a few scattered and shrinking ponds.

Unsustainable water management is a critical problem facing Mexico City as it develops in the 21st century. The mega city's water supply depends primarily on an intensely overexploited aquifer below the city, and secondarily on infrastructure that pumps water over 200 km from two rivers far below the city (see Figure 8.2). Overexploitation of the aquifer is causing the city to sink which cracks the network of pipes that distribute water, meaning over 30% of the city's water is then lost to leaks. Even with this intense extraction, 750,000 people in the valley of Mexico City lack access to water while throughout the country this number balloons to 18 million (See Figure 8.3). This forces urban families to buy expensive trucked water while rural families travel to collect water from impure sources. The future promises greater scarcity as predictions point to increasing demand and decreasing supply which will disproportionately affect the poor.

Mexico City's water problems are compounded by geography (it is over 2200 m above sea level and far from any coast or large body of water) and a history of poor governance. Sustainability will require watershed level management that makes the most of naturally available water resources, while resilience must involve greater local control and self-reliance. Rainwater harvesting is a tool that works towards both ends. Currently, rain runs off into a combined sewer that expels it from the valley, while the population depends on water pumped uphill from watersheds outside. The gap between demand and supply is growing rapidly, resulting in less water availability throughout the city, but affecting poorer areas disproportionately. Introducing and teaching rainwater harvesting in these areas makes use of an abundant water source that is now almost entirely

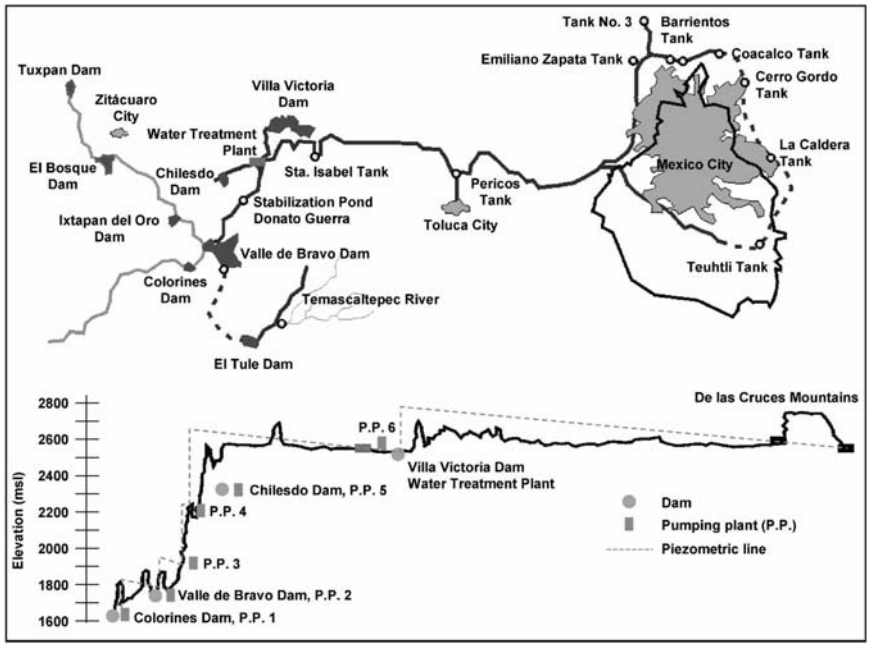

Figure 8.2 Overview of the Cutzemala Water system that provides 30% of the city's water (Tortajada, 2006).

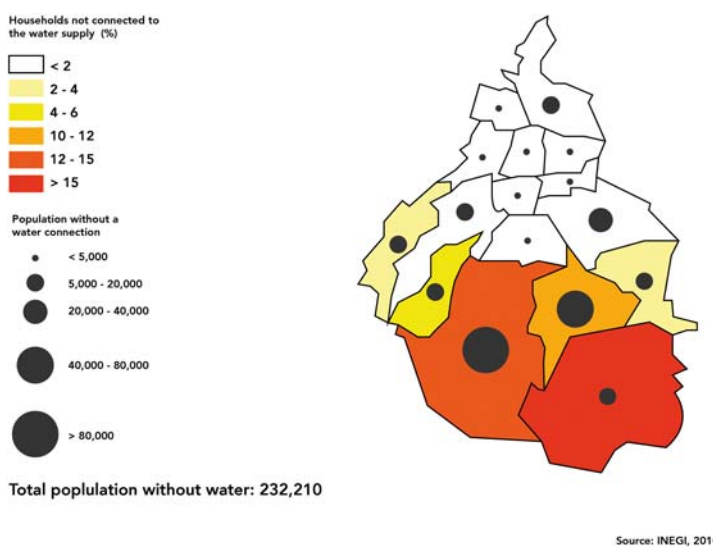

Figure 8.3 Population without access to water connection by delegation in Mexico City. (*Source*: Isla Urbana, 2015).

wasted, while reducing the population's dependence on a struggling system over which they have no control.

The overall situation is critical. With a rapidly deteriorating aquifer providing most of the city's water, and a lack of viable alternative sources anywhere nearby, projections for the future are extremely worrying. The World Bank, in association with the National Water Commission (CONAGUA) released projections calculating that, at current trends, only 50% of the city's demand could be met by sustainable sources in 2030, and at least 27% (Banco Mundial, CONAGUA, 2013) assuming the aquifer has not been depleted and can still be overexploited at current rates) will have to come from new, as-yet undefined sources.

And still, draining the rains from the Valley of Mexico continues to be a central part of the city's water management strategy. Currently, the rain that falls on the city makes up around 70% of the combined sewage that is expelled into the river Tula. Even as securing water for human uses becomes an increasingly critical problem, the floods that have affected the city since colonial times continue to devastate low-lying areas every year. The canals and tunnel systems built to drain the valley overflow during downpours, and the mixed sewage temporarily covers entire neighbourhoods. A billion-dollar drainage tunnel is currently under construction, the latest stage in the eternal struggle to rid the city of its rainwater.

Mexico City, in its evolution from a valley of lakes to a megalopolis looking anxiously at a future of thirst, presents an amazing case study in unsustainable management of water. But in recent years, an abundance of new ideas and proposals has been arising, mainly from academic and civil society organizations, which seek to fundamentally reimagine the relationship we have with water. These diverse proposals, which include ideas like regenerating Lake Texcoco in the largely empty and barren eastern section of the valley, and disentangling rivers from the sewage system and making them open once again (as was done in Seoul), all seek to plot a new course that breaks from our present trajectory, in the hope that Mexico City can once again become a place where people and water exist in harmony.

8.3 ISLA URBANA MODEL

Isla Urbana has adapted rainwater harvesting to the Mexican context to maximize impact. Most of the work focuses on low-income areas where most homes already have a cistern built to cope with constant water scarcity problems. We have designed systems that connect existing roofs and cisterns, eliminating the most expensive component one would normally need to provide. Skilled installers can put up a customized rainwater system for $1000 USD, providing between 5 and 12 months of full water autonomy to its users. The systems are designed to be expandable, and families can add storage capacity over time,

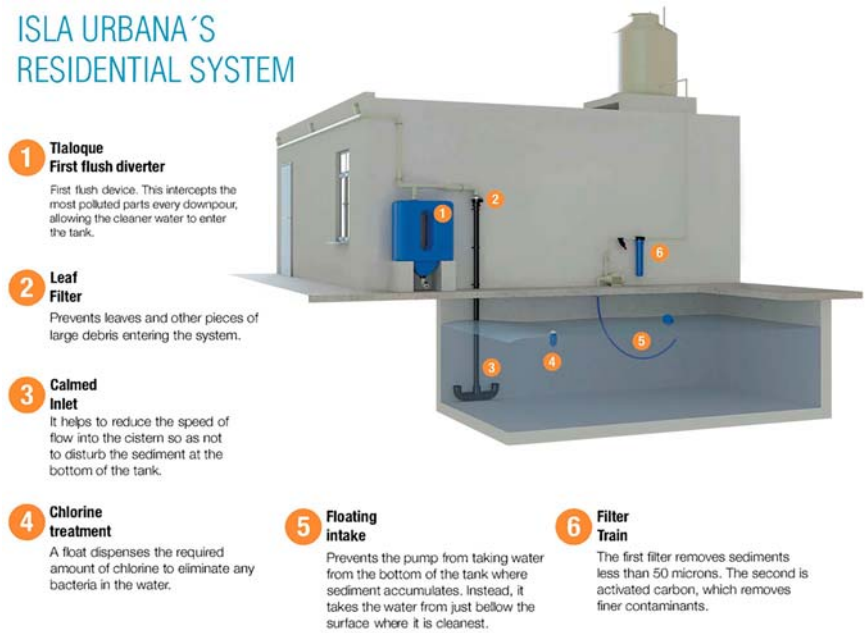

Figure 8.4 Typical RWH system as designed by Isla Urbana. The components as installed by Isla Urbana are numbered 1–6 and the more general components labelled. (*Source*: Isla Urbana).

increasing the number of months of water autonomy. As the water crisis worsens, the systems' capacity can be easily increased in response. This takes advantage of the fact that low-income families here use a gradual approach to construction anyway in order to get around the high cost of building a home. The systems are therefore dynamic and able to respond to future needs.

8.4 OTHER TESTED SOLUTIONS

The government solution to the current water shortage focuses on both the supply and demand yet still falls short. On the supply side, the government has been working to fix leaks in city pipes which has the potential to save up to 30% of the city's supply which is currently being lost. However, the plan spans 25 years and new leaks are sure to appear during that period. On the demand side, the government is implementing educational programs aimed at reducing water use among citizens. This is an important and necessary component, but changing the culture of water use and individual habits will take years. For the many areas that are not connected to the city grid, municipalities sometimes subsidize water trucks that bring water to households at a high cost. In rural areas, standard

supply approaches aren't feasible because of the remoteness and subsequent high cost so the government is unable to currently provide water to villages of less than 3000 people.

So, as the future projections show, what is really needed in Mexico is another water source that is sustainable and affordable for the many low-income families. Current proposals for Mexico City involve pumping in water from even farther away than is the case today which is neither sustainable nor affordable. The rainwater harvesting (RWH) that Isla Urbana promotes can fill this gap in urban supply and rural access while being both sustainable and affordable.

8.5 SOCIAL ENTREPRENUERSHIP SOLUTION MARKETING APPROACH

After years of testing in our living laboratory, Isla Urbana has developed a RWH system that works with existing infrastructure to efficiently capture and clean rainwater for household uses which is also easy to install and maintain. In addition, we have developed an implementation model to ensure proper use and acceptance of this technology.

The economic opportunity of our RWH systems is in removing the cost of current water delivery systems for families, businesses and governments. In water scarce neighborhoods in Mexico City, families often must spend time and up to 20% of their income to buy water from a truck and municipalities rack up costs subsidizing the trucks. A RWH system that can be paid off in four and a half years is therefore a viable and attractive investment for governments that are required by law to provide their citizens with water service.

We have chosen a hybrid for-profit/non-profit structure in order to reach the most people. Within the non-profit, Isla Urbana has chosen to geographically focus much of our work in water scarce low-income neighborhoods in the south of the city which rely on water trucks despite their above average rainfall. These municipalities wanting to take advantage of the savings from RWH, have sought out Isla Urbana because of the recognition that we have already received for our innovative concept. In rural areas, Isla Urbana seeks out the most marginalized areas which are typically home to indigenous communities. Within the social enterprise, the products have been developed for the specific price levels of low- and middle-income people. We anticipate that in the future, the evidence of success from installed systems together with growing recognition will catalyze city and country wide adoption.

Relationships with RWH customers are extremely important to Isla Urbana as they are the ambassadors of this alternative to standard water provision. Beyond installation, Isla Urbana provides educational activities and resources to promote understanding of our systems and remains in personal contact with households to obtain the feedback necessary for our continual improvement. Isla Urbana

partners consistently with universities and institutions to study water quality and investigate impact and with other NGOs when entering new communities. The close relationship we have with suppliers is shown by the fact that one has chosen to donate parts of their profits to the non-profit side of the projects in order to install more systems.

An important determinant of our success is the choice to work with communities or individuals that are the neediest or that approach us. We also require buy-in from beneficiaries through co-financing of the project or at minimum participation through work. This ensures that our systems will be used and will have a definitive positive impact. Additionally, the cultural, social, and educational programs promote the paradigm shift we seek to sustainable water management.

The current water system is very unsustainable, but with centuries of investment and inertia, also very hard to quickly change. Our approach is based on the idea that single rainwater systems provide immediate benefits to individual households, but when replicated in large numbers can have more systemic impacts, increasing resilience and reducing the need to extract or import water from other sources. These systems offer a paradigm-shifting approach to water management, transferring more control from the centralized model to the population itself. Such fundamental shifts would be impossible if they required enormous initial investment and support to work, but the fact that a single rainwater system is in itself highly useful to its users means that progress can be made at any scale, starting with single water-scarce households whose small impacts add up to systemic effects. This allows a potential strategy to build sustainability despite a difficult political and economic context.

8.6 GOALS AND EXPECTED IMPACT

The goal of this initiative is to 'detonate' widespread adoption of RWH in Mexico by installing 100,000 systems at homes, benefitting around 700,000 people. If half of these systems were installed in the city and accounting for leaks in the grid, water extraction would reduce by 3.5 billion liters/year as well as eliminate the energy, emissions and cost required to transport that amount. This would also save municipalities 12 million USD by the end of the three-year period by displacing water trucks. Less quantifiable is the increased resilience of marginal neighborhoods since widespread RWH adoption leaves more water in the grid, lowering the risk of water cutoffs. In rural areas, health and sanitation would be improved by a clean water source. Economic and educational opportunities would increase as the time spent collecting water would be eliminated during the rainy season. Additionally, the training of technicians in designing and installing these systems will provide green job opportunities.

Fundamentally, our goal is to make a serious contribution to water sustainability and equality in our country and city. We believe that effective rainwater harvesting technology and implementation strategies will play an important role in the transition towards sustainability. In the face of the water crisis we are experiencing, our initiative will ensure that the most affected populations in the city have an effective, well adapted and locally controlled means of obtaining water for themselves.

Over the past years, we have been developing and testing rainwater-harvesting technologies in some of the most water stressed areas of the city. These systems have been closely monitored and studied and have proven to be highly effective. Thousands of families are already using them to obtain large percentages of their total water supply. We have been simultaneously developing implementation strategies and collaborating with local governments and universities to study and install them in larger numbers. In order to achieve our larger goals and impacts, we intend to further develop the technologies themselves, reducing their cost and creating more flexible options for people to acquire them. We will continue our work in community and local government outreach to bring the practice to more areas and continue monitoring and evaluation to further demonstrate its effectiveness and potential. Developing financial tools to help low-income families acquire them will also be key.

Currently, local governments have been hiring us to install large numbers of systems in areas with poor water access. This is a great avenue to achieve our goals, but we do not want to depend heavily on government subsidy. Direct sale to users is part of our model, but so far it is more limited to middle- and upper-income families. We want to develop marketing and financing strategies to make rainwater systems fully accessible to the low-income populations most affected by water scarcity.

8.7 IMPLEMENTATION PLAN

Mexico City faces a daunting challenge in achieving water sustainability. The progressive deterioration of the aquifer and surrounding watersheds impose critical questions on how the city will meet its future water needs. Current proposals consist almost entirely on finding and pumping water from farther away, while treating the rainwater that falls on the city as a problem to be solved by expanding the sewage system. Isla Urbana's long-term goal is to develop RWH into a viable, replicable, and proven alternative, able to provide clean water by taking advantage of a wasted resource. By designing and installing systems adapted to the Mexican context, teaching people to do the same, and successfully providing water to areas where the conventional model is failing, we seek to detonate a process of adoption of RWH which will grow as the current system becomes more problematic. As the city fills with RWH systems, the rains that fall upon it will fill its millions of cisterns with clean

water, instead of flooding it with combined sewage. As adoption spreads, a wasted resource will become an important source of water, and help the city become more sustainable and less dependent on dwindling, increasingly contested outside sources.

8.8 CONCLUSION

The transition from an intensive unsustainable model of water management to one better integrated with natural water cycles and local availability is not easy and will not likely be sudden in a city as massive and complex as Mexico. Still, the extremely alarming prospects of the city depleting its aquifer and the growing hope for a more rational and sustainable model of water management are creating both the need and opportunity to explore real alternatives.

Mexico City needs to develop new sources of water, as well as to find ways of using it in more rational ways. Even by optimistic projections where the city implements all recommendations to reduce its profligacy, a quarter of water needs in 2030 will have to come from undefined new sources. The geographic location of the Valley of Mexico, 2200 m above sea level and far from any major rivers or lakes, makes this a daunting challenge. And yet the city has an abundant source of water naturally transported directly to it though the yearly torrential rains that fall over the valley.

Currently this rainwater is mostly drained out of the valley through the sewage system, becoming intensely polluted and causing widespread flooding. With proposals for increasing supply to the city consisting largely in grandiose, hugely expensive plans to pump water from far greater distances, the possibility of learning how to use the rainwater within the valley must be explored in earnest. This is the mission of the Isla Urbana project which, since 2009 has been developing technologies and implementation methods to adapt Mexico City's houses to harvest and use the water that falls on their roofs.

By demonstrating that houses in the city can viably be made water independent for much of the year though the adoption of simple harvesting technologies, Isla Urbana seeks to develop a truly alternative, sustainable form of water management that can add resilience to the city and reduce the need to import or extract water on such massive scales. It has been working to develop a water-stressed section of the city into a first example of widespread adoption of household rainwater use where all the potential benefits can be shown and questions on how this can be achieved can be answered.

In collaboration with the Secretary of the Environment of Mexico City, Isla Urbana is currently working to bring this pilot to full development. It has a goal of installing 100,000 RWH systems in the area over the next four years, enough to supply water for much of the most water stressed population, while carrying out research and evaluations of their impact. If successful, this effort will

demonstrate the potential of using RWH as a means of adding resilience and sustainability to the city's water management strategy and provide the practical knowledge on how to bring it to reality.

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