



Mainstreaming Rainwater Harvesting (RWH) to build climate resilience in the Caribbean Water Sector

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Background

Caribbean countries face a number of challenges in maintaining adequate supplies of water for their populations. Challenges range from low annual rainfall levels to inadequate storage, polluted water sources, and poor management of existing water resources (San Martin 2002). The twin Island state of Antigua and Barbuda, for instance, experiences a low mean annual rainfall of approximately 1057.1mm/year (Caribbean Institute for Meteorology and Hydrology n.d.) and is thus considered water scarce, as less than 1000 m³ of water is available per capita per year (Walling et al. 2005). Trinidad and Tobago, even though its mean annual rainfall of approximately 1877.7mm/year (Caribbean Institute for Meteorology and Hydrology n.d.) is higher than that of many Caribbean islands, is still considered water stressed given that more than 80 percent of the water available is withdrawn annually (Reig, Maddocks, and Gassert 2013).

Caribbean water supply challenges are exacerbated by climate change and variability manifested as severe and protracted dry seasons and more intense rain events. High intensity rainfall events and more intense storms and hurricanes increase the potential of damage to water supply infrastructure through flooding and landslides (Bates et al. 2008, Cashman 2012). Damaged water infrastructure in turn can lead to impaired water quality with resultant human health effects. Climate impacts coupled with expanding Caribbean populations and water intensive economic sectors like tourism put further pressure on the region's water supplies. All of the above translate to increased uncertainty and reduced availability of water supplies, necessitating water supply augmentation, including the exploitation of multiple water sources.

Rainwater Harvesting (RWH) is currently being promoted across the Caribbean region as a key low cost and low technology water supply augmentation method. It is seen as a means to improve resilience to water related climate impacts at both, the national and community level. While prevalent in the past, there are only approximately 500,000 persons currently in the Caribbean who depend at least partially on RWH. The vast majority of the Caribbean's populace depend on centralised pipe-borne municipal water supplies derived from surface water, groundwater, or desalination. However given climate impacts, there is a concerted effort to re-introduce a RWH culture in the Caribbean as one option to reduce water security concerns. In particular, RWH is seen as a viable means to augment existing water supplies after disaster events, when access to municipal water supplies may be disrupted.

Decisions and Actions Taken

As threats from climate change and variability become more tangible, GWP-C, along with other national regional and international organisations, is working to reintroduce and mainstream RWH in the Caribbean. Agencies have focused on RWH knowledge sharing and capacity building along with the creation of an enabling environment for RWH, and the development and enhancement of suitable frameworks, policies, and legislation. There has also been a concurrent increase in regional cooperation and coordination with regards to RWH research, funding, and project and programme development and execution. These are described in more detail below.

RWH enabling environment: Frameworks, financial incentives, policies, and legislation

National legislation addressing RWH has been in existence for many years in water scarce Caribbean countries such as Barbados. Recently, national water policies, programmes and plans have also started to incorporate RWH aspects (Table 1 below), often with technical input and support from regional agencies.

Country	Legislation/ Instrument	RWH components
Antigua & Barbuda	Draft IWRM Policy	Policy recognises <i>inter alia</i> the need to invest in RWH. The policy was developed with financial and technical support from GWP-C
Barbados	Legislation, incentives	Rainwater tanks must be installed on every building as of 1996 (König 2001), new residential buildings must include water storage facilities. Incentives are offered in the form of \$0.50 per gallon (3.79l) of installed tank capacity by the Barbados Water Authority (United Nations Environment Programme n.d.).
Bermuda	Building codes	Eighty (80) percent of any home's roof has to be converted into a rainwater catchment area (Institute for International Urban Development 2015).
Grenada	Legislation	New residential properties must be equipped with RWH systems (United Nations Environment Programme 2010).
Grenada	National RWH Programme	Awareness raising, capacity building, legislative and policy reform, infrastructural development and administration, and monitoring and evaluation form the basis of this programme developed in 2006 (Caribbean Environmental Health Institute 2006).
Grenada	Water Policy/ Roadmap	The IWRM Roadmap speaks to RWH capacity building.
Turks and Caicos	Government support, legislation	Public rainfall catchments were constructed by the government. Regulations require that all developers construct cisterns at a size of 100l/m ² of roof area.
US Virgin Islands	Legislation	Legislation requires that all new houses constructed include guttering and cisterns (United Nations Environment Programme n.d.). Cistern construction is regulated by the U.S. Virgin Islands Building Code (United Nations Environment Programme n.d.).

Table 1: Indicative National-level legislation programmes and policies supporting RWH

A regional programme for promoting RWH in the Caribbean was developed in 2006 by the United Nations Environment Programme (UNEP) and the Caribbean Environmental Health Institute/the Caribbean Public Health Agency (CEHI/CARPHA) (The Caribbean Environmental Health Institute (CEHI) 2006). This programme's objective is to 'contribute to the conservation of the water resources of Small Island Caribbean States through adoption of sustainable water management and conservation technologies' and aims to 'strengthen capacity for the implementation of RWH for household and commercial purposes' and to 'support policies and incentives developed and mainstreamed into national development strategies and policies' (The Caribbean Environmental Health Institute (CEHI) 2006). A number of agencies, including GWP-C, use this framework as a guideline for their RWH activities, implementing measures incrementally as funding becomes available. The recent OECs Model Water Policy and Model Water Law also refer to the need for investment in alternative water supply options, such as RWH. The use of communal RWH systems is suggested, alongside the need for licensing requirements and oversight by regulatory bodies.

Across the region, there have been repeated calls for the inclusion of financial incentives to offset the cost of equipment and materials for RWH construction and maintenance (Caribbean Environmental Health

Institute et al. 2008). Work is currently being executed in this regard through the Pilot Program for Climate Resilience (PPCR), by conducting appropriate economic analyses to facilitate investment in RWH (Caribbean Public Health Agency et al. 2014). Countries such as Barbados already offer incentives to households for the acquisition of RWH hardware, although this has not been furthered in many Caribbean nations.

RWH demonstration projects

Regional and international agencies have executed a number of demonstration projects to showcase and promote RWH for domestic, agricultural and industrial use. For example, a Food and Agriculture Organization-run project in South St. Elizabeth, Jamaica, for instance, facilitated the purchase of reduced cost RWH equipment and the creation of credit facilities via a revolving door fund. Agricultural water catchment and storage systems have been constructed in a number of Caribbean nations by the OECS' Reducing Risk to Human and Natural Assets Resulting from Climate Change (RRACC) Project in an effort to increase resilience against droughts. In Saint Lucia, community RWH installations were set up through the Global Environment Facility Integrating Watershed and Coastal Areas Management (GEF-IWCAM) Project.

From 2012 onwards, GWP-C, the National Institute for Higher Education, Research, Science and Technology (NIHERST) and other partners, have engaged rural communities in Trinidad and Tobago in RWH demonstration projects and capacity building exercises. RWH systems were installed in 18 schools, three community centres, and one NGO facility. Training on the installation and maintenance of the systems as well as possible RWH business opportunities was provided to community members resulting in the replication of RWH in private households in Trinidad. Projects for rain fed agricultural micro-dams and RWH systems for disaster shelters incorporating gender related and disaster preparedness aspects are currently under development by GWP-C and other regional and national partners.

Best practices and innovation of RWH system components for improved health and safety

Traditionally RWH systems are made up of a catchment, a conveyance system, and storage elements, typically a roof, gutters, and a tank or cistern respectively (Caribbean Environmental Health Institute and United Nations Environment Programme 2009). While these suffice for rudimentary RWH, regional agencies have been designing and promoting additional components to improve water quality and protect human health. These innovations include a first flush diverter which is an additional downpipe channelling the first set of rainwater into a separate pipe to prevent debris from entering storage devices. These devices are highlighted in the GWP-C RWH models as part of the RWH education and capacity building campaign. Storage tank water level indicators and filtration baskets are other technological advancements promoted and utilised in projects like the Environmental Solutions for Sustainable Communities project in Trinidad implemented by GWP-C and partners.

Vector-borne diseases present a major challenge in the Caribbean region, particularly mosquito-borne diseases such as dengue, chikungunya, and zika. Thus regional agencies have focused on reducing vector breeding within RWH systems by promoting proper covering of storage containers along with regular inspections and the involvement of the respective health department, where necessary. Technical publications and knowledge products also advocate disinfection through boiling, UV disinfection, chlorination, and by the use of charcoal filters (Caribbean Environmental Health Institute and United Nations Environment Programme 2009). Consistent system cleaning and maintenance, along with regular water quality testing, has also been emphasised.

RWH capacity building, knowledge exchange, and regional cooperation

One of the main challenges in mainstreaming RWH in the Caribbean is that it is considered an outdated practice, alongside the stigma of being practiced solely by low income groups. Regional organisations are trying to overcome this negative perception through the development and promotion of suitable knowledge products, including technical publications, videos, and models. Many of these resources are found in the GWP-C and CEHI/CARPHA online Rainwater Harvesting ToolBox, which was first launched in 2011 (Figure 1). Since then, the ToolBox has been updated regularly by GWP-C. These resources are advertised at educational events throughout the region, along with the display of a GWP-C portable travelling RWH model, which was updated and replicated by GWP-C in 2014 (Figure 2). The old and new models have been displayed in Grenada, Saint Lucia, and Trinidad. The Jamaica Water Resources Authority (WRA) produced a model of their own, following the original GWP-C/CEHI design, which has since been displayed at a number of events, most recently at the Jamaica Climate March in 2015 in a collaborative effort with GWP-C and the Caribbean Youth Environment Network (CYEN). An IWRM technical expertise database is also hosted by GWP-C, highlighting *inter alia* contact information for the region's RWH specialists.

Recent knowledge sharing activities include a regional RWH Forum held in Saint Lucia in October 2014. This forum was hosted by GWP-C and regional partners (see Figure 3) and consisted of presentations, field visits, and group activities. The forum was attended by country delegates, representatives from GWP-Mediterranean and GWP-Central America as well as staff from regional and international organisations. The forum facilitated the exchange of information and identified a way forward for RWH within the region, including the establishment of partnership arrangements among relevant Caribbean agencies. For example, CARPHA, GWP-C, the Caribbean AquaTerrestrial Solutions programme (CATS) and UNEP Car/RCU are partnering to update and implement aspects of the 2006 UNEP and CEHI/CARPHA regional programme for RWH. GWP-C's RWH activities emphasise partnerships, coordination and building on existing work. This is showcased in the timeline of GWP-C RWH interventions highlighted in Figure 4.



Figure 1: GWP-C RWH Toolbox available at <http://www.caribbeanrainwaterharvestingtoolbox.com/>

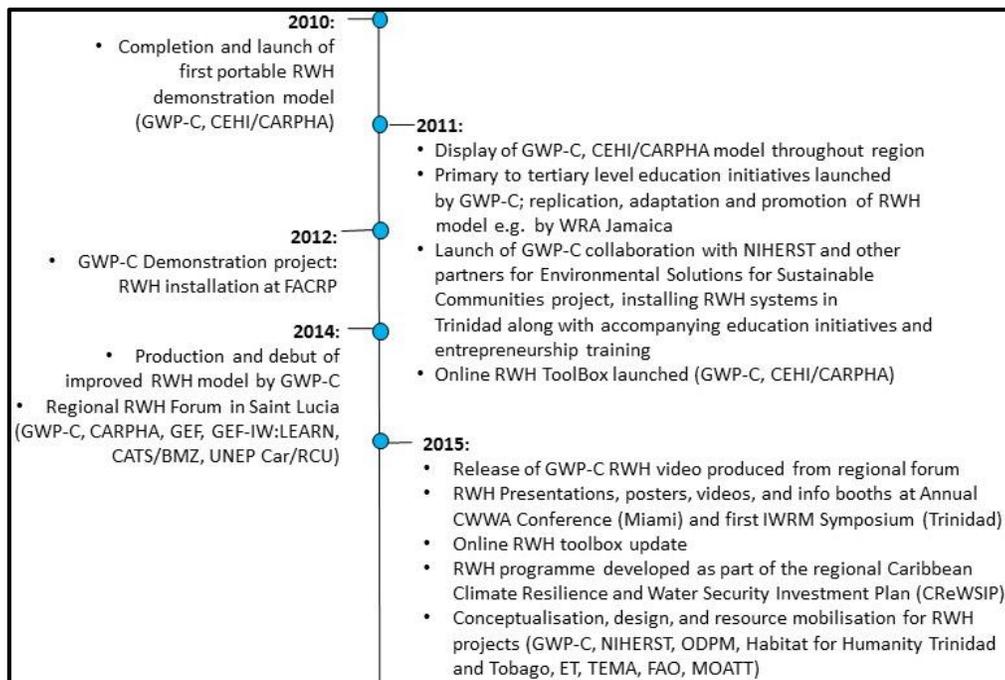


Figure 2: GWP-C RWH Model



Figure 3: Field visits during the Caribbean RWH forum held in St. St. Lucia in 2014, organized by GWP-C and partners

Figure 4: GWP-C RWH activities 2010-2015 (see page 7 for list of acronyms)



Outcomes

Through the actions of regional and national agencies working in concert or independently - there have been significant strides in re-establishing a RWH culture in the Caribbean. Overall, there has been a substantial increase in the number of persons made aware of RWH technology and applications as well as the safe and efficient methods for RWH. This knowledge sharing along with improved options for financing have resulted in the replication of RWH installations in many private households and the utilisation of RWH for commercial applications. Train-the-trainer workshops have resulted in increased capacity building and replication of efforts exerted. Policy and legislative efforts have resulted in the institutionalisation of RWH in some of the countries. Collaboration among agencies working in RWH has allowed for the maximisation of scarce resources geared towards achieving all of the above. There is a

strong need to continue efforts, especially with regards to the policy, legislative, and financial aspects to further mainstream RWH back into the Caribbean psyche.

Lessons learned and replicability

Regional advancement of RWH

1. A multi-pronged approach has aided in the regional advancement of RWH. As a result, not only is there focus on knowledge sharing and capacity building activities, but also policy, legislation, and investment for RWH.
2. The development of a regional programme for RWH in 2006 by one of the regional agencies has helped guide, coordinate, and shape the regional RWH agenda and activities for a number of the agencies, including GWP-C. While funding for the entire programme has never been realised, regional agencies have been able to implement aspects incrementally as smaller pockets of funding become available. Thus, overarching reference frameworks are recommended.
3. Coordination, communication, and partnerships have proven useful in reducing duplication of efforts, allowing for more efficient use of financial and technical resources to advance RWH in the region. Both formal and informal avenues for the above have proven successful.

Knowledge sharing and capacity building

1. Knowledge sharing among countries and among regions have pushed RWH further. A regional Caribbean RWH Forum in 2014, which included Central American participants, has redounded to a planned 2016 Central American RWH Forum. Regions have learnt from each other in terms of successful technological solutions and policy interventions, among other aspects.
2. Knowledge sharing has been successfully advanced by the utilisation of multiple media and multiple approaches including videos, online tool boxes, demonstration models, manuals, lectures, and exhibits. Approaches have been tailored to the specific audience, for example, physical models have worked best with younger audiences.
3. Capacity building for communities that have incorporated business training has furthered the replication of RWH as trainees have pursued RWH installation as a business initiative.
4. The need to target multiple audiences for knowledge sharing and capacity building has been recognised and addressed. Thus, the methods outlined above have been used for communities, NGOs, government agencies, and the private sector. More knowledge sharing and capacity building is needed in the private sector.

RWH enabling Environment

1. Knowledge sharing and capacity building can only go so far. Policies and legislation have proven the most effective way of advancing RWH at the domestic level thus far and is needed in countries where they don't exist. For example, no mention is made of RWH in the National IWRM Policy of Trinidad and Tobago (The Water Resources Management Unit 2005). Thus despite a renewed enthusiasm for the practice in that country through knowledge sharing and capacity building activities, the lack of a RWH policy discourages individuals and industries from investing in a system due to concerns of potential future tariffs attached to this activity.
2. Another area that requires more focus is the development of a market for specialised RWH equipment as supplies are often difficult to obtain and maintenance services are often unavailable. The business sector, as well as the region at large, will therefore greatly benefit from

the development of RWH products and services, inclusive of equipment installation and maintenance.

3. More financial incentives for individuals and funding for RWH projects are also needed. Thus RWH resource mobilization for RWH is a key aspect of the Climate and Development Knowledge Network (CDKN) funded GWP-C and the Caribbean Community Climate Change Centre's (CCCC) Caribbean Climate Resilience and Water Security Investment Plan (CReWSIP) project. This project focuses on the identification, prioritization, and sourcing of finance to increase climate resilience in the Caribbean water sector.

List of acronyms

Acronym	Organisation
BMZ	Federal Ministry for Economic Cooperation and Development (Germany)
CARPHA	The Caribbean Public Health Agency
CATS	Caribbean Aqua-Terrestrial Solutions
CCCCC	Caribbean Community Climate Change Centre
CDKN	Climate and Development Knowledge Network
CEHI	Caribbean Environmental Health Institute
CYEN	Caribbean Youth Environment Network
ET	Environment Tobago
FACRP	Fondes Amandes Community Reforestation Project
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GEF-IWCAM	Global Environment Facility Integrating Watershed and Coastal Areas Management
GEF-IW:LEARN	Global Environment Facility International Waters Learning Exchange & Resource Network
GWP-C	Global Water Partnership-Caribbean
MOATT	Ministry of Agriculture Trinidad and Tobago
NIHERST	National Institute of Higher Education, Research, Science and Technology
ODPM	Office of Disaster Preparedness and Management (Trinidad)
OECS	Organization of Eastern Caribbean States
TEMA	Tobago Emergency Management Agency
UNEP	United Nations Environment Programme
UNEP Car/RCU	United Nations Environment Programme Caribbean/Regional Coordinating Unit
WRA Jamaica	Water Resources Authority Jamaica

Contact and organisation

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Complementary studies

Rain Water Harvesting Tool Kit; GWP Caribbean in cooperation with CARICOM:

<http://www.caribbeanrainwaterharvestingtoolbox.com/about2.htm>

<http://www.caribbeanrainwaterharvestingtoolbox.com/>

Brief: GWP-C Tackles Water Scarcity by Promoting Improved Rainwater Harvesting Practices (GWP-Caribbean):

[http://www.gwp.org/Global/GWP-C%20Files/GWP-](http://www.gwp.org/Global/GWP-C%20Files/GWP-C%20Tackles%20Water%20Scarcity%20by%20Promoting%20Improved%20Rainwater%20Harvesting%20Practices.pdf)

[C%20Tackles%20Water%20Scarcity%20by%20Promoting%20Improved%20Rainwater%20Harvesting%20Practices.pdf](http://www.gwp.org/Global/GWP-C%20Files/GWP-C%20Tackles%20Water%20Scarcity%20by%20Promoting%20Improved%20Rainwater%20Harvesting%20Practices.pdf)

Rainwater: Catch it While You Can; A Handbook on Rainwater Harvesting in the Caribbean (UNEP and CEHI, 2009)

<http://www.caribank.org/uploads/2013/08/em-rainwater-handbook-caribbean.pdf>

A Programme for Promoting Rainwater Harvesting in the Caribbean Region (CEHI and UNEP, 2006)

<http://www.caribbeanrainwaterharvestingtoolbox.com/Media/Print/Programme%20to%20Promote%20ORWH%20in%20the%20Caribbean%20Region.pdf>

Rainwater Harvesting in rural communities in Trinidad: Success stories and lessons learnt

<http://www.caribbeanrainwaterharvestingtoolbox.com/Images/Posters/Poster%20-%20ORWH%20in%20Rural%20Communities.pdf>

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