



KEY FINDINGS

Decentralised solutions for water supply, such as rainwater harvesting, community-level storage, and small-scale desalination, present opportunities for resilience building in communities that are some of the most vulnerable to climate change

Achieving buy-in and uptake from community members is vital for the success of such solutions

Community buy-in requires meaningful consultation, engaging awareness raising, and easily understood DIY solutions made from readily available components

Microfinance offers a solution for increasing private sector investment in small-scale decentralised solutions

Building Resilience through Decentralised Water Resource Management in the Caribbean

Water resources are greatly impacted by the effects of climate change, and so it comes as no surprise that many of the programmes implemented by PPCR countries focus on enhancing water resilience. The case studies presented here, provide some examples of how PPCR countries in the Caribbean are working towards achieving this goal through decentralised solutions.

CONTEXT: Water scarcity is a reality for many small island developing states (SIDS) in the Caribbean. Climate change threatens water availability further through hotter, drier conditions and less predictable rainfall, worsening the impact of droughts, leading to what is termed absolute scarcity.

However, there are also instances of relative scarcity. Water supply, and supporting infrastructure, such as dams, pipelines, pumping stations and roads, are impacted by natural disasters such as hurricanes, storm surges, floods and landslides. This results in irregular and unreliable water supply, with water not reaching people or communities who need it, when they need it. Relative scarcity can also be a function of low institutional capacity, or financial barriers, to deliver safe water to all, in locations that are often difficult to access even when water resources are available.

NEED FOR ADAPTATION: Under both instances of water scarcity, large-scale, centralised water supply systems are not always able to provide safe and reliable water supply to everyone, necessitating innovative, decentralised Water Resource Management (DWRM) solutions to tackle these challenges. The experiences told throughout this case story, provide examples of various aspects of Water Resource Management (WRM) through decentralised



solutions, which build towards water security and climate change resilience.

SOLUTIONS: The case studies presented below demonstrate the application of a number of innovative DWRM solutions in the Caribbean, including rainwater harvesting, community storage tanks, and small-scale desalination. Additionally, the case studies point towards the factors that affect the adoption of such solutions.

This rainwater harvesting pond was built by a recipient of the Climate Change Line of Credit in the Blue Mountains of Jamaica. Access to a reliable source of water was identified as a significant issue affecting the recipient's ecotourism business.



Rainwater Harvesting

Rainwater Harvesting (RWH) is a simple practice that has been used across the world for thousands of years. In regions such as the Caribbean, RWH provided the only source of water security before the advent of centralised supply systems. At its simplest level, RWH consists of a surface to catch falling rainwater (such as the roof of a building), a tank for storing water, and a system of pipes and gutters connecting the collection surface to the storage tank. RWH significantly enhances household water access, however there are some health risks in terms of water quality and the possibility of contamination. To deal with this, various technological advancements have been produced to accompany RWH systems. These

include systems such as first-flush diverters, overflow mechanisms, and water filters and purifiers. Many such off-the-shelf systems exist; however, finding simple, affordable solutions is important for wider uptake and long-term sustainability. Organisations such as CARICOM, Global Water Partnership Caribbean (GWP-C) and UNEP, have been working to showcase the designs of simple, affordable, and in some cases, do-it-yourself (DIY) solutions in the Caribbean. Videos, radio announcements, models, posters, technical brochures, handbooks and training opportunities are all used to promote these solutions. Access the GWP-C Rainwater Harvesting Toolbox here: <http://www.caribbeanrainwaterharvestingtoolbox.com/>.

The First-Flush Diverter

The first-flush diverter is a simple, effective solution for improving water quality in RWH systems. The first rain that washes off of a roof (the 'first flush') usually contains unwanted materials from the surface, for example animal droppings, leaves and dust. These materials can all reduce the quality of the stored water, if this first-flush enters the storage tank. A first-flush diverter is a simple installation that is part of the downpipe. It is set up to remove the first water that comes off the roof so that it does not enter the tank. It channels the first flow down the downpipe to its base, where it drains away. Thereafter, the cleaner water settles on top, and relatively clean water enters the tank.



Example of an installed First-Flush Diverters, CARICOM & GWP

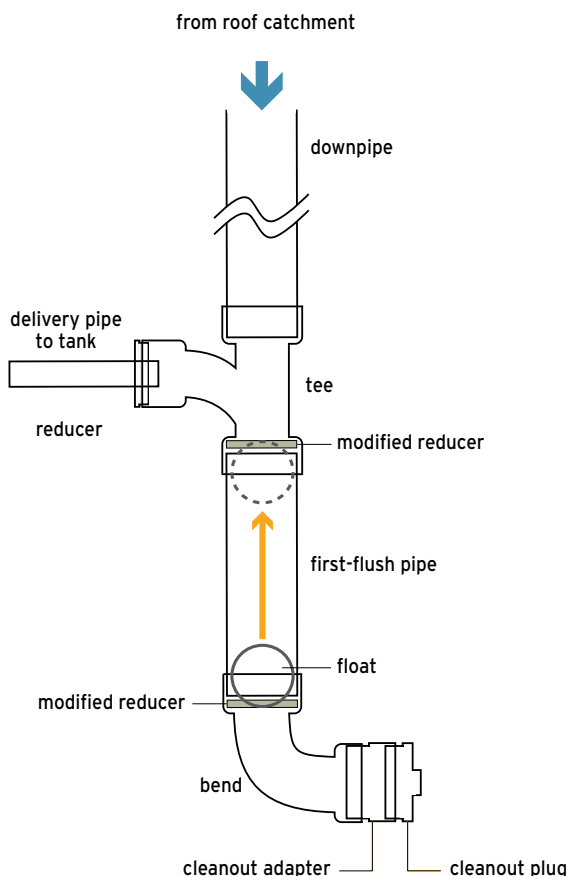


FIGURE 1. FIRST-FLUSH ASSEMBLY DIAGRAM

Key lessons

The Caribbean experience highlights the following key points:

- **Simple diagrams and available components:** The designs used in the region show how a first-flush diverter can easily be made from available, standard plumbing components, on a DIY basis, following simple diagrams. Other simple solutions include baffle tanks, pipe screens, up-flow filters and overflow mechanisms.
- **Communicating:** These simple technological solutions effectively can greatly advance uptake of RWH. It is important that the promoted designs respond to the local context by focussing on components that are readily available in the area.
- **Broad sectoral uptake:** Such solutions extend beyond household application, as demonstrated across the Caribbean. Improved RWH solutions have been used to increase the resilience of small-scale farmers and hotels in Jamaica, as well as schools and community centres in Trinidad.
- **Development of these systems can also lead to opportunities for job creation.** In Trinidad for example, local community members took part in building a demonstration RWH system at a local school, which empowered some of them to start RWH installation businesses. Refer to the NIHERST Environmental Solutions Project: <http://www.niherst.gov.tt/projects/projects-rainwater.html>.

Community Storage Tanks

“ Decentralised water storage solutions allow schools to continue to operate when central water supply is interrupted. ”

Although RWH is an affordable and accessible solution, especially at the household level, it cannot on its own guarantee universal and reliable access to potable water for all applications. Medium-scale water storage and distribution systems are more applicable at the community level, providing water for schools and clinics, community centres, hotels, and small commercial agricultural initiatives.

Some PPCR countries, such as Grenada, have already tested the technologies, such as desalination and storage tanks, through pilot projects detailed below.

Benefits of Medium-Scale Solutions:

- Spread the risk of disasters affecting central water supply.
- Offer the co-benefit of mitigating the impacts of floods and landslides, as they reduce the runoff by capturing a significant amount of rainwater.
- Involve a lot of local community engagement and therefore usually build a sense of ownership at the community level.
- Opportunities for developing microenterprises, thus providing co-benefits for local economic development, as in the Grenada example below.



Attendees of the recent PPCR LAC Regional Exchange event in Grenada visit the construction of a reservoir funded by the world bank.

Carriacou's Community-Level WRM Solutions

The Government of Grenada has implemented several projects under the PPCR, piloting medium-scale, community-level water supply solutions, with the aim of moving away from centralised WRM. Three key WRM projects formed part of the Regional Disaster Vulnerability Reduction Project, funded with blended finance from PPCR, World Bank and other external funding.

Two of the three Grenada PPCR projects are located on Carriacou, one of Grenada's three main islands. Carriacou has a population of just over 6,000 and an area of 34 square kilometres. It has no perennial streams and very little groundwater, but receives annual rainfall of about 1200 mm. This is significantly more than the 400 mm that the United Nations Environment Program considers to be the minimum for reliable, sustainable RWH.

The island has no water supply utilities and as a result, RWH has become the main source of potable water. Because of the widespread adoption of RWH, Carriacou's water supplies were less badly affected by Hurricanes Ivan (2004) and Emily (2005).





Desalination plant, Seville, Carriacou



Water storage tanks at the desalination plant, Seville, Carriacou

Solar-powered, small-scale desalination plant, Seville, Carriacou

One of the PPCR projects on Carriacou is a small-scale desalination plant in the community of Seville. The plant uses a Saltwater Reverse Osmosis System for sea water desalination and has a processing capacity of 80,000 gallons per day. The plant is powered by a 113.4 kW solar photovoltaic (PV) plant, located in the community of Limlair. The solar PV plant produces enough electricity to power the desalination process and the storage tank system, with excess electricity being sold into the national grid.

The high electricity costs associated with pumping water are one of the critical barriers for the expansion of potable water supply, especially in a SIDS context. Integrating solar PV systems for powering WRM solutions is a technologically innovative approach and Grenada's experience offers a valuable model for other PPCR countries.

Storage tanks (left) form part of the desalination process in Seville, Carriacou, powered by the nearby solar PV plant (below).



Solar PV powers the desalination plant at Seville, Carriacou.

Water storage tank, Laca Pierre

The second major project on Carriacou is a large water tank on a high hill in Laca Pierre. The tank has a storage capacity of 100,000 gallons (about 378,500 litres), and it stores water pumped up from the desalination plant in Seville, on the ocean. Water from the tank is distributed by gravity feed to Hillsborough, Carriacou's main town and is also sent by truck to other communities on Carriacou.



The storage tank at Laca Pierre is on a hill, allowing gravity-feed distribution of water to local communities.

Water storage tank and reticulation pipes, St David

The third major WRM project is situated in the Grenada parish of St David and is implemented by the National Water & Sewage Authority (NWSA). The project includes a water tank with a storage capacity of 300,000 gallons (about 1.1 million liters) and 1.5 kilometres of pipes. The system is powered by an on-site generator. This system stores excess water during the rainy season for use and distribution during the dry season, thus improving WRM and building climate resilience.

Key lessons from Grenada

The advantages of medium-scale solutions include the following:

- Medium-scale solutions can create economies of scale by supplying water to more people in neighbouring communities.
- The medium-scale model has opened up opportunities for local water supply microenterprises, bringing the co-benefits of job creation and local economic development. Authorities in

Grenada are currently considering these options and testing various ownership models.

- Projects at the community level require significant stakeholder engagement. Communities were involved in the process from the start, for several reasons:
 - Some communities had to relocate to make space for the storage tanks.
 - The project carefully considered the socioeconomic implications for local communities, including benefits and costs. Social costs were planned for or mitigated, even when this impacted on the speed and cost of implementation.
- Having a number of medium-scale solutions spreads the risk of climate impacts and disasters, and thereby increases community resilience. However, perceptions that centralised water services are 'better' sometimes prevail, reducing uptake of decentralised solutions - often where they are needed most.
- The Seville and Laca Pierre WRM projects are innovative because they are modular. This allowed the implementers to choose the best location for each component, thus optimising the use of resources and allows for future expansion.



Participants at the LAC PPCR Regional Learning Exchange in September 2017 were impressed by the innovative nature of Grenada's WRM solutions.



Factors Affecting the Adoption of DWRM Solutions

In different countries, different factors advance or block the adoption of DWRM solutions.

In Jamaica, for example, the government intends to grow the rates of access to potable water from 50% to 85%, using centralised utility water services, and to bridge the final 15% of access through RWH and other decentralised technological solutions. The government intends to drive the uptake of RWH in Jamaica through formalising its inclusion as a priority in the new National Water Policy, and by developing national RWH Guidelines to support this.

There is an ongoing discussion in Jamaica around making RWH mandatory for new developments. In view of this, the Guidelines are also meant to create an enabling environment for developing financial incentive schemes. This will offset some of the costs, in case RWH is made mandatory, increasing affordability and accessibility. The specific objective of the Guidelines is to set implementation and

safety standards for RWH, especially with regards to new planned developments. The GoJ sees multiple co-benefits in promoting this approach: from flood prevention through decreased run-off, to watershed protection and reduction in landslides.

However, Jamaica faces a challenge in getting community buy-in. RWH solutions are seen by many as being a sub-standard alternative to piped water, which communities have come to expect as part of the government's service delivery mandate. The government has recognised the need to raise awareness and spread information on how quality water supply from RWH can be achieved through the application of technological solutions such as the first-flush diverter and water filtration and purification systems.

In order to facilitate further implementation of RWH by the private sector, Jamaica has pioneered an innovative microfinance mechanism (detailed in the Microfinance Knowledge Brief as part of this Knowledge for Resilience Series). Small businesses

THE LAND CHALLENGE

DWRM projects often depend on the availability of land (for example for storage tanks) and they therefore sometimes displace communities. Land ownership is one of the key challenges when implementing community-level WRM projects.

Norms and frameworks for land ownership and acquisition vary widely across PPCR countries. Often, ownership is based on customary law. For example, in the Caribbean region, close to 90% of the land is managed under inheritance law, with inter-generational land transfers through wills and testaments.

To implement medium-scale WRM systems successfully, in the context of the PPCR, it is important to promote an understanding of local land management practices and align PPCR procedures for land acquisition with local customs.



Col. Oral Khan, Chief Technical Director, Ministry of Economic Growth and Job Creation, discusses microfinancing options for investing in DWRM solutions, at Jamaica's premier agricultural event in Clarendon recently.

in the agriculture and tourism sectors have used this mechanism to secure water supply for business continuity and expansion.

Other countries in the region, such as Grenada, have made great progress in the rollout of RWH despite the absence of a national regulatory framework. Grenada's experience is primarily formed by an acute need, and a lack of viable alternatives has driven cultural acceptance of this. Hurricane Ivan in 2004 and Hurricane Emily in 2005 caused significant damage, and disruption to central water supply across the Caribbean, for long periods. However, on Carriacou, long before the disaster hit, RWH was widely established as the primary means of accessing potable water. As a result, communities on Carriacou were not as severely affected by water shortages and potable water was readily available during the disaster recovery period.

This may be because in 2006, the Govern-

ment developed a Rainwater Harvesting Programme, to stimulate wider adoption of RWH as an alternative solution for the country as a whole. The Programme aims to raise awareness and support the development of RWH policies and incentives, as well as facilitate household and commercial RWH. Although RWH was already well established in Grenada, it was important for the government to focus on promoting best practice in RWH, to advance new adoption in a sustainable way.

The examples of Jamaica and Grenada both demonstrate the need to raise awareness around decentralised solutions and the related best practices, in order to drive uptake and adoption. This is irrespective of the level to which such solutions have become a formal part of a country's policy framework. Efforts to drive awareness raising in the Caribbean have had great success, as detailed in this section.

“ *The adoption of rainwater harvesting solutions may be driven more by need than by policy, yet policy can play a role in driving awareness and changing mindsets.* ”

Raising awareness with a RWH Model

Global Water Partnership Caribbean (GWP-C) is committed to raising awareness and sharing knowledge with stakeholders at all levels, on RWH best practices in the Caribbean. GWP-C, with the Caribbean Environmental Health Institute created a scaled-down, portable model of a RWH system and launched it at the Annual Conference and Exhibition of the Caribbean Water and Wastewater Association in Grenada in 2010. Thereafter, the model travelled to Trinidad and Tobago and St. Lucia, where it was presented at various events (such as St. Lucia Water Week for World Water Day), as well as in several rural communities in Trinidad and Tobago.

The RWH model came to be a great success. It was easy to engage with and people could see a scaled-down version of how the system actually works and learn about its benefits. The model was unique, in that it was technologically innovative, and equipped with a first-flush diverter. Although the model was used most extensively in Trinidad and Tobago, knowledge was shared throughout the Latin American and Caribbean (LAC) region through GWP's network of partners.

Other partners in the region replicated it and a new model was developed with the technical support of Jamaica's Water Resource Authority (WRA). The Government of Jamaica used the model to help promote the microfinance credit line (a PPCR project) for financing such solutions (see the Microfinance Knowledge Brief in this series for more information).



Model of an RWH system (Global Water Partnership)





School children from Trinidad and Tobago were fascinated by the RWH model at a local exhibition.

SUCCESSES: DWRM solutions such as RWH, community-level storage, and small-scale desalination present opportunities for resilience building in communities that are some of the most vulnerable to climate change, such as those located in the SIDS.

However, to be successful, such solutions need to extend beyond the technical nuts and bolts that make them function. The community members themselves are a part of the overarching system that to be understood in order for such solutions to be implemented and adopted. Achieving buy-in and uptake from community members is vital for the success of such solutions.

Achieving community buy-in requires meaningful consultation (as seen for example in the development of Jamaica's RWH Guidelines and Grenada's community water tank placement). It also requires awareness raising efforts (GWP-C's RWH model), and the distribution of simple diagrams demonstrating DIY solutions made from readily available components.

By understanding community needs and capacities, DWRM solutions can be tailored to achieve maximum impact. This will build resilience not only through the supply of reliable water, but through the many co-benefits that come along with such solutions, including job creation and private sector investment.

ACKNOWLEDGEMENTS

We would like to thank representatives of the CIF and the PPCR Community of Practice (COP) for their support of and inputs to this document. We would particularly like to thank the participants at the Regional Learning Exchange for Latin American and Caribbean (LAC), held in Grenada in September 2017, for the discussion that contributed to the conceptualisation and content. Special thanks to PPCR COP members from the Caribbean for participating in discussions and interviews which formed the basis of this series of case studies; your time and expertise were invaluable.

Context of PPCR Learning

The PPCR Knowledge for Resilience series aims to share the observations of and lessons learnt by countries implementing projects under the PPCR. Such lessons facilitate evidence-based learning to advance climate resilience goals, both in the PPCR and globally. The knowledge products in this series are co-created by designated implementing entities in each PPCR country and the appointed Learning Partner for the PPCR, drawing on interviews with a range of stakeholders. The series is part of the work undertaken by the Learning Partner to create and facilitate a dynamic, actively-engaged knowledge and learning network

amongst the PPCR Community of Practice (COP).

The Climate Investment Funds (CIF) community recognises that the onset of climate change requires urgent responses, that often do not allow the time for academic, traditional, or compliance-driven evaluation and learning. Instead the emphasis needs to be on generating practical and timely insights, through learning by doing, that guide decision-making among investors and practitioners. The Knowledge for Resilience series seeks to address these aims, and includes a range of products, from case studies and photo stories, to policy and research briefs.

DISCLAIMER

The development of this material was funded by the World Bank through the Pilot Program for Climate Resilience (PPCR). However, the views expressed do not necessarily reflect the official policies or views of the World Bank or the PPCR. While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the World Bank does not take responsibility for

the accuracy or completeness of its contents and shall not be liable for loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

PHOTOGRAPHIC CREDITS: PPCR Grenada, PPCR Jamaica, PPCR Learning Partner, GWP Caribbean
DESIGN: Pete Bosman (pete@guineafolio.co.za)