Proceedings

Technical Seminars

On

Best Practices for Improving Water Quality in Rainwater Harvesting Systems

under the project

Promoting Rainwater Harvesting in the Caribbean Region - Phase 2

APUA Training Room, Cassada Gardens, Antigua
Council Hall, Cordrington, Barbuda
21st and 22nd October 2009

A collaborative effort between the
Caribbean Environmental Health Institute (CEHI), the Antigua Public Utilities Authority (APUA), and the United Nations Environment Programme (UNEP)

October 2009

Preamble

This Technical Seminar series on Best Practices Rainwater Harvesting held over the 21st and 22nd October 2009 was designed to raise awareness of the critical issues associated with water safety associated with eth practice of rainwater harvesting in Antigua and Barbuda. The seminars familiarized participants on the importance of integrating water safety measures in conventional Rainwater Harvesting (RWH) systems and measures that can be taken to maximize rainwater capture. The seminars showcased special demonstration models for rainwater harvesting for small commercial enterprises and households using a special first-flush diverter designed under resources provided from the United Nations Environment Programme (UNEP) under a collaborative initiative with the Caribbean Environmental Health Institute to promote the practice of rainwater harvesting in the Caribbean. The following is a summary of the CEHI-UNEP project.

CEHI, with support from UNEP is implementing a demonstration initiative in Antigua and Barbuda to promote the practice of Rainwater Harvesting (RWH) in the Caribbean. This support is follow-up to a first phase of a UNEP-assisted effort to raise the profile of the practice of RWH in the region. During that first phase Grenada was used as a pilot to develop a National Programme to promote RWH. The lessons learned and strategic directions that emerged from the national pilot were used to develop a Regional RWH Programme for the Caribbean. The project also funded the production of public awareness material that included posters, radio public service announcements, a feature-length video and a technical brochure.

In the second (current) phase, the emphasis is on the development of demonstration models that showcase best practices in rainwater harvesting to the Caribbean. Antigua and Barbuda was selected as the candidate country given the fact that the practice is well established in the majority of households and business enterprises. Two candidate models were initially selected; a typical household, and a small business enterprise (likely an agricultural enterprise). This was subsequently expanded to include a second business enterprise and a school. The project financed upgrades and retro-fitting of the existing RWH systems to bring them to recommended standard so that they represent best practice and serve as training resources for householders, contractors, business operators in Antigua and Barbuda, and the rest of the Caribbean. The project supported the hosting of a national symposium (held in January 2008), sensitization activities, the development of a handbook on implementing RWH practices in Caribbean States including provision of mapping RWH harvesting potentials across landscapes.

Information on the RWH collaboration between CEHI and UNEP is posted at the CEHI website at http://cehi.org.lc/rainwaterharvest.htm.

The local collaborator in the hosting of the seminars was the Antigua Public Utilities Authority (APUA).

Seminar Objectives

The major objectives of the technical seminars were to:

- Familiarize participants with the project inputs and outcomes.
- Raise awareness on the risks associated with poor practices in rainwater harvesting;
- Present technical options towards improvement in water quality in RWH systems;
- Gather feedback from stakeholders on the practicality of the technical solutions as presented in the demonstration models;
- Gain testimonials from the project beneficiaries on the application of the improvements to the RWH systems.

Participation

Participants were drawn from a wide range of interest groups across Antigua and Barbuda representing both public and private sectors. The key technical resource persons came from the Caribbean Environmental Health Institute, the Antigua Public Utilities Authority and the Central Board of Health.

The Workshop Agenda and List of Participants are contained in **Annexes 1 and 2**.

About CEHI

The Caribbean Environmental Health Institute (CEHI), an agency under CARICOM, was established in 1989 with the broad mandate to provide technical assistance on matters of environmental management to Member States. The Institute is headquartered in St. Lucia. For more information on the Institute please visit www.cehi.org.lc.

Day 1 - Antigua Proceedings

Opening remarks

Left to right: Lionel Michael (CBH), Ivan Rodrigues (APUA), Dr. Christopher Cox (CEHI)

The opening ceremony was presided over by the APUA's Water Services Manager, Mr. Ivan Rodrigues. He welcomed the participants and CEHI to the forum. He highlighted the role of the APUA in the project and the support provided. He outlined the challenges associated with water services provision and the role the rainwater harvesting can play in advancing water security.

CEHI's representative, Dr. Christopher Cox, Programme Director thanked the APUA and other local partners such as the Central Board of Health for their support in the project and he gave a brief background on the origins of the project and the support by UNEP at the global scale in the promotion of rainwater harvesting particularly in the light of climate change. The climate change dimension will command greater importance in water security as long-term rainfall trends toward drier and drought conditions, sea levels rise, intruding into coastal groundwater aquifers and more devastating hurricanes create water supply crises post-disaster. He noted that the key beneficiaries of this project will be those communities across the Caribbean that are water-scarce, where access to water is a very real socio-economic barrier to development. He added that in some countries RWH is looked on as an outdated practice where there is universal access to potable municipal water supply systems. The project is therefore intended to address this perception. He concluded by again thanking the APUA for its support as the lead national agency in the advancement of Integrated Water Resources Management (IWRM) in Antigua and Barbuda.

Mr. Lionel Michael, Chief Health Inspector of the Central Board of Health (CBH) highlighted the need for improvement in sanitation practices in RWH, noting that the vast majority of RWH practitioners in Antigua do not adequately integrate best practices in harvesting and storing rainwater. He highlighted in particular the absence of the use of proper filtration and improper point-of-use practices. In cases when cistern water has been tested invariably all tests have returned positive for presence of colliform bacteria, an indication that the water will likely contain harmful pathogens. Mr. Michael recommended that the American Association of Rainwater Harvesting's website be consulted as it has resources on the subject that can contribute to adoption of best practices. He welcomed the initiative that can assist in promoting the best practices toward reducing the public health risk.

Presentations

Dr. Christopher Cox, Caribbean Environmental Health Institute

The key elements of the presentations included:

- The CEHI-UNEP collaboration
- The historic applications of RWH in the Caribbean
- Why invest in RWH and main selling points
- Phase 1 collaboration with UNEP; objectives and key outputs
- Elements of the Caribbean programme for RWH
- Regional-level actions for promoting RWH
- Phase 2 collaboration with UNEP; objectives and key outputs
- Demonstration models

See Annex 3.1 for the full presentation

Discussion and comments

- There needs to be consideration given to securing plastic water tanks during hurricanes. There is an example of a harness that secures the tank so that it does not get blown away in high winds (particularly when the tank is not full).
- Hillside community RWH surfaces should not be completely decommissioned as has happened over time in Antigua. These catchments can still serve useful purpose for water security for agriculture and other municipal uses. The question of investment in "cascading" catchments for surface runoff capture was raised. This type of investment could be used for farming applications. There were many historic surface ponds there were constructed for rainwater surface diversion for use in agriculture. Over time these ponds were filled in and built on but at the risk of these homes being flooded out. The fact that there is not a comprehensive water resources master plan the strategic outlook for the country many of these issues are not adequately addressed.
- The issue of minimization of sludge build-up in storage tanks is seen as a major issue. The problem can be addressed by regular maintenance and installation of a sump pump and sediment filters. The installation of the draw-off from the tank should be installed several inches above the base of the tank to minimize the possibility of sediment residue drawn into the water.

- It is felt that the public health department is not visible enough in promoting best practices and advising on what can be done to avoid public health risks in rainwater harvesting. Information needs to get out.
- There should be investment in large-scale water storage projects built around municipal surface catchments.

Jerome Greene, Central Board of Health

The key elements of the presentation included:

- A background on rainwater harvesting
- Safety issues associated with rainwater harvesting – testing results
- Disease risks associated with private water supply systems
- What can be done to enhance water quality

See Annex 3.2 for the full presentation.

Discussion and comments

- There is a practice of not cleaning cisterns to remove the sludge. The practice also is observed with owners of the black plastic tanks. The accumulation of sludge is a significant factor.
- The public health department must be more aggressive in promoting the message that cisterns must be de-sludged on a regular basis
- It is observed that persons often build cisterns with service manholes that are too small for entry; this presents a significant problem for maintenance. The manholes are often not sealed properly.
- Persons who have single-chambered cisterns have a challenge in cleaning them where complete drainage is required. If the cistern needs to be drained then the household is without water. Two-chambered cisterns are recommended for maintenance while retaining supply.
- The message from the public health sector regarding the safety of cistern water must be cast in a positive light so that persons are not caused to perceive that consuming rainwater is bad and that they are encouraged to invest in good practices to make the water for drinking safe, rather than discouraging them from drinking the water.
- It costs approximately EC$ 0.15 per gallon for investment on ultra-violet light treatment for microbes.

Hastin Barnes, Antigua Public Utilities Authority

The key elements of the presentation included:

- An overview of rainwater harvesting
- The challenges of maintaining a clean and hygienic supply
- The potential points for contamination of stored water
- The first-flush diverter mechanism
- The CEHI-UNEP demonstration project and how the mechanism works

See Annex 3.3 for the full presentation.

Discussion and comments

- The first-flush diverter is good mechanism but use of the 6" piping and coupling may be a challenge in terms of replication. It will be better to use 4" pipes and fittings that are more readily available. Use of "Y" piece fitting may replace the coupling used in the current design.
- The influx of the Cuban Frog (a recent invasive specie to Antigua) is considered a risk to RWH systems as it is believed the animal produces toxins that can get into the water. They are particularly attracted to unprotected cisterns.
- The issue of pollution in urban environments is one that cannot be discounted. The demonstration model in Tindall Road in Ottos (in the southern suburbs of St. John's) showed that the filter in the first-flush diverter quickly became fouled with black soot residues.

Field Visit – Demo model at Glanvilles

Following a refreshment break, the group visited the demonstration site at Glanvilles operated by Granma Aki an agro-processing company (owned by Novella Payne) specializing in fruit and juice products. The group witnessed first-hand how the upflow first-flush diverter works through a demonstration by the designers, Hastin Barnes and McClure Simon (APUA engineers).

- It was revealed that the materials cost for the installation was EC$2,700 (equivalent to US$1,000). The cost will be significantly less using 4" pipe and fittings.
- While replication should consider use of smaller pipe, the first-flush diverter will need to be longer, but this must be balanced against that height of the roof catchment that will need to create the head to drive the water through the upflow filter.
- The water quality at this demonstration site is cleaner than other locations based on comparative observations of the condition of the filter. This is due to the fact that the site is in a rural location.
- Ms. Payne stated her satisfaction with the RWH system and thought that that water actually tastes better than what she had before.

H. Barnes explaining how the system operates

Left to right: Hastin Barnes (APUA), Novella Payne (Granma Aki, demo project beneficiary), Ivan Rodrigues (APUA), McClure Simon (APUA), Dr. Christopher Cox (CEHI)

Day 2 – Barbuda Proceedings

Opening remarks

The meeting was chaired by McClure Simon of APUA. He welcomed the participants to the workshop and highlighted the fact that while Barbudans were very familiar with the practice of rainwater harvesting, there needs to be attention paid to improvements in the quality of water. He noted that persons will often not clean their cisterns, allowing the accumulation of sludge and harmful microbes. The stated that the project was designed to assist in improvement of the water safety aspects of rainwater harvesting. Dr. Christopher Cox thanked the audience for their attendance at this meeting and provided an overview of the project. He reinforced the purpose of the technical assistance being provided by UNEP in improvement of best-practices for RWH and invited the audience to share their experiences that would be valuable in the effort to compile these best practices in a Caribbean Handbook on RWH. He noted the potential influences of climate change on rainfall patterns combined with rising sea levels may spell real threats to Barbuda's water supply security and that all efforts must be made to carefully manage all water supply options. He concluded by thanking the collaborative efforts with the local secondary school and other local stakeholders for assistance.

Presentations

Dr. Christopher Cox, Caribbean Environmental Health Institute

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- Phase 2 collaboration with UNEP; objectives and key outputs
- Demonstration models

See Annex 3.1 for the full presentation

Discussion and comments

- The issue of safety of the plastic 'black tank' was raised with respect to the possibility of potentially harmful substances becoming dissolved in the stored water, particularly where the tank becomes heated by the sun. It was noted that the black tanks are designed for both storage of drinking and non-drinking water (wastewater). Care must be taken to ensure that the correct type of tank is used for drinking water storage. The potential for harm should be weighed in the context of the risk of contaminant leaching, which is likely very low. Further, if the water is not stored for too long before use (short contact time) the potential for contamination will be reduced.

- Airborne pollution associated with industrialization and acid rain was raised as an issue. The possibility of acid rain affecting RWH systems in the Caribbean (and Barbuda) is very low as this is only a significant factor on heavily industrialized areas in more developed countries. However the prevailing Atlantic Trade Winds tend to pick up Saharan dust and deposit it across the Caribbean. There has been some cause for concern over pollutants carried in the dust but this problem has not been researched to warrant alarm at this stage.

- There should be increased awareness over the issue of water safety in rainwater harvesting in Barbuda as residents do not take the necessary measures due to the fact that there simply is not readily available knowledge. There needs to be more visibility by the responsible authorities is raising awareness.

- Groundwater reserves in Barbuda may be under threat due to climate change. It is well known that the wells used for local water supply are impacted by tidal movements; the water becomes more brackish as the tides are high. With rising sea levels the frequency of saline intrusion of the well will increase, negatively impacting water availability.

- The question of the best water storage option was raised. There is no recommended best storage solution. Cisterns will work just as well as plastic tanks. It is a question of how well the system is maintained.

Hastin Barnes, Antigua Public Utilities Authority

The key elements of the presentation included:

- An overview of rainwater harvesting
- The challenges of maintaining a clean and hygienic supply
- The potential points for contamination of stored water
- The first-flush diverter mechanism
- The CEHI-UNEP demonstration project and how the mechanism works

See Annex 3.2 for the full presentation.

Discussion and comments

- With a smaller house is a smaller first-flush needed? There is not entirely a direct translation although this generally is the rule. Other factors includes the length of the rainless period, as it will mean how caked-up the residues are (how easily they will be washed off the roof), and the physical location of the building; in a rural setting the amount of residues will likely be less compared to urban settings where soot from vehicle exhaust is a significant contributor to fouling of the roof catchment.

- The availability of the components used in the demonstration models was raised. The demo models were built using 6" pipes and fittings. The coupling that held the filter was a piece that was available to the APUA as the component is typically used in pipeline infrastructure. However, the coupling is not readily available in hardware stores. The demo project demonstrated the configuration of the upflow first-flush diverter; a system using 4" piping and fittings is being recommended for translation to household use in particular. The larger 6" pipe system will be appropriate for larger applications.

- A sample of the first-flush from the school demo was showed to the participants. Except for a few small particles the water appeared to be relatively clean. The school is located within a green belt and further, there are too few vehicles to cause problems related to soot build-up on the roof.

- The cost of the enhanced RWH system (first-flush diverter) was raised. For the household system the materials and labour cost for the installation will be a few hundred dollars (East Caribbean currency – US$1.00 is equivalent to EC$2.70).

- Assuming that the first flush diverter minimizes sediment entry, how safe is the stored water? Although the water will be cleaner, there will likely still be microbes present as it is virtually impossible to bring to zero level. The best course of action is to add regular household bleach to the water to kill off microbes. The less foreign material in the water, the easier it is to treat.

- What is the recommended volume of chlorine that should be added? The amount will depend on the amount of water that is in the tank. It follows that the cleaner the water, the less chlorine that will be needed. Cleaning the roof and guttering should be done on a period basis.

- How effective are special filter systems? These generally work well and can be purchased off the shelf. Use of the first-flush diverter will extend the service life of the filter.

- The capacity for inspection of stored water supplies is a great challenge in Barbuda and possibly a factor in persons not safely harvesting and storing rainwater.

- Although there is a Development Control Authority (DCA) requirement for homes to be built with water storage capacity it is not complied with as it is not enforced. In Barbuda this is not an issue as RWH is universally practiced.

- There is no government subsidization programme to assist persons in obtaining the proper equipment and materials to augment RWH systems to improve water safety. Pumps and tanks in particular are expensive and poorer households do not have the means to invest beyond the basic needs for RWH. A government programmes to assist in this regard should be implemented.

Field Visit – Demo model at Sir McChesney George Secondary School

Following a refreshment break, the group visited the demonstration site, the Sir McChesney George Secondary School. The group witnessed how the upflow first-flush diverter mechanism works through a demonstration by the designers, Hastin Barnes and McClure Simon. The school RWH system was designed to harvest the rainfall of the building roofs and directly recharge a 60,000 gallon storage tank (2-chamberd) on the school compound. Under the project the inlet piping was replaced and the first-flush diverter installed before the inlet. The principal noted that the water seemed to be of higher clarity.

Upflow first-flush diverter (left) and inflow to tanks

Left to right: McClure Simon (APUA), Hastin Barnes (APUA), John Mussington (school principal, demo project), Dr. Christopher Cox (CEHI)

Annex 1. List of Participants

Antigua

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Rev Patrick THOMAS	Barbuda Ministerial Association	460-0496	

Annex 2. Agenda

Agenda

Technical Seminar

On

Best Practices for Improving Water Quality in Rainwater Harvesting Systems

under the project

Promoting Rainwater Harvesting in the Caribbean Region - Phase 2

APUA Training Room, Cassada Gardens

21st October 2009

8:30 – 9:00	Registration	
9:00 – 9:30	Welcome Remarks Participant introductions	• Ivan Rodrigues - Antigua Public Utilities Authority (APUA) • Patricia Aquing – Executive Director, Caribbean Environmental Health Institute (CEHI) • Representative, Central Board of Health
9:30 – 10:00	A Programme to promote RWH in the Caribbean	Caribbean Environmental Health Institute
10:00 – 10:30	Health and sanitation issues associated with RWH	Central Board of Health
10:30 – 11:15	Demonstration of the improved rain water harvesting techniques	Hastin Barnes, Planning Engineer, APUA
11:15 – 11:45	Question and answer session	Facilitated by CEHI
11:45 – 12:00	Refreshments	
12:00 – 1:00	Field trip to demo site Media showcase	APUA

An initiative financed by the
United Nations Environment Programme (UNEP)
Division of Environmental Policy Implementation (DEPI)
P.O. Box 30552, Nairobi, Kenya

Implemented by the
Caribbean Environmental Health Institute (CEHI)
P.O. Box 1111
The Morne, Castries, St. Lucia

In partnership with the
Antigua Public Utilities Authority (APUA)
Cassada Gardens
St. John's, Antigua

Annex 3. Presentations

3.1 Christopher Cox – Caribbean Environmental Health Institute

Programme to promote Rainwater Harvesting in the Caribbean

Pilot Project funded by
The United Nations Environment Programme
Executed by
The Caribbean Environmental Health Institute

Christopher Cox
Programme Director

Antigua and Barbuda
October 2009

Presentation outline

- Background
- Regional RWH Programme
- Antigua and Barbuda National RWH Programme

Caribbean Environmental Health Institute
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RWH in the Caribbean

- The Caribbean region has less available water per capita compared to other SIDS regions
  - Caribbean SIDS have only 13.3 % of the Indian Ocean island group's existing resources and 1.7 % of the South Pacific island group's existing resources (UNEP 1999)
- Main source of water for three centuries
- An estimated 500,000 people across the region depend on RWH to varying degrees
- Virgin islands, Turks and Caicos, and the Grenadines are heavily reliant on RWH systems
  - Islands characterized by small land area, no perennial streams and little significant ground water reserve

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Why invest in RWH?

- RHW increasingly attractive as water availability declines due to competing uses
- Conservation of water from existing surface sources is of top priority – reduce sole reliance on these sources
- Stakeholders to benefit include:
  - Households – ease stress due to short-fall (increasing population, lifestyle changes) during dry months
  - Industry – enable maintenance of production capacity
  - Agriculture – enable irrigation of arable lands in arid areas (extend growing season); livestock watering
  - Hospitality sector – enable hotel plant expansion without need for costly alternative technologies (e.g. desalination)
    - Potential for use in pools, washing, sanitation and irrigation
  - Institutions (schools, hospitals) - ease stress due to short-fall
    - washing, sanitation

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Why invest in RWH?
Main selling points

- Supply security
  - Reduce reliance on intermittent potable water network
  - Reduce vulnerability after natural disaster
    - Augmented supply after natural disasters (notably hurricanes) when potable water infrastructure is disabled
- Quality
  - The physical and chemical properties of rain water are often better then ground or surface water
- Cost
  - RWH is a simple and low cost method. No additional distribution systems necessary

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CEHI's Previous Collaboration with UNEP

- UNEP has worked with CEHI in 2005 in Grenada to develop a National Rainwater Harvesting Strategy
- A Regional RWH Programme was developed for the Caribbean
- A Draft RWH Handbook was developed

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Regional RWH Programme
National-level actions

- Component 1: Awareness Raising
  - **Objectives:**
  - To enhance positive public awareness on the practice of RWH
  - To increase investment in RWH
  - To promote RWH as a viable augmentation measure for conventional potable networks in water-stressed areas, and promote water conservation
  - To foster best practices with respect to health and sanitation
- Component 2: Capacity Building
  - **Objectives:**
  - To develop and improve national competency in developing (design and construction) and operating RWH systems
  - To train communities in operation and management of community RWH systems
  - To train professionals in water governance

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Regional RWH Programme
National-level actions

- Component 3: Legislative and Policy Formulation
  - **Objectives**
  - To promote integration of RWH within national IWRM plans through policy and legislative reform
  - To create an enabling environment to foster investment in RWH
- Component 4: Infrastructural Development
  - **Objectives**
  - To optimize RWH systems to increase the quantity and improve quality of water
  - To enhance capacity to manage and maintain communal RWH systems

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Regional RWH Programme
Regional-level actions

- Lead regional agency – to be determined
- Partnerships - strengthen advocacy efforts, resource mobilization
- Website - dissemination of best practices in RWH
- Toolbit and handbooks - educational resources
- Integration with other regional programmes (e.g. FAO School Feeding and School Gardening programmes)
- Public awareness promotion;
- Monitoring of national RWH initiatives;
- Training and certification of resource persons (e.g. via CBWMP)
- Building capacity within agencies and develop skills bank
- Develop model RWH applications

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Public awareness

- Posters
- Technical brochure
- Feature video

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Water Availability Mapping

- Objective: map areas on mainland Grenada subjected to moisture deficit
- Based on simplified water balance
  - Determine the depth of runoff from water catchment areas (areas upstream of NAWASA intakes)
- Three analytical steps
  1. Determine spatial variability in monthly rainfall
  2. Determine spatial variability in evapotranspiration (ET)
  3. Determine spatial variability in water deficit
- Catchments with low yield/runoff (during dry months) – downstream communities expected to experience shortfalls – PROMOTE RWH!

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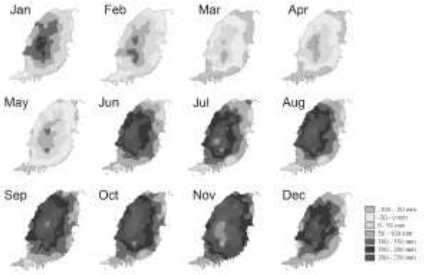
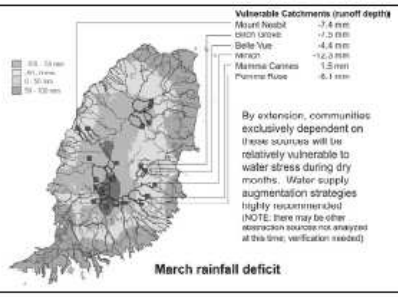
Water Availability Mapping



Water Availability Mapping



Objectives of the Antigua & Barbuda Project

- To raise awareness at the public and policy makers level
- Capacity building at both individual and institutional levels
- Development of infrastructure
- Development of maps to reflect the impact of climate change on water resources under various climate change scenarios

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ANU RWH Pilot

- Antigua and Barbuda selected:
  - Opportunity to share experiences already in place in Antigua and Barbuda for the benefit of other Caribbean countries
  - Opportunity to raise the awareness of best practices already in place in ANU for other proponents

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Rainwater Harvesting Initiative 2008 - 2009

- National Symposium
- Training Seminars (2) for RWH practitioners
- Selection of two (2) demonstration models – low income household and small business
  - These models would be provided with assistance in order to improve their RWH systems. The process (technical specifications and costs) would be documented
- Showcase seminar
- RWH Handbook
- Water Availability Mapping

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Partners

- Antigua Public Utilities Authority
- Central Board of Health
- Ministry of Communications and Works
- UNEP
- Environmental Division

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National Symposium (Jan 2008)

- Open to a broad cross section of the public and private sector
- Kickstarted the IWRM process in Antigua and Barbuda
- Designed to raise awareness of the importance of investment in RWH particularly in the context of increased water scarcity associated with the impacts of climate change

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Capacity Building

- Two technical seminars will be conducted for practitioners
- Training on configuration, installation/retro fitting appropriate RWH systems on building structures, paved and ground surfaces

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Demonstration Models

Low Income Household

- Must have a RWH system in place
- Project will provide funds for the improvement of the infrastructure

Small Business

- Preferably agro processing
- Must use RWH in the production process
- Project will provide funds for the improvement of the infrastructure

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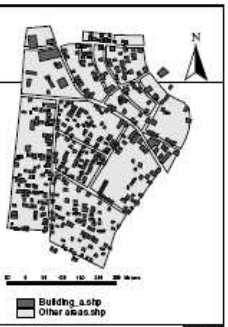
Mapping

- Develop GIS maps indicating climate change impact on water resources for different climate change scenarios
- Involve modelling projected changes in rainfall inputs and temperature regimes
- Used to estimate changes in the overall budget for the island



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Caribbean RWH Handbook

- A RWH technical handbook will be produced (will reflect the work done in Antigua and Barbuda)
- These handbooks will be distributed to other countries in the Region

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Thank You!

http://cehi.org.lc/rainwaterharvest.htm

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3.2 Hastin Barnes – Antigua Public Utilities Authority

Towards Best Practices in for improving Water Quality in Rainwater Harvesting Systems

Antigua and Barbuda Model

Hastin Barnes

APUA

Background

Several reasons for the long tradition of RWH in Antigua and Barbuda

- No Public water supply
- Augment public water supply
- Taste and aesthetics
- Others?

Traditional usage of rain water

- Mainly potable purposes- cooking, drinking etc.
- Watering plants
- Washing- Has superior lathering quality over pipe borne water because of the low total dissolved solids (very soft)
- Others?

Types of catchments

- Buckets
- Oil drums
- Galvanize tanks
- Plastic tanks
- Concrete underground cistern
- Others?

Challenges

- Unwanted particles out of water
- Unwanted Microorganisms – Public Health Department always found high levels of coli forms in water catchments.
- Insects and vermin – mosquitoes, roaches and now the Cuban frog
- Bird and lizard droppings
- Others

Methods of preventing extraneous matter

Several methods have been used to minimize extraneous matter entering into catchments These include

- Gauze in roof gutter at the junction with the upper section of the down spout
- Gauze at the inlet of the catchment
- Cloth on drums and tanks
- First flush system
- Settling in storage system

Issues with screening

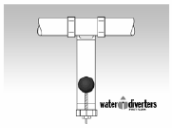
- Gauze that is located in the roof gutter are hard to reach
- A significant amount of contaminants still reaches the storage container since they are smaller than the pore sizes in the gauze
- Cloth on large tanks require significant effort to remove and replace
- Cloth does a better job in removing smaller particles. However, significant amount of micro-particles and bacteria still get into storage system.
- Dissolved solids and other chemicals cannot be removed by physical screening.

First flush concept

The first flush of water from the roof can contain amounts of bacteria from decomposed insects, bird and animal droppings, sediments, possible water borne heavy metals and other chemical residues and other undesirable elements to have in a water storage system.

A first flush system is designed to allow the first portion of water derived from a storm to be blocked from or diverted away from the storage system

Example of first flush system



- Designed to be fully automated without mechanical parts
- However, it has its draw backs

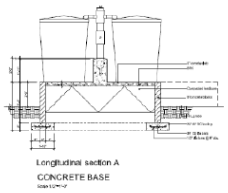
Settling in Storage System

- Particles do settle out to
- The draw off point is usually placed above the zone of settling
- However, as the particle builds up in the storage vessel, the get closer and closer to the draw off point.
- The thicker the settling zone the greater the potential for the particles to get into the water that is drawn off for use
- Remember these particles will include bacteria that are harmful to human health
- Water containing particles is more difficult to treat

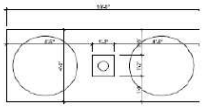
Objective of new design

- Combination of first flush with filtering system as it seeks to prevent extraneous matter from entering the storage system
- It provides screening from insects and also prevent mosquito breeding
- It is not totally Automatic as the first flush system. However, it provides less involved methods of cleaning than traditional screening

New design



Plan view



Plan above base

Design Consideration

- Quantity of water need to store
- Particle sizes to be screened
- Height of roof in relation elevation of storage system
- Cost
- Availability of material

Summary

- The first flush/filter system is aimed at improving the water quality collected from roof gutters.
- It is important that householders/owners understand that it is not a totally automated system and that a level of involvement is necessary for the smooth operation of the system to meet the objectives.
- The design seeks to maximize the amount of water captured from rainfall events while removing a significant portion of extraneous matter.

Operations continued

- Open the drain valve after each rainfall event to flush the system. This prepares the system for the next event and allows for the inspection of the quality of water in the lower section of the system.
- Inspect the filter after each major rainfall and back flush or replace filter if necessary
- When opening the drain valve, remove the upper cap to allow air in and make it easier to get the valve opened.