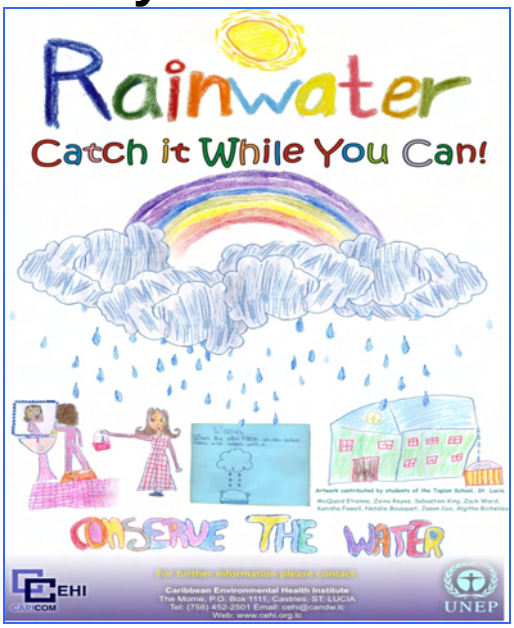
Promoting Rainwater Harvesting in Caribbean Small Island Developing States

Grenada National Workshop Proceedings
February 8th to 10th 2006



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Under the aegis of the
Ministry of Health, Social Security, Environment and Ecclesiastical Affairs, Government of Grenada

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DAY 1 Sensitization and Project Planning Workshop
Venue: John's Unique Resort, Hillsborough, Carriacou

Opening Session

The workshop commenced at approximately 9:30 am.

Dr. Christopher Cox, Senior Programme Officer at CEHI opened the meeting on behalf of the Executive Director of CEHI, Mr. Vincent Sweeney who was on overseas mission and could not be present at the proceedings. He gave an overview of the Project and the expected outcomes, the rational for selection of Grenada and its dependencies as the pilot country for this initiative, and highlighted the Institute's mandate in the area of water and environmental health. He noted in particular the Institute's initiatives in water, notably the GEF-funded Integrating Watershed and Coastal Areas Management (IWCAM) Project which will be complementary to the present initiative.

Dr. Cox noted that the Carriacou workshop was intended to realize two key outcomes: (1) sensitization of participants to sanitation issues associated with traditional methods of rainwater harvesting (RWH) and (2) articulation of a project concept that will be eventually developed into a project to lend assistance to refurbishment of community RWH systems and capacity building in operation and maintenance.

The Permanent Secretary in the Ministry of Carriacou and Petit Martinique Affairs, Ms. Bernadette Lendor-Sylvester gave opening remarks, thanking CEHI for their role in championing this initiative along with the United Nations Environment Programme (UNEP). She noted the firm and longstanding affiliation of the residents of Carriacou and Petit Martinique with the practice of rainwater harvesting, given the extreme water-scarce nature of these islands. She recounted the experiences of the communities with water problems and hoped that this Project would see tangible benefits for the communities of Carriacou and Petit Martinique. She underscored her Ministry's commitment to the Project.

Mr. Lyndon Robertson, Senior Programme Officer at CEHI gave a detailed background of the Project and its key deliverables, and reported on the results of an assessment survey that was conducted on mainland Grenada, Carriacou and Petit Martinique in November 2005. The assessment was geared towards a situation analysis of RWH in the State of Grenada and determined the critical needs and strategy for promoting RWH as a viable means of supply augmentation and the way forward. The presentation is included as Annex 3A.

Technical Session

Design and Construction of RWH Systems in the Caribbean.
Presenter: Alphonsus Daniel, Technical Consultant

This presentation focused on the following areas:

- Why invest in RWH
- Design aspects
- System components; catchments, first-flush system, conveyance system, storage system
- Storage options and construction methods
- Operation and maintenance
- Cost aspects

The presentation is included as Annex 3B

The following points emerged out of that presentation:

- That special apparatus may be installed to deal with first-flush. However, this may also be dealt with by disconnecting the down-pipe from the storage tank so that initial contaminants can be channeled away. Once the catchment surface is sufficiently clean, then the down-pipe may be re-connected to the tank.
- Some concerns were voiced over the use of thatched roofing as was the case with some resorts that aim to maintain traditional architecture. This type of surface has the potential to easily harbour organic matter which leads to contamination. Special measures to ensure minimal contamination should therefore be employed. These usually include the use of filters.
- Clarification was given that that PVC pipe does in fact degrade in ultra-violet (UV) light.
- It was stated that it is traditional in Carriacou to discard the "first-bucket" catch to exclude contaminants such as leaves and other floaters.
- The dangers of improperly mounted tanks (plastic in particular) were discussed. Very large plastic tanks can topple over when full, and easily rupture if not built on a stable platform. Use of 1,000 gallon tanks for household purpose is therefore not recommended.
- It was noted that some builders do not make accommodation for operation and maintenance in the cases of cisterns built as part of the house structure (citing of inflow and outflows and service entry points to allow for maintenance).
- Sanitation of the RWH system must always be of high priority with regular cleaning. Frequency of cleaning varies according to how the system is designed. If there are no filters (no first-flush), cleaning will be more frequent.
- With the increasing prominence of bird-flu, attention needs to be paid to the possibility of contamination by birds and the need to practise the requisite sanitary measures.
- On Carriacou and Petit Martinique, chlorination of cistern water is not culturally accepted. Participants recognized that efforts must be made to instill the practice among the population for the sake of public health.
- Concerns were raised about paints used on roofing as potential sources of contamination.

- Concerns were raised over whether the commonly available black polyvinyl chloride (PVC) tank is the proper type to use. These tanks were initially manufactured for sewerage and wastewater containment. The concerns are related to introduction of potential contaminants from the PVC which are known to be carcinogenic over time.
- Safety concerns over the use of asbestos pipe were raised. It was however noted that it is not a major issue where used in water delivery infrastructure. The main concern lies in inhalation of air-borne asbestos, a possibility workers are exposed to when cutting asbestos pipes for fitting.
- Cost of installation of RWH systems have increased since Hurricane Ivan (September 2004) as construction rates have increased significantly. Added to this, there is a difficulty in obtaining construction materials, caused by the re-construction efforts in the US following Hurricane Katrina (September 2005).

Sanitation Issues in RWH.
Presenter: Alan Edwards, Senior Environmental Health Officer (SEHO, Ministry of Health of Grenada

This presentation focused on the following areas:

- Definition of rainwater harvesting
- Historical perspective in the Grenadian context
- Status of rainwater harvesting in Grenada
- Public health implications
- Vector control issues

The presentation is included as Annex 3C

Some of the discussions emerging out of the presentation were:

- Participants expressed alarm over the high mosquito population on Carriacou. The SEHO explained that mosquito prevalence is linked directly to the rainfall pattern, explaining that during August and September, the mosquito population typically peaks and drops off over subsequent months. It was further explained that recent heightened occurrence was due to the significant rainfall accumulations delivered by Hurricane Emily (July 2005).
- Participants were advised that improper use of collection vessels serve to encourage mosquito breeding. This is primarily due to inadequate or lack of proper screening to exclude mosquitoes.
- The meeting was informed of the use of fish in the collection vessels to eliminate mosquito larvae. This practice can be categorized as a biological control measure. The alternative option is chemical, which typically requires the use of chlorine.
- A question was raised as to whether open holes dug by land crabs contribute to the mosquito problem as these holes tend to accumulate water during the rainy season. No clear correlation can be discerned.
- Besides mosquitoes, rodents were cited as the other main vector that impact on human health in Carriacou. The SEHO noted that these vectors proliferate once sanitation and RWH systems are not properly maintained. The rat population on Carriacou has been

observed to have increased. This appears to be linked to the passage of Hurricane Ivan in 2004 with the consequent disruption in waste collection systems.

- The meeting agreed that health promotion and public awareness is of high importance in promoting RWH.

Project Planning Session

This session sought to develop a related project concept for the rehabilitation of key rainwater harvesting systems that serve communities in Carriacou and Petit Martinique, using the Logical Framework Analysis (LFA) approach. The rehabilitation of RWH systems was a critical need identified during the assessment stage of the project carried out in November 2005. The project, when fully articulated, will also focus on raising public awareness and operation and maintenance of catchment systems.

It was stressed by CEHI that a local champion should be identified to assist in the project articulation and development. Although this "champion" was not identified at the time, the Permanent Secretary (Ministry of Carriacou and Petit Martinique Affairs) suggested that the community of Bogles in Carriacou could serve this role. CEHI affirmed its commitment to continue to lend technical support to develop the project in conjunction with local stakeholders.

Based on the LFA approach, the meeting was requested to articulate the Overall Objective, Specific Objectives, Expected results and Activities in the context of the project concept. (A basic concept of project design using the LFA approach was delivered by CEHI to the meeting and ios included in Annex 3E).

Participants expressed their desire that the project include rehabilitation of the community catchment that serves Bogles/Cherry Hill/L'Esterre communities on Carriacou, and the catchment that serves Petit Martinique. Public education and operation and maintenance training (for the catchment systems) were also identified as key complementary elements.

The following are the key logframe inputs contributed by the meeting. This logframe and overall project document will be further elaborated based on this material.

Overall objective	***What are the overall broader objective to which the action will contribute?***	***What are the key indicators related to the overall objective?***
	Improved standard of living in the targeted communities	
Specific objectives	***What specific objective is the action intended to achieve to contribute to the overall objective?***	***Which indicators clearly show that the objective of the action has been achieved?***
	To develop water policy (Institutional Code of Practice) for RWH and communal systems	*Policy Document endorsed by Government through NAWASA*
	To build a comprehensive education and awareness-raising exercise	*Survey results - percent of surveyed respondents who use proper disinfection*

		practice at or exceeds (80 %)
	To strengthen rainwater harvesting capacity in the selected communities of Bogles/Cherry Hill and L'Esterre and PM	*Increase to 60 % the freshwater available to entire communities specified* *Communal systems repaired and functional – 100% system reliability*
	To increase health and sanitation among households	*Reduce FC and FS counts to acceptable Ministry of Health levels* *Results of Epidemiological Data on occurrence of water borne disease (before and after analysis)*
Expected results	***The results are the outputs envisaged to achieve the specific objective. What are the expected results?***	***What are the indicators to measure whether and to what extent the action achieves the expected results?***
	Appropriate policy statement developed and incorporated into national water sector policies and plans	
	Awareness heightened on best practices *Changes in practices effected*	*Community survey results*
	Catchments and storage in Cherry Hill/ Bogles, L'Esterre and Petit Martinique refurbished	*Catchment refurbished. Assessment of works – condition assessment by relevant authority*
	Incidence of water-borne disease associated reduced	
Activities	***What are the key activities to be carried out and in what sequence in order to produce the expected results?(group the activities by result)***	
	Result #___; Activity #____	
	Result #___; Activity #____	
	Result #___; Activity #____	
	Result #___; Activity #____	
	Result #___; Activity #____	
	Result #___; Activity #____	

Given the time constraint, it was not possible to complete all the required inputs for the logframe. It was agreed that CEHI will complete this in collaboration with the identified "champion" community organization, Ministry of Carriacou and Petit Martinique Affairs and NAWASA.

The workshop was declared closed at approximately 2:45pm.

DAY 2: Sensitization and Policy Planning Workshop

Sensitization component
Venue: Tropicana Inn Conference Room, St. Georges, Grenada

Opening Session

Dr. Cox, opened the proceedings by welcoming participants, acknowledging the presence of the Permanent Secretary of the Ministry of Health, Social Security, Environment and Ecclesiastical Affairs and staff of the MOH (Grenada) who collaborated in mounting this initiative. He went on to apologize for the absence of the Executive Director of CEHI, Mr. Vincent Sweeney who was on travel mission under a prior engagement.

Dr. Cox gave participants an overview of the Institute in terms of its function and role in water management and advocacy, citing the close linkage with the Integrating Watershed and Coastal Areas Management (IWCAM) Project. He gave an overview of the UNEP/CEHI RWH project progress to date, noting that this workshop activities were a follow-up to a national assessment survey that was conducted on mainland Grenada, Carriacou and Petit Martinique during November 2005, the objectives of which are: a) to inform future capacity-building workshops; b) to optimize the effectiveness of the delivery by indicating the areas for emphasis and c) to direct the national programme development and by extension the regional programme for rainwater harvesting.

The Grenada workshop had two key objectives: (1) sensitization of participants to the value of rainwater harvesting as a key water supply augmentation option during time of water stress and (2) development of national policy imperatives that will support the articulation of a national programme to support the practice of RWH. He concluded that the deliverables from the national project will be expanded at the regional level for uptake by responsible agencies for water in the various countries.

The Permanent Secretary in the Ministry of Health, Ms. Gemma Bain-Thomas thanked CEHI for their assistance in convening the workshop and looked forward to continued collaboration. She went on to welcome participants and the media. She also expressed appreciation to CEHI for their services offered during the post-Hurricane Ivan and Emily response effort.

Quoting from Thomas Fuller (1732) "*We never know the worth of water till the well is dry*" she underscored the importance of careful management of water and that rainwear harvesting is an important traditional way of securing water in Grenada, Carriacou and Petit Martinique. She added that this RWH initiative is timely since Grenada is attempting to rebuild post-hurricane disaster, noting the need to incorporate RWH in the effort. In the broader context, she highlighted the need to practise sustainable watershed management; to be mindful of the challenges posed by climate change and the need to adopt sustainable approaches in development. She added that access to clean, potable water and sanitation are fundamental elements for meeting Grenada's obligations to the Millennium Development Goals (MDGs). She concluded by endorsing Grenada's commitment to the Project.

Mr. Lyndon Robertson, Senior Programme Officer of CEHI gave a detailed background of the Project and its key deliverables and gave an account of the Assessment Survey that was conducted in mainland Grenada, Carriacou and Petit Martinique. The presentation is included as Annex 3A.

Technical Session

National water system in the context of development and supply constraints in Grenada and its dependencies.
Presenter: Alan Neptune, Acting Operations Manager National Water and Sewerage Authority

Mr. Neptune apologized for the absence of Mr. Christopher Husbands the Manager of Planning, Design and Construction, in NAWASA.

He affirmed that rainwater harvesting is an important water security measure and that communities should re-look the practice and revert to some of the traditional ways.

The highlights of the presentation included the following:

- Dry season water production typically declines by 40% of potential production capacity. However, during severe dry seasons this may decline further to 50% of production capacity.
- The desalination plants installed on Carriacou and Petit Martinique were in retrospect, not a wise investment given the high operation and maintenance costs of these plants and the fact that total demand from these communities does not exceed 1% of plant capacity.
- The desalination plant in the south of mainland Grenada was built in light of the heavy potential demand from the commercial and hospitality sectors
- NAWASA is now exploring new water sources based on bedrock technology where the intention is to tap into deep reserves where there is a guaranteed supply that is less susceptible to seasonal variation as compared to surface sources.
- NAWASA is currently engaged in two major initiatives to enhance national supply capacity: an EU-funded southern water supply project (tentative) and the Vendome water supply project funded by the French government. These initiatives are being crafted with a view to maximize all potential water resources
- The Authority will lend full support to rainwater harvesting particularly in context of water security for residents of Carriacou and Petit Martinique. It is noted that the lifestyles of residents of Carriacou and Petit Martinique have become more like those on the mainland and this is a factor that needs to be considered in RWH programme development.
- Major areas of emphasis continue to be on reduction of non-accounted-for water and adoption of water conservation measures by the public.
- The institution of universal metering is meeting with some success in conservation effort but this may likely be transitionary as use patterns are readjusted over time to original patterns

- NAWASA needs to meet challenges associated with trade related issues with respect to water in the context of the CSME and WTO. One issue pertains to the commercial export of fish products where water utilized for icing (during transport) has to meet strict technical specifications.
- Other key challenges include keeping pace with domestic commercial and industrial developments and requirements and addressing institutional weaknesses through capacity building. Replacement of aging infrastructure is of priority.

The key issues arising out of the presentation were as follows:

- Concern was expressed by some participants about NAWASA's expressed plans to exploit groundwater reserves, with the sentiment that deep groundwater reserves should be explored as a last resort and that more readily available options of water abstraction presently exist. The issue of saline intrusion and land subsidence (Guyana cited) associated with excessive exploitation of boreholes was raised. NAWASA responded that this will be a possibility but unlikely if extraction is carefully monitored and systems properly implemented and maintained. The prospect of increasing storage capacity (as an alternative to deep wells) to buffer short-falls in abstraction during deficit situations was also raised. NAWASA indicated that investment in groundwater will meet this to some degree but stressed that surface waters will continue to be exploited. The meeting expressed concern associated with pumping of groundwater. NAWASA was also queried on whether they will be able to sell groundwater at the real cost of production in an environment where most of society is not prepared to pay the relatively high cost. The non-utilization of the desalination plant in southern Grenada was cited as an example of unwillingness to pay for high-cost water.
- It was noted that since the advent of universal metering, persons in some communities have resorted to returning to river washing (of clothes), a practice that is illegal.
- The uncontrolled runoff from urban areas was raised in the context that this un-used water can be harvested. Storm runoff over urban areas where the infiltrative capacity of the land has been reduced, has been steadily leading to severe erosion in certain locations. Singapore was hailed as an example where virtually all surface runoff is abstracted for use. It was noted that in some countries the recycling of sewerage for potable purposes is increasing with the introduction of highly effective technologies.
- In light of the level of debate on management of the water sector it was lamented that there are no formal avenues to engender formal technical debate amongst professionals and civil society. This would be useful in garnering opinion that would guide decision-making in the water sector and make the decision-making process more transparent.

Design and Construction of RWH Systems in the Caribbean.
Presenter: Alphonsus Daniel, Technical Consultant

This was the same presentation as was delivered in Carriacou and is included as Annex 3B.
The key issues arising out of the presentation were as follows:

- Cost of installing RWH systems was noted as a constraint.

- The question of safety concerns in use of the common black PVC plastic tanks was raised. A Study by the University of the West Indies (UWI) revealed that there may be some risk of leaching of potentially carcinogenic contaminants notably phthalates from the plastic into stored drinking water. A CEHI study in 1999 suggested however that these compounds are ubiquitous in all plastics used in everyday purpose and that the actual health risk posed by drinking water from these tanks need to be considered in this context.
- The issue of the deleterious effect of ultra-violet light on PVC guttering was raised in the context of maintenance of RWH systems.
- The issue of ownership of the community catchments in Carriacou was discussed as a constraint in long-term commitment to operation and maintenance. In short, the catchment is treated as a common resource where there does not appear to be a statutory responsibility for upkeep of these catchment and ancillary systems. Case examples cited included growing of vegetation (including large trees) on the concrete catchment (which breaks the surface), openings in the security fencing permitting livestock to enter thereby causing pollution, poorly maintained tank systems. Recuperation of costs for maintenance of catchment systems is non-existent since Carriacou residents on communal systems do not pay for water. This was cited as another contributory factor for the low level of maintenance of community catchments.

Water availability mapping and planning for water allocation schemes
Presenter: Christopher Cox, Senior Programme Officer, CEHI

This presentation focused on the following areas:

- Procedure for mapping water deficit areas in Grenada
- Assumptions associated with the methodology
- Data quality issues in modeling rainfall variability
- Results from rainfall interpolation, evapotranspiration and water availability analysis
- Water sector planning applications

The presentation is included as Annex 3D

The main areas of discussion that emerged include:

- The utility of these maps as a planning tool to facilitate NASAWA in strategic planning
- The water availability analysis and the map presently closely follows the observed water regime in particular locations, notably the dry south and northern extreme of the island and the west-central coast corridor which tends to be wetter than surrounding areas.

Sanitation Issues in RWH.
Presenter: Alan Edwards, Senior Environmental Health Officer, Ministry of Health

This was the same presentation as was delivered in Carriacou and is included as Annex 3C.

The main points of discussion that emerged include:

- The Project needs to take stock of the crude RWH measures and design appropriate measures rather than solely advocating relatively more expensive and sophisticated measures.
- The high incidence of mosquito infestation at particular times of the year is due largely to man-induced factors. In the natural environment, generally no more than 5 % of mosquito larvae survive.

DAY 3: Policy planning component

Overview of existing policy and incentive frameworks related to the water sector in Grenada
Plenary session; facilitated by CEHI

In the first part of the day's proceedings, the participants of the workshop were asked to give a verbal account of the existing legislative, policy and incentive frameworks that guide water consumption in the sector they represent. This constituted mainly a Round Table forum where many of the issues from the presentations were reviewed in the context of policy and legislative limitations.

Analysis of key legislative and policy instruments – identification of institutional structure, relationships and gaps
Plenary session; facilitated by CEHI

In the second part of the proceedings, the participants were engaged in a participatory assessment of the key legislative and policy instruments that guide the utilization and management of water resources and concomitant sanitation issues in the context of developing policy support for rainwater harvesting in Grenada. Table 1 contains the inputs from the participants on legislative instruments governing the water sector.

Table1: Legislative instruments governing the water sector in Grenada

Name of instrument	**NAWASA Act No. 25 of 1990**
Responsible agency for execution/oversight	National Water and Sewerage Authority (NAWASA)
Key stakeholder agencies (list)	• Ministry of Health - Responsible for regulation and enforcement of water quality. • Ministry of Agriculture, (specifically the Forestry Dept) and Public Utilities - Responsible for protection of watersheds and catchment areas • Ministry of Works • All other agencies represented on NAWASA's Board
*Relevant policy/Act section(s) (quote number)**	All areas applicable
*Describe how RWH practice may be supported through incorporation into policy/legal instrument under review; propose modification to existing text or new inclusions if required (focus should be on gaps where policy and legal instruments under review are inadequate)**	• Provisions need to be made for setting appropriate tariffs to offset operating and maintenance costs of communal cisterns. Community catchments on Carriacou and Petit Martinique are not legally vested in NAWASA; this presents a "grey" area for management in the context of the legislation. • The possibility of operation of community cisterns and delivery infrastructure by private concerns may need to be considered under regulations. This may apply also to commercial suppliers of harvested water.
Other related policies and or legal instruments. Describe briefly the relationship to the instrument under review.	Water quality Act 2005 specifically related to Carriacou and Petit Martinique to adhere to EU Standards related to fish export (use of safe water for icing during transport)

Name of instrument	**Public Health Act 1958, 1990 revised law of Grenada Chapt. 263**
Responsible agency for execution/oversight	Ministry of Health (MOH)
Key stakeholder agencies (list)	• Grenada National Solid Waste Management Authority • NAWASA • Ministry of Works
*Relevant policy/Act section(s) (quote number)**	Nuisance Regulations related to vector control
*Describe how may RWH practice be supported through incorporation into policy/legal instrument under review; propose modification to existing text or new inclusions if required (focus should be on gaps where policy and legal instruments under review are inadequate)**	• Act does not give enforcement authority to Vector Control Inspectors; hence they have no power to rapidly effect change in response to emergency situations. This power is held by other officers and can result in bureaucratic delays. Vector control officers are mainly responsible for data collection. • Act and policies should strengthen/mandate collaborative linkages between associate agencies. Collaboration tends to be weak/ad-hoc since there are generally no formal arrangements and MOUs between agencies. • Legislation should be reviewed to mandate the MOH to do spot checks and conduct quality assurance activities.

	This should be established as a tool for decision making.
Other related policies and or legal instruments. Describe briefly the relationship to the instrument under review.	NAWASA Act - NAWASA's Board consists of Members from a number of agencies such as the Ministry of Health, Ministry of Agriculture, Physical Planning Unit.

Name of instrument	**Town and Country Planning Act of 1946/Land Development Control Authority Act of 2003**
Responsible agency for execution/oversight	Physical Planning Unit (PPU) of Ministry of Finance, Land Development Control Authority (LDCA) under the aegis of the Ministry of Finance
Key stakeholder agencies (list)	• Grenada Institute of Professional Engineers (GIPE) • NAWASA • Ministry of Health • Ministry of Agriculture • Grenada Bureau of Standards • Grenada Industrial Development Cooperation (GIDC)
Describe how RWH practice may be supported through incorporation into policy/legal instrument under review; propose modification to existing text or new inclusions if required (focus should be on gaps where policy and legal instruments under review are in	• Enhancement of the legislation to foster obligatory/mandatory investment in RWH in formally designated zones such as "end-of-network" and high water deficit areas. • Enhancement of legislation to foster implementation of special conservation measures for commercial operations. • Development of regulations providing guidance for design and construction codes for cisterns and catchments.
Other related policies and or legal instruments. Describe briefly the relationship to the instrument under review.	

Name of instrument	**Grenada Bureau of Standards Act No. 6 of 1989**
Responsible agency for execution/oversight	Grenada Bureau of Standards
Key stakeholder agencies (list)	• Ministry of Health • NAWASA • Produce Chemist Laboratory - PCL (MOA)
*Relevant policy/Act section(s) (quote number)**	• SRO 71 of 2003 - Specifications for Water packaging • SRO72 of 2003 - Good Hygienic practices
Describe how RWH practice may be supported through incorporation into policy/legal instrument under review; propose modification to existing text or new inclusions if required (focus should be on gaps where policy and legal instruments under review are in	Legislation needs to make provision for sale of rain harvested water (and ice) to yachts. This is being done on Petit Martinique. The regulation currently specifies bottled water only.

Other related policies and or legal instruments. Describe briefly the relationship to the instrument under review.	Public Health Act NAWASA Act

Review of public outreach material, suggestions for design of public awareness programme
Plenary session; facilitated by CEHI

In the final session of the workshop, participants were asked to review and comment on the draft posters and brochures that were developed by the CEHI project team to complement the initiative.

It was noted that a handbook was currently under development and that this product will be available electronically together with some hard copies, although it is intended that the full text will be posted on CEHI's and UNEP's websites along with all relevant material. Photographic images of the posters and brochures are contained in Annex 4.

With respect to the posters, the following were the key comments from participants:

- A child's visual interpretation on rainwater harvesting should be developed. This will assist in gaining appreciation of the practice among young persons at a level that is easier understood.
- Language used can be simplified
- One participant suggested a slogan "*Don't Waste the Rain in Vain*" with a characteristic cartoon image. Another slogan proposed was "*Maintain and It will Remain*"
- Modification of the small graphic illustrating the first-flush system
- The photos showing the roof and guttering on the 'Good Practices' poster needs to be made clearer for easy interpretation.

Workshop Closing

The workshop proceedings were brought to a close by Christopher Cox who thanked all in attendance for their contributions during the two days and looked forward to their continued commitment to the project, and in the general promotion of rainwater harvesting in Grenada and the wider Caribbean.

Participant Workshop Evaluations

Participants were asked to fill out evaluation forms at the end of the workshop sessions. The following is the synopsis of responses received.

A. Grenada and Carriacou

Content & Format

	Excellent	Good	Fair	Poor	Comment
	18 %	82%			

Presenters:

	Excellent	Good	Fair	Poor	
	27%	73%			

Logistics

	Excellent	Good	Fair	Poor	
		64%	36%		

General comments from the workshops

I have benefited from the workshop in the following ways:	• Participants stated they learned new information about RWH systems, in particular the first-flush filter system, maintenance and cleaning procedures.
What did you like about the RWH programme?	• The workshops were generally very informative. • The water availability mapping and the information about water resources were highly welcomed. • The health/sanitation and educational materials were well-received.
What could be improved?	• The workshop should have lasted for a few more days • Participation/representation of key ministries and agencies could have been better.
I wish to make the following comments and recommendations for a RWH programme.	• Greater promotion and awareness-raising programmes (especially related to sanitation issues) should be conducted. • The national RWH program should be implemented and advanced as the most cost-effective means to gain good water. • The development of guidelines for the quality, storage and treatment of rainwater is desired. • A practical/training workshop on focus on best practices in rainwater harvesting should be developed for builders, home-owners.

ANNEXES

ANNEX 1: Workshop Agenda

Caribbean Environmental Health Institute
UNEP/CEHI Project on Promoting Rainwater Harvesting in the Caribbean
Sensitization and Policy Planning Workshop
Tropicana Hotel, Grenada
9 and 10th February, 2006

DAY 1 SENSITIZATION SESSION

Time	Agenda Item	Presenter
8:30 – 9:00	Participant registration	
	Opening Ceremony	
9:00 – 9:15	Opening Remarks	Christopher Cox, CEHI
9:15 – 9:30	Feature Address	Permanent Secretary, Ministry of Health
9:30 – 10:00	Background on project	Lyndon Robertson, CEHI
10:00 – 10:15	**Refreshments**	
	Technical Session I	
10:15 – 10:45	Design and construction of RWH systems in the Caribbean	Alphonsus Daniel, Consultant
10:45 - 11:15	Question and answer session	
11:15 – 11:40	National water system in the context of development and supply constraints in Grenada and its dependencies	Alan Neptune, NAWASA
11:40 – 12:15	Water availability mapping and planning for water allocation schemes	Christopher Cox, CEHI
12:15 – 12:30	Question and answer session	
12:30 – 2:00	LUNCH	
	Technical Session II	
2:00 – 3:30	Sanitation considerations in design of RWH systems	• Alan Edwards, Ministry of Health
3:30 - 4:30	Question and answer session	

DAY 2 POLICY PLANNING SESSION

Time	Agenda Item	Presenter
8:30 – 9:00	Video presentation – RWH in Small Island South Pacific States	
9:00 – 10:30	Overview of existing policy and incentive frameworks related to the water sector in Grenada	• NAWASA • Ministry of Health rep • Ministry of Agriculture rep Forestry Department rep • Ministry of Finance rep • Ministry of Tourism rep
10:30 – 10:45	**Refreshments**	
10:45 – 11:45	Question and answer session	
11:45 – 1:30	**Working group session** – Analysis of key legislative and policy instruments – identification of institutional structure, relationships and gaps (to support design of incentive and policy support measures for RWH)	Facilitated by CEHI
1:30 – 2:30	LUNCH	
2:30 – 4:30	Review of public outreach material, suggestions for design of public awareness programme (posters, brochures, etc)	Facilitated by CEHI
4:30 – 4:45	Closing Remarks and next steps	CEHI

Caribbean Environmental Health Institute

UNEP/CEHI Project on Promoting Rainwater Harvesting in the Caribbean

Sensitization and Project Planning Workshop

John's Unique Resort, Carriacou

8th February, 2006

Time	Agenda Item	Presenter
9:00 – 9:10	Opening Remarks	Christopher Cox, CEHI
9:10 – 9:20	Remarks	Permanent Secretary, Ministry of Carriacou and Petit Martinique Affairs
9:20 – 9:40	Background on project	Lyndon Robertson, CEHI
	Technical Session	
9:40 – 10:30	Design and construction of RWH systems in the Caribbean	Alphonsus Daniel, Consultant
10:30 – 10:45	***Refreshments***	
10:45 – 11:00	Sanitation issues in RWH	Alan Edwards, Ministry of Health
11:00 – 11:15	Review of project design inputs	CEHI
11:15 – 12:30	**Work group session – Project Concept design** Key inputs to be captured: • Overall project goal • Specific objectives • Key results • Key activities •	Facilitated by CEHI
12:30 – 1:30	*LUNCH*	
1:30 – 2:15	Work group session – Project Concept design **(cont'd)**	Facilitated by CEHI
2:15 – 2:45	Finalization of project Logical Framework	Facilitated by CEHI
2:45 - 3:00	Wrap-up and next steps	CEHI
3:00	Closing remarks, way forward	CEHI

ANNEX 2: List of Participants

A. Grenada Sensitization and Policy Planning Workshop (Feb 9-10th, 2006)

Name	Designation	Company/ Organization	Company address	Tel/Fax/Email
Cuthbert Mc Queen	Chief analytical officer	Bureau of Standards Grenada	Queens Park St. Georges Grenada	Tel:440-5886 Fax: (473) 440-5554 Email: gdbs@caribsurf.com
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Christopher Husbands	Manager of Planning, Design and Construction	National Water & Sewerage Authority	Carenage, P.O. Box 392 St. Georges	Tel: 473-440-2155/3468 Fax: 473-440-4107 Email: nawasa@caribsurf.com
Royden A Beharry		Grenada Informer	Market Hill St. Georges Grenada	Tel: (473) 440-5762 Fax: Email: none
Pancy Cross	Manager	Visitor Magazine Grenada Hotel Tourism Asso.	Morne Rouge P.O. Box 440 St. Georges	Tel: (473) 444-1535 Fax: (473) 444-4847 Email: visitormagazine@ghta.org
Francis Balwant	Sr. Environmental health officer	Ministry of health + environment	Botanical Gardens Tanteen St. Georges Grenada	Tel: (473) 440-3485/407-4174 Fax: (473) 440-4127 Email: balwant@caribsurf.com
Allan Edwards	Sr. environmental health officer	Min. of Health	Botanical Gardens Tanteen St. Georges Grenada	Tel: (473) 440-2846 Fax: (473) 440-4127 Email: none given
George Willson	Curriculum officer	Ministry of education	Botanical Gardens Tanteen St. Georges Grenada	Tel: (473) 440-2737 Fax: (473) 440-6601 Email: none given
Wilan Hamilton	Forestry officer 2	Forestry and Nat. parks Dept. Min. of Agriculture Forestry ,Fisheries	Queens park St. Georges Grenada	Tel: (473) 440-2934/406-6739 Fax: Email: wilanhamiton@hotmail.com
Kelvin Dotin	Environmental Liaison officer	UNDP/UNU Attached to Min. of Health	Ministerial complex Botanical Garden Tantten St. Georges	Tel: (473) 403-3988 Fax: Email: ktdotts@yahoo.co.uk

			Grenada	
Crofton Stroud	Sr. Dental surgeon	Min. of health	P.O. Box 295 St. Georges Grenada	Tel: (473) 440-2815 Fax: Email: orthodent@caribsurf.com
Bernadette Lendore-Sylvester	Permanent Secretary	Min. of Carriacou Petite Martinique Affairs	Beausejour Carriacou	Tel: (473) 443-6026 Fax: (473) 443-6040 Email: sylvesterbennadette@hotmail.com
Stephen Alexander	Personal assistant to Min. Carriacou P.Martinique Affairs	Min. Carriacou P. Martinique Affairs	Beausejou Carriacou	Tel: (473) 443-6026 Fax: (473) 443-6040 Email: salexander@caribsurf.com

B. Carriacou Sensitization and Project Planning Workshop (Feb 8th, 2006)

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Shaunell Blair	Public health dept.	Public health department	Public Health Department Administrative Building Hillsborough Carriacou	Tel: (473) 443-7619-8947 Fax: Email:
William Guadelupe	Environmental health officer	Public Health Dept., Ministry of Health,	Public Health Dept. Hillsborough, Carriacou	Tel: (473) 443-6150/8947 Fax: Email:
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Stanal Duncan	Operations Manager	NAWASA	Administrative Building, Carriacou	Tel: (473) 443-6150- Fax: (473) Email
Cuthbert Cyrus	President CBO/NGO	Bayaleau Development Committee	Bayaleau, Carriacou	Tel: (473) 443-7790/8825 Fax: (473) 443-6666 Email:bayaleau@gmail.com
Benson Patrice	Forest officer	Ministry of Agriculture	Beausejour, Carriacou	Tel: (473) 443-7004/403-0545 Fax: Email:bensonpatrice@yahoo.com
Christopher Joseph	Board Member	NAWASA		Tel: (473) 443-8307/407-2928 Fax: (473) 443-8194 Joseph-grenada@yahoo.com

C. Project team

Name	Designation	Company/ Organization	Company address	Tel/Fax/Email
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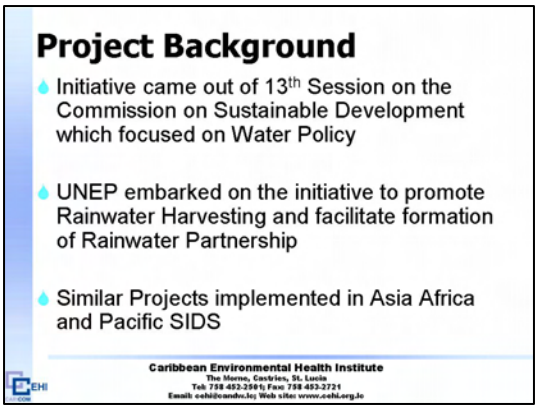
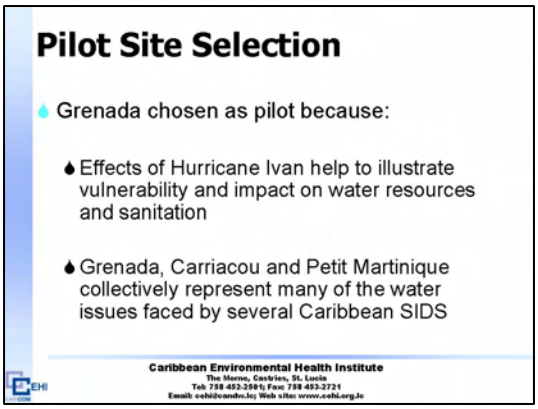
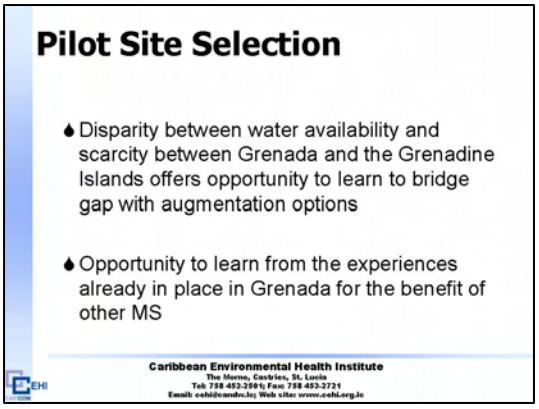
Lyndon Robertson	Senior Programme Officer / Facilitator	Caribbean Environmental Health Institute	P.O. Box 1111 The Morne, Castries St. Lucia	Tel: (758) 452-2501 Fax: (758) 453-2721 Email: lrobertson@cehi.org.lc
Christopher Cox	Senior Programme Officer / Facilitator	same	same	Tel, Fax: same Email: ccox@cehi.org.lc
Djihan Beuter	CEHI Intern	same	same	Tel, Fax: same Email: djihan@gmx.de

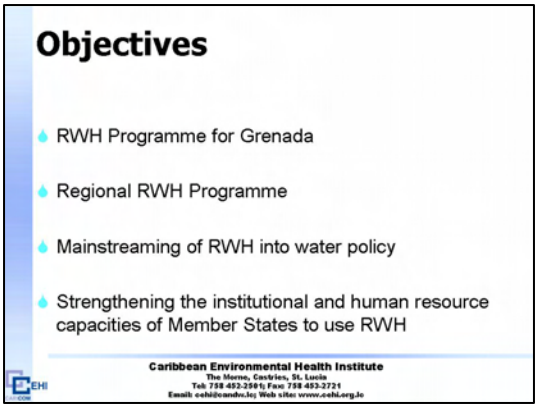
ANNEX 3: Presentations

Annex 3A Background on Rainwater Harvesting Project
Presenter: *Lyndon Robertson, Senior Programme Officer, CEHI*









Activities

- Needs Assessment
- Sensitization Workshops
- Preparation of awareness building materials
- RWH potential mapping

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Activities

- Evaluation of Grenada Pilot Project to modify and replicate for other Member States
- Regional RWH Programme

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RWH Needs Assessment

- Checklist for Data and Information Capture
- Inter-Agency Data Collection
- Community Data Collection (EHD)

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RWH Needs Assessment

NAWASA
LUD
Veterinary Division
EHD
PPU
MOA-C'cou
MCPMA
GIPE
CEC
PM-CC
GCA
GHTA
GRENCODA
ART

Petite Martinique
L' Esterre
Harvey Vale
Windward
L' Esterre Primary School
Hillsborough Secondary
Princess Alice Hospital.

Worburn;
Calivigny;
Woodlands;
Westerhall;
D' Arbeau;
River Road
Rose Hill;
Mount Rose;
Levera;
Guapo.

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Assessment Findings

- Agency Survey
  - 20 % of population on Grenada practices RWH to complement public supply
  - Entire islands of Carriacou and PM harvest rainwater

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- Benefits to be derived from RWH
- Potential to develop RWH among sectors
  - Construction
  - Agriculture and animal husbandry
  - Hospitality

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Assessment Findings

Elements Assessed	Grenada	Carriacou and Petite Martinique
Persons practicing RWH	55 %	100 %
RWH is the primary source of potable water	6 %	100 %
Preference for the consumption of rainwater	66 %	96 %
There is a need to develop RWH	91 %	85 %
Willing to practice RWH	83 %	100 %

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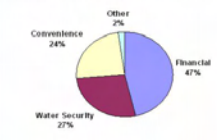
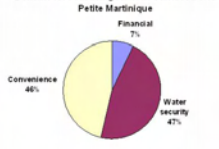
Assessment Findings

- Community Survey





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Assessment Findings

- Community Survey

Incentives for RWH in Grenada

Incentives for RWH in Carriacou and Petite Martinique

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Needs and Way Forward for RWH

- Policy and incentives for RWH in Grenada, Carriacou and PM
- Incentives should be provided for RWH
- Programme for Protection, Monitoring and treatment of RWH systems
- Refurbishment of Communal Cisterns

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Needs and Way Forward for RWH

- Assistance to the less fortunate households in the acquisition of RWH systems
- Build on previous or ongoing initiatives such as:
  - RWH and Food Security
  - RWH and Poverty Alleviation
  - Work of the St. Vincent DePaul
  - Collaborate with NGOs for project proposal

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Thank you

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Annex 3B Design and Construction of RWH Systems in the Caribbean.
Presenter*: Alphonsus Daniel, Technical Consultant*

Promoting Rainwater Harvesting in Caribbean Small Island Developing States

Design and Construction of RWH Systems in the Caribbean

Sensitization and Planning Workshop

Pilot Project funded by
The United Nations Environment Programme
Executed by
The Caribbean Environmental Health Institute
February 2006
Grenada & Carriacou

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Why invest in RWH?
Criteria for assessing need for RWH

- Key criteria that guides investment in RWH
  - No access to main pipe-borne supply
  - Sporadic availability of water through main pipe-borne supply
  - Lack of fresh surface or groundwater reserves in close proximity
  - Annual rainfall should exceed 400 mm
    - This is a standard guide; all the islands in the Caribbean receive in excess of this amount

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PART 2

Configuration and operation of Rainwater Harvesting Systems

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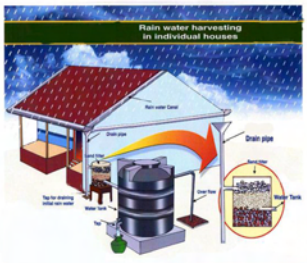
System configuration
General

- RWH systems consist of three components:
  - Catchment area
  - Delivery system
  - Storage facilities



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- Design Aspects
- - Three interrelated Parameters to evaluate
  * storage capacity per consumer (m^3/cons)
  * catchment area per consumer (m^2/cons)
  * Supply level (%) express the percentage of the time that the required consumption is available from the system

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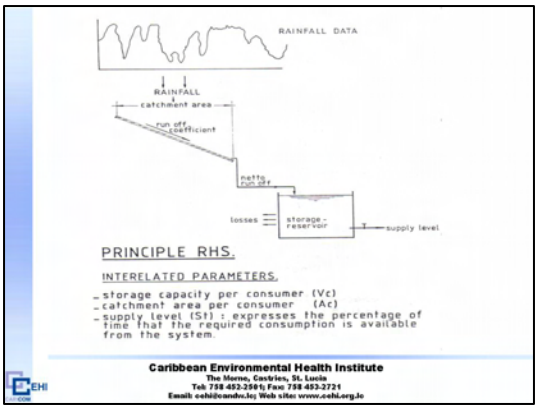
RAINFALL DATA
RAINFALL
catchment area
run off coefficient
netto run off
losses
storage - reservoir
supply level
PRINCIPLE RHS.
INTERELATED PARAMETERS.
- storage capacity per consumer (Vc)
- catchment area per consumer (Ac)
- supply level (St) : expresses the percentage of time that the required consumption is available from the system.
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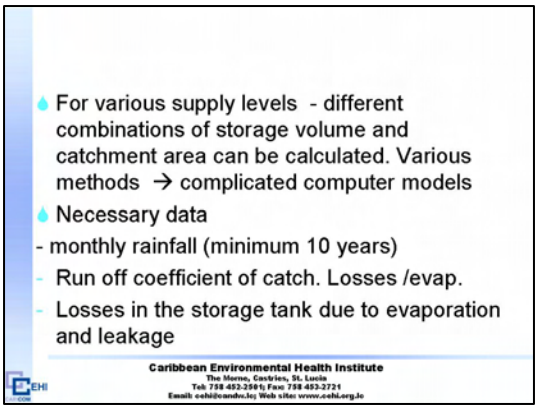
For various supply levels - different combinations of storage volume and catchment area can be calculated. Various methods → complicated computer models
Necessary data
- monthly rainfall (minimum 10 years)
- Run off coefficient of catch. Losses /evap.
- Losses in the storage tank due to evaporation and leakage
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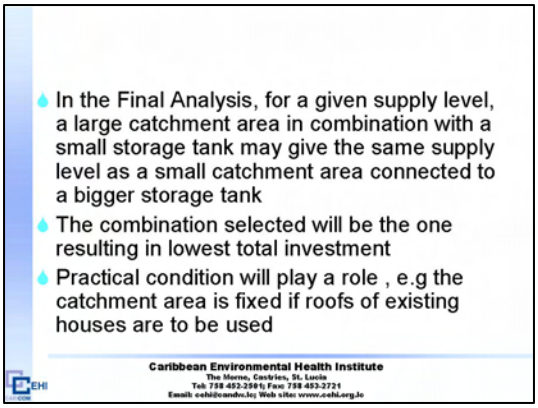
In the Final Analysis, for a given supply level, a large catchment area in combination with a small storage tank may give the same supply level as a small catchment area connected to a bigger storage tank
The combination selected will be the one resulting in lowest total investment
Practical condition will play a role , e.g the catchment area is fixed if roofs of existing houses are to be used
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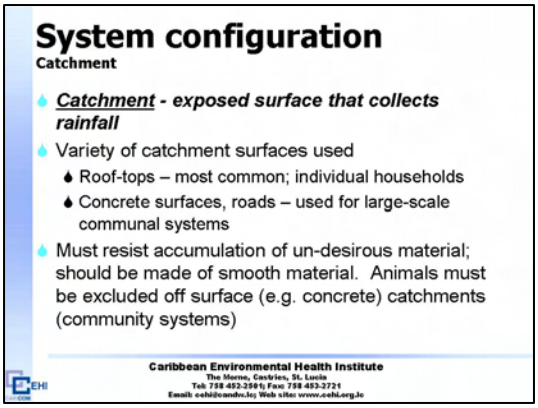
System configuration
Catchment
Catchment - exposed surface that collects rainfall
Variety of catchment surfaces used
Roof-tops – most common; individual households
Concrete surfaces, roads – used for large-scale communal systems
Must resist accumulation of un-desirous material; should be made of smooth material. Animals must be excluded off surface (e.g. concrete) catchments (community systems)
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If it is roof catchment - appropriate material;
Corrugated metal – light , easy to install but expensive
Clay tiles – Cheap and long lasting however heavy hence strong roof support structure is necessary
Thatched material - grass or palm leaves – inexpensive and durable but run off may contain organic matter – smell, taste and odour hence filtering system charcoal, sand, etc may have to be used
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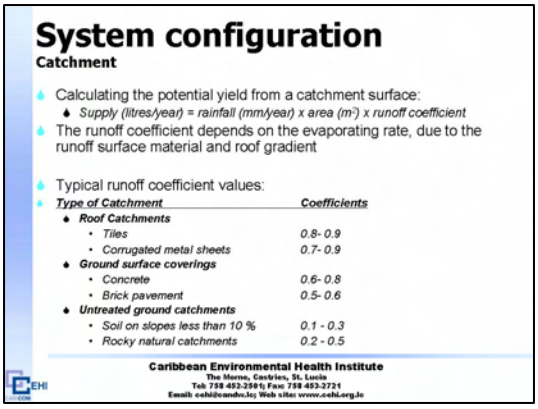
System configuration
Catchment
Calculating the potential yield from a catchment surface:
Supply (litres/year) = rainfall (mm/year) x area (m2) x runoff coefficient
The runoff coefficient depends on the evaporating rate, due to the runoff surface material and roof gradient
Typical runoff coefficient values:
Type of Catchment Coefficients
Roof Catchments
Tiles 0.8- 0.9
Corrugated metal sheets 0.7- 0.9
Ground surface coverings
Concrete 0.6- 0.8
Brick pavement 0.5- 0.6
Untreated ground catchments
Soil on slopes less than 10 % 0.1 - 0.3
Rocky natural catchments 0.2 - 0.5
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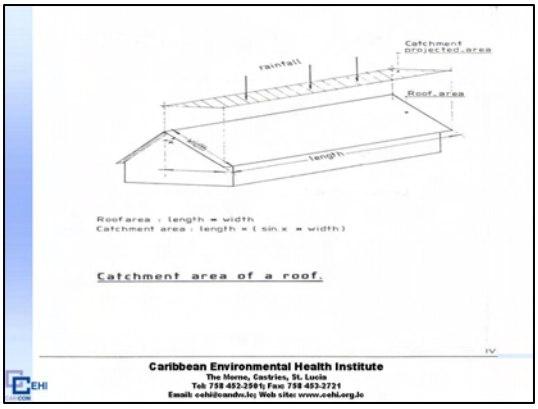
rainfall
Catchment projected area
Roof area
width
length
Roof area : length = width
Catchment area : length = (sin x = width)
Catchment area of a roof.
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System configuration
Delivery system

- ***Delivery system* – the network of guttering, piping and filter systems that transfers water from the catchment to the storage facility**
- Gutters are installed along the roof line to catch runoff
  - PVC is a preferred material – smooth, does not degrade, low cost and easy to install


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Gutter system Requirements

- Light weight, water resistant and easy to join. To keep no of joints at a minimum thus reducing leakages – material with long straight sections
- To main a self- cleansing velocity minimum recommended slope: 1 cm/m (1/8 inch/foot)
- Gutters will be heavy when loaded with water hence they need to be well supported – not sag or pull away

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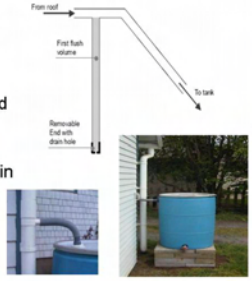
System configuration
Delivery system

- Foreign object exclusion
  - First flush arrangement: Entrapment of the first runoff containing dirt, bird droppings, leaves and other organic matter
  - First flush allowed to drain out of the system
  - Pipe must be cleaned of material occasionally



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First Flush System Requirements

- The First flush system should at least divert and waste the first 10 -20 liters (2.46 – 5 gallons) of rain water
- First Flush Traps – plastic tube with a removable end cap or plug which allows discharge after each shower of rain
- Flexible joint in the pipes conveying water from the gutter to the tank. During the dry season or before the first downpour the down pipe should be disconnected

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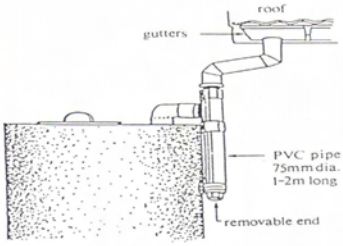

First Flush Trap

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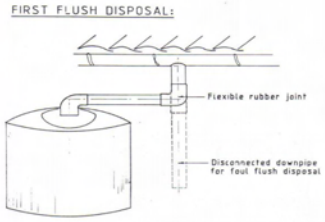

FLEXIBLE JOINTS.

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Other Devices

Sieves in the gutter and down pipes

- Sand Filters
- Baffle tank with sieves
- These system may clog and need frequent maintenance
- **The Preferred is diversion by First Flush**

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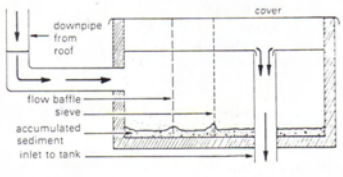

Baffle tank (10 litres) to hold back debris

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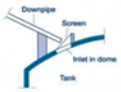
System configuration

Delivery system

- Filters - prevent detritus and other foriegn matter from entering the tank; exclude mosquitoes
  - Coarse filters: exclude larger materials (leaves). Typically 5mm mesh installed approx 23 cm before tank entry
  - Fine filters: exclude mosquitos and fine particles. Insect-proof mesh should be installed at both inlet and outlets of the tank (strong cloth can be used as a substitute)



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System configuration

Storage systems

- ***Storage systems - reservoir***
- Several options:
  - Below ground cisterns – typically built below building structure footprint; require pump. Costly depending on capacity
  - Plastic (PVC) tanks – common, low cost alternative; capacity limited to number of tanks used

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Storage Tank Requirements

- In summary:
- An appropriate design will depend on local conditions
- It must be water tight
- A Max. of 2 m (6.5 feet) is recomm. height To prevent high pressures
- Covered – to keep of sunshine, insect and dirt
- Access man way for Cleaning and repairs
- Screened overflow and entry pipes rodent and flies, etc

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Storage Tank Requir. Cont'd

- A means of removing water, i.e. a tap at the bottom

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Methods of Construction

- Cast concrete ring tanks. Concrete pour within concentric steel forms – volumes up 7 m^3 (1500 Imp. Gallons)
- Ferrocement tank – local skills, cement, sand, water (mortar) and mesh wire, generally cheap
- Sheet metal – used for many years but expensive and even some are galvanized there are prone to corrosion
- Reinforced concrete tanks – large volumes reinforcing steel – durable and reliable once construction is conducted properly

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- Most common these days - plastic/ Polyethylene Tanks

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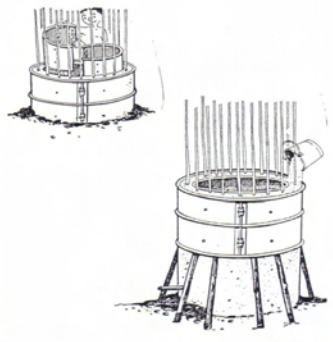
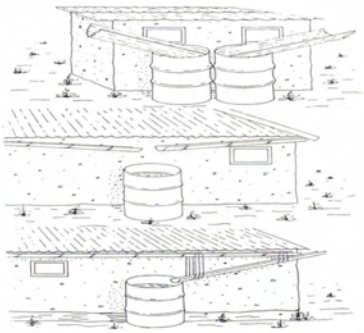


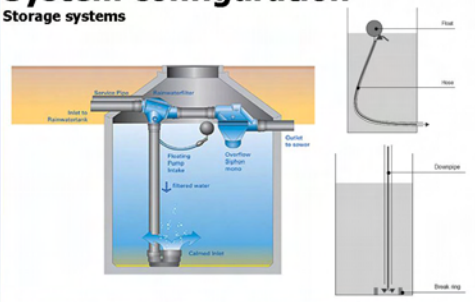
Cast concrete ring tank.



Improvised rainwater collection with 200 l oil-drums used for storage.

System configuration

Storage systems



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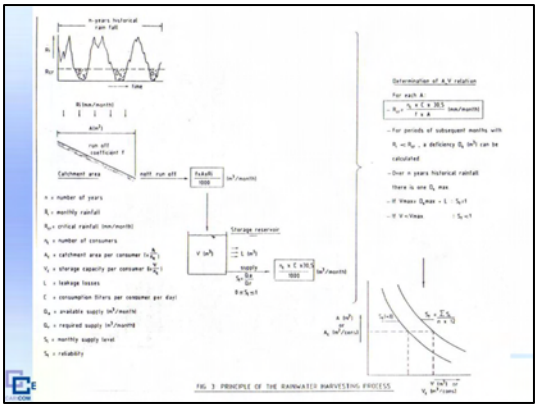
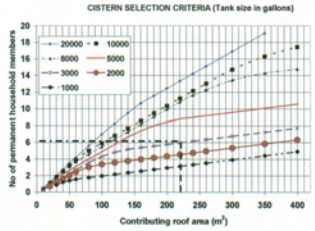


System configuration

Storage systems

- Sizing storage systems
- **Illustration:**

Six person household with a 225 m² roof area requires 3,000 gallon storage



Source: Evans Peterson

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System maintenance and quality

- To maintain water quality system maintenance is important
  - Emphasis on excluding organic matter (detritus, bird droppings)
- In general disinfection is not necessary.
  - May be required for persons with weakened immune systems (illness) elderly or very young
- Boiling or disinfecting (chlorine tablets) is easy, cheap and safe.

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O & M Aspects Cont'd

- Task Needing Frequent Attention
- Roof and Gutter to be kept free of dust, organic matter and bird droppings
- Check mosquito nets on overflow pipe
- If automatic diversion of first flush, the inflow pipe should be disconnected in dry season – then 15-20 minutes after rain begins put it back
- Check for leaks and wet spots on the wall

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Infrequent task

- Repair tank if necessary
- Check roof, gutters & pipes, repair if necessary
- If filters are used, wash or renew medium
- Remove deposits from the bottom of the tank
- After the tank has been repaired or cleaned, the interior should be scrubbed with vinegar, baking soda or chlorine bleach solution

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Cost Aspects

- The Investment cost is determined mainly by the cost of the storage tank especially if the roof catchment already exist.

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Items	Retail cost
6" Down pipe (13 –foot long) and Guttering	$68.00
90 ^{0} bends for guttering	$40.00
32 ^{0} bend for guttering	$32.00
Guttering to down pipe fitting	$20.00
90 ^{0} bend for down pipe	$12.00
45 ^{0} bend for down pipe	$12.00
200 –gallon plastic Tank	$450.00
400 – gallon Plastic Tank	$500.00
600 – gallon Plastic Tank	$950.00
800 – gallon Plastic Tank	$1250.00
1000 – gallon Plastic Tank	1500.00

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Guidelines for Reinforced Concrete Tanks

- If concrete blocks are to be used, use in the construction of small tanks up to (600-800) - gallon tanks
- Place adequate reinforcement and fill all block holes with properly mixed mortar
- For larger tanks use in-situ or cast-in-place concrete instead on concrete blocks
- Seek professional help for design of tanks from an engineer or experienced builder

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- We know of a water Engineer who designed and constructed a 20,000-gallon tank under his newly constructed House. This tank didn't hold a gallon of water. He didn't supervise the construction
- Try to construct tank with one pour of concrete, if that is not possible, cast the bottom with a "Kicker" on sides and use water bars to help seal the joint
- Install pipes for overflow and washout with puddle flanges before concrete is poured. Set these firmly in place and inspect them while concrete is being poured to ensure that they remain in the prescribed location

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Reinforced Concrete tanks

The Cost of construction these tanks vary from Simple construction to difficult formation, i.e, hard rock and soggy soil from: $3.00 per gallon to $ 4.5 per gallon: average $3.75 per gallon.

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No. of Rooms per Household	Total No. of Persons	Area of roof catchment	Storage Volume (gallons) Required	Approx. Cost
2	3	100 m^2 (1076 Sq.ft)	1000	$3,750.00
2-3	4	180 m^2 (1937 Sq.ft)	2000	$7,500.00
3-4	6	225 m^2 (2421 Sq.ft)	3000	$11,250.00

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COST ASPECTS NON-PIPED SYSTEMS.

	Investment costs US$ per capita	Annual operational costs US$ per capita	Annual recurrent costs US$ per capita
Protected springs	5 - 30 ⁾⁾	0.10 - 0.20	0.10 - 0.20
Open shallow well	3 - 7 ⁾⁾	0.15 - 0.30	0.15 - 0.30
(hand) pumped shallow well	5 - 15 ⁾⁾	0.50 - 1.00	0.30 - 0.60
(hand) pumped deep well	15 - 30 ⁾⁾	0.50 - 1.00	0.70 - 1.20
(motor) pumped shallow well	25 - 50 ⁾⁾	1.50 - 2.00	2.50 - 3.00
(motor pumped) deep well	30 - 60 ⁾⁾	1.50 - 2.00	2.50 - 3.00
Rainwater harvesting	25 - 80 ⁾⁾	0.50 - 1.00	0.50 - 1.00

⁾⁾ : coverage 100 - 200 persons
⁾⁾ : coverage about 500 persons, including reservoir
⁾⁾ : coverage 20 persons

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Thank You!

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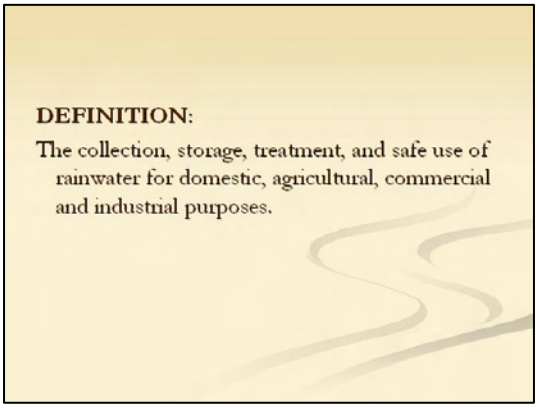
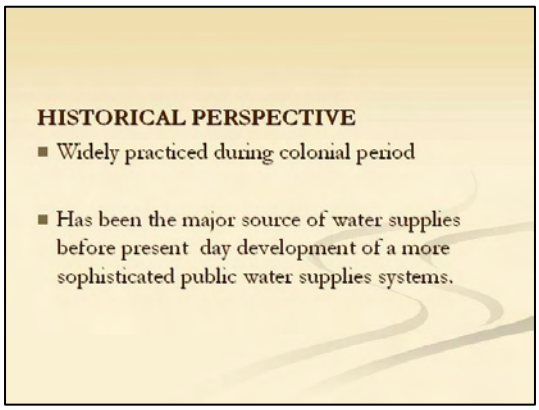
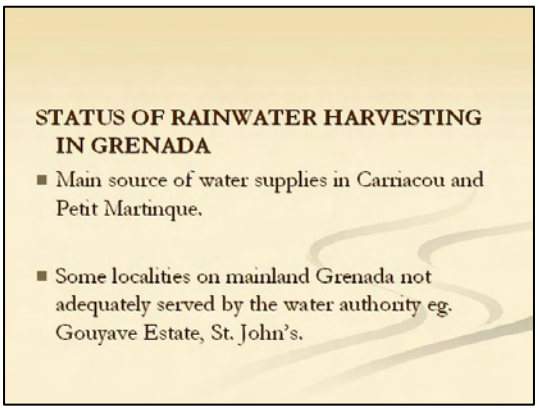
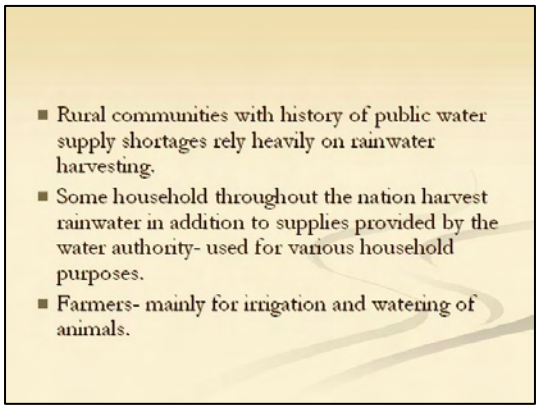
Annex 3C Sanitation Issues in RWH.

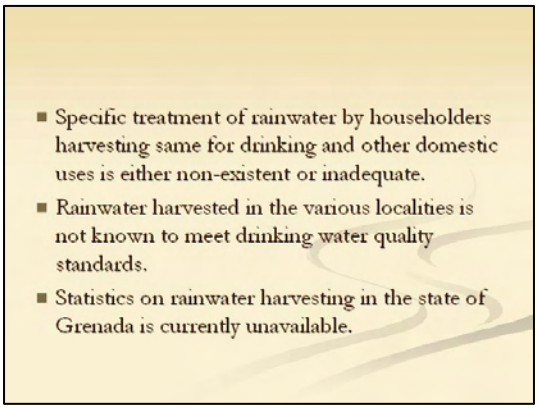
Presenter*: Alan Edwards, Senior Environmental Health Officer, Ministry of Health*











- Generally it appears that most people show a preference for public water supplies provided by the water authority.
- Observations in the field show that methods and practices applied in harvesting rainwater predispose individuals and communities to significant public health risks.

PUBLIC HEALTH IMPLICATIONS

- Proliferation of Disease Vectors
  - Mosquitoes eg. Aedes Aegypti
  - Man-made Habitats
  - Outbreaks of vector-borne diseases eg. Dengue fever, DHF, DSS
  - Nuisances

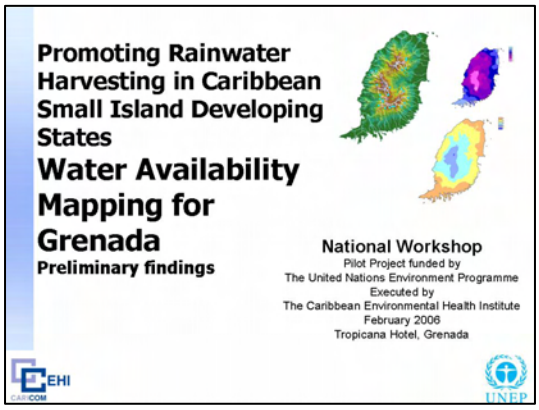
- Poor Sanitation
  - Improper collection and storage
  - Unsafe collection points
  - Lack of maintenance of facilities
  - Enteric diseases due to contamination

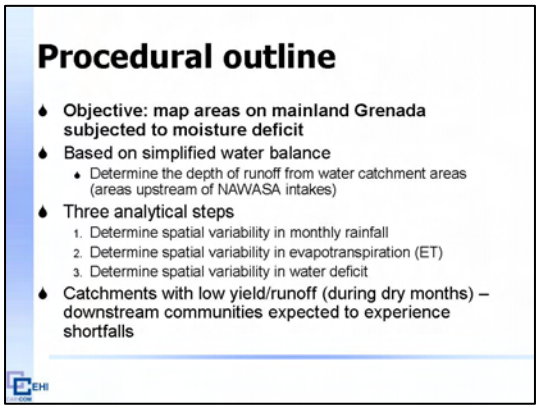
- Sources of contamination
  - Catchments areas eg. Roof catchments (animal droppings, other extraneous materials)
  - Storage containers
  - Particulate matter (atmospheric)

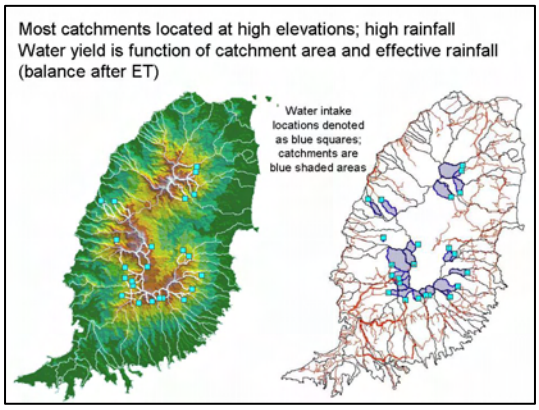
VECTOR CONTROL ISSUES:

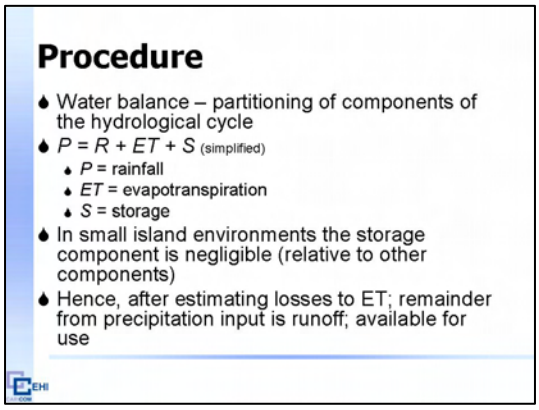
- High mosquito infestation levels experienced in localities practicing rainwater harvesting.
- Knowledge, attitudes, and practices of community members – traditions, beliefs, perceptions.
- Structural integrity of rainwater collection and storage facilities.
- Control measures – physical, biological, chemical.
- Health Promotion and public awareness.

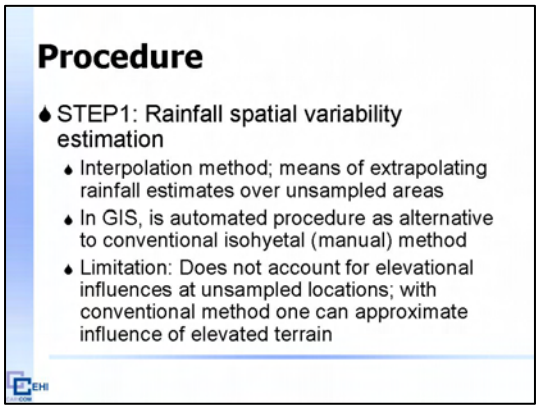
Annex 3D Water availability mapping for Grenada.
Presenter: *Christopher Cox, CEHI*

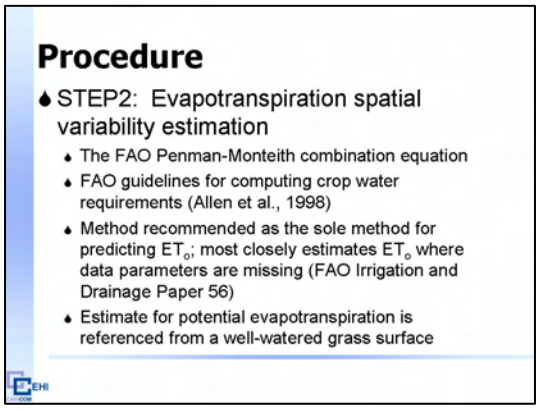












Procedure
FAO Penman-Monteith combination equation

$$ET_o = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

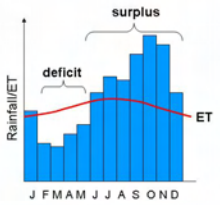
ET_o = reference evapotranspiration (mm/day)
R_n = net radiation at crop surface (MJ/m²/day)
G = heat flux density to the soil (MJ/m²/day)
T = air temperature at 2 m height (°C)
u_2 = wind speed at 2 m height (m/s)
e_s = saturated vapor pressure (kPa)
e_a = actual vapour pressure (kPa)
$e_s - e_a$ = saturation vapour pressure deficit (kPa)
Δ = slope of vapour pressure curve (kPa/°C)
γ = psychrometric constant (kPa/°C)

Assumptions
Estimating ET

- Temperature (mean daily min, max) data across island not available; values derived from GIS map source. Adiabatic lapse rate to account for decrease in temps with elevation used
- Windspeed data across island not available; assumed at 2 m/s over island surface (FAO, 1998)

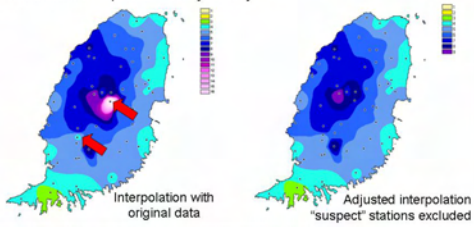
Procedure

- STEP 3: Estimating water deficit
  - Simply the difference between rainfall input and ET losses
  - Also referred to as effective rainfall
    - Water available for abstraction – potable (domestic) water; irrigation, livestock watering

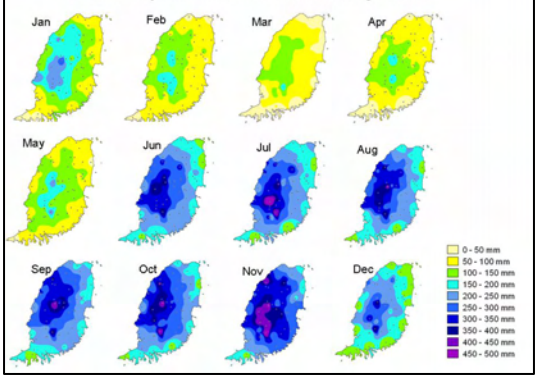


Data quality
Monthly rainfall data observations

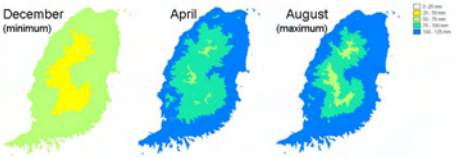
Interpolation revealed inconsistencies in rainfall monthly observations
Vendome WTP station – consistent under-reporting for all months
Nianganfoix station - large deviation for September (excess of 800 mm!)
Vendome WTP station excluded from analysis; Nianganfoix station excluded from September analysis only



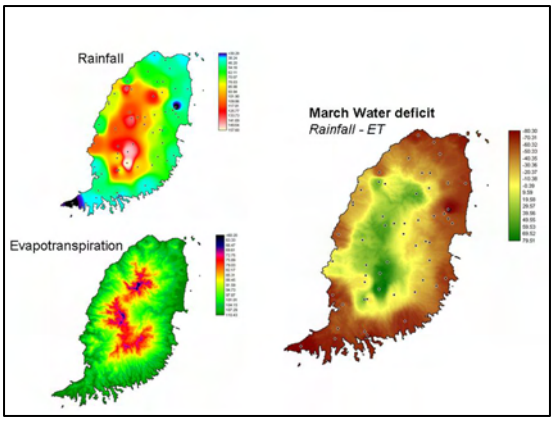
RESULTS: Spatial variation in mean monthly rainfall



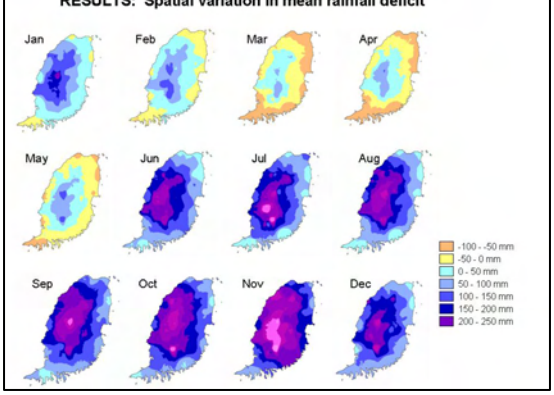
RESULTS: Spatial variation in monthly evapotranspiration

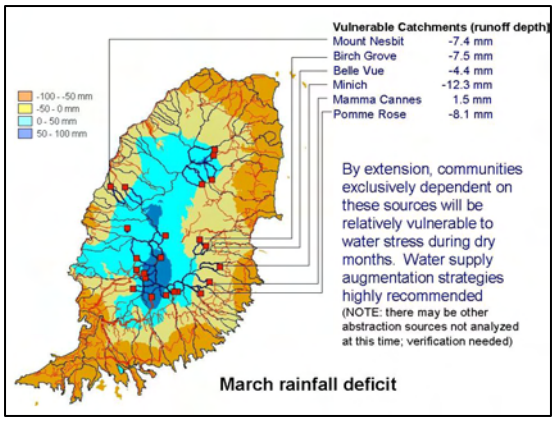


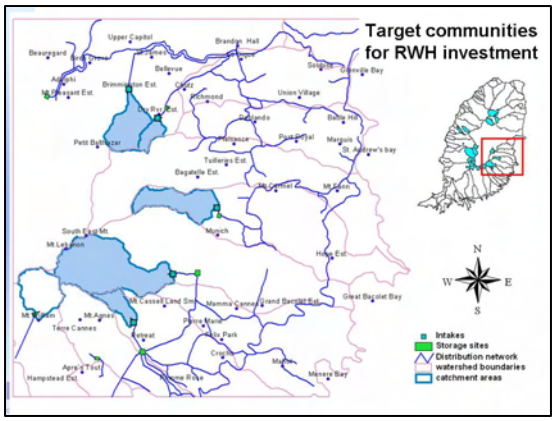
ET is primarily a function of temperature (seasonal variation and elevation)

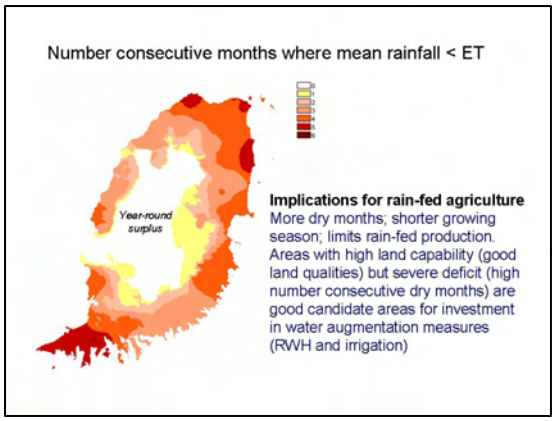


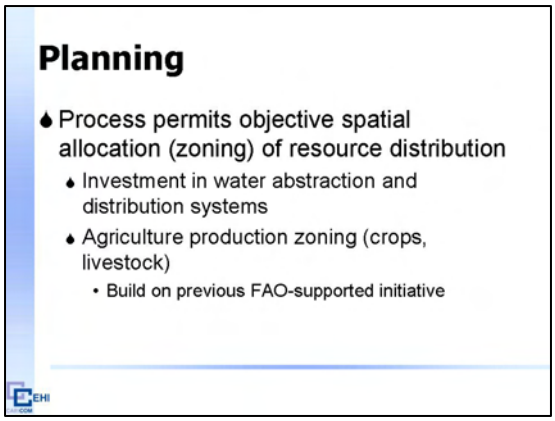
RESULTS: Spatial variation in mean rainfall deficit

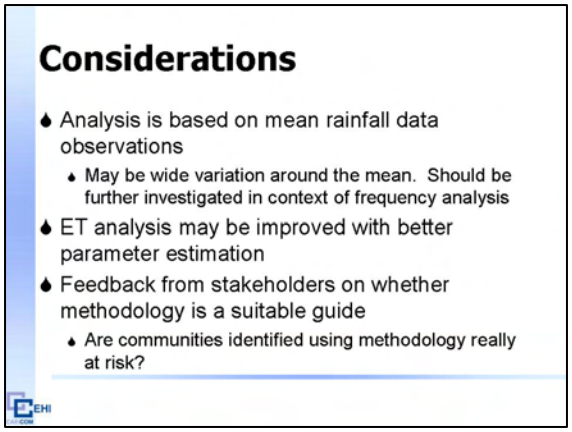



Vulnerable Catchments (runoff depth)
Mount Nesbit -7.4 mm
Birch Grove -7.5 mm
Belle Vue -4.4 mm
Minich -12.3 mm
Mamma Cannes 1.5 mm
Pomme Rose -8.1 mm
-100 - -50 mm
-50 - 0 mm
0 - 50 mm
50 - 100 mm
By extension, communities exclusively dependent on these sources will be relatively vulnerable to water stress during dry months. Water supply augmentation strategies highly recommended
(NOTE: there may be other abstraction sources not analyzed at this time; verification needed)
March rainfall deficit


Target communities for RWH investment
N
W
E
S
Intakes
Storage sites
Distribution network
watershed boundaries
catchment areas


Number consecutive months where mean rainfall < ET
Year-round surplus
Implications for rain-fed agriculture
More dry months; shorter growing season; limits rain-fed production. Areas with high land capability (good land qualities) but severe deficit (high number consecutive dry months) are good candidate areas for investment in water augmentation measures (RWH and irrigation)


Planning
Process permits objective spatial allocation (zoning) of resource distribution
Investment in water abstraction and distribution systems
Agriculture production zoning (crops, livestock)
Build on previous FAO-supported initiative


Considerations
Analysis is based on mean rainfall data observations
May be wide variation around the mean. Should be further investigated in context of frequency analysis
ET analysis may be improved with better parameter estimation
Feedback from stakeholders on whether methodology is a suitable guide
Are communities identified using methodology really at risk?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Annex 3E Project Planning for Community RWH System Enhancement.
Presenter: *Christopher Cox, CEHI*

Promoting Rainwater Harvesting in Caribbean Small Island Developing States

Project Planning for Community RWH System Enhancement

John's Unique Resort
Carriacou, Grenada
February 8th 2006

Presented by the
Caribbean Environmental Health Institute

Rationale

- Key issues (based on assessment) – operation of community-based RWH systems
  - Infrastructure decay; need for rehabilitation
  - Capacity building in maintenance
- Workshop output:
  - Project concept document – logical analysis framework approach

Project design considerations

- Nature of the proposed project
  - What is the problem/issue being addressed
  - What is the overall goal
  - What are the specific objectives
  - Description of the proposed project
    - Activities (NOTE: activities identified must address one or more of the specific objectives)
- Anticipated project results
  - Expected outcomes, impacts and how will impacts be measured
- Relationship of the project to other projects/programmes
  - Local, district or national government agencies or programmes
- Risks to successful implementation
- Project costs
- Reporting, Monitoring and Evaluating

Project conceptualization

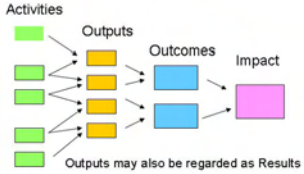
Hierarchy

- **Impact:** a long-term sustainable result that comes out of successful outcomes. (CPMT, 2005)
- **Outcomes:** an end-of-project (or portfolio) result which comes as a consequence of a number of successful outputs. (CPMT, 2005)
- **Outputs:** the immediate result of a given activity. (CPMT, 2005)
- **Inputs:** human, technical, financial or any kind of resources that are used to implement activities out of which come outputs.

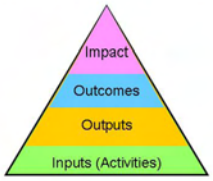
THE RESULTS CHAIN

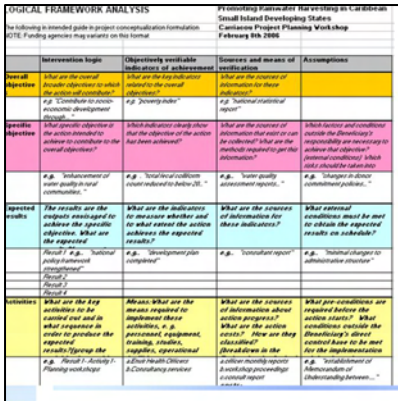
Inputs → Outputs → Outcomes → Impacts

THE IMPACT CHAIN



THE IMPACT PYRAMID

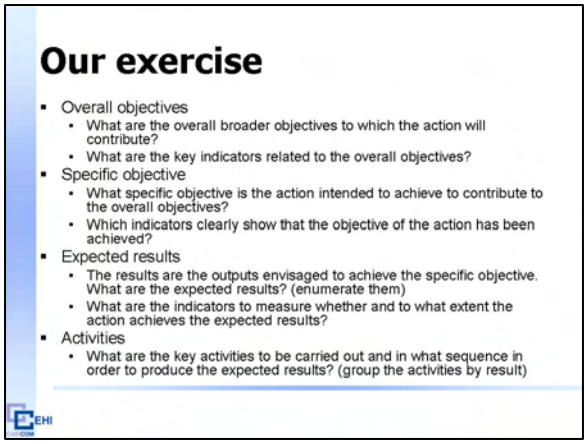


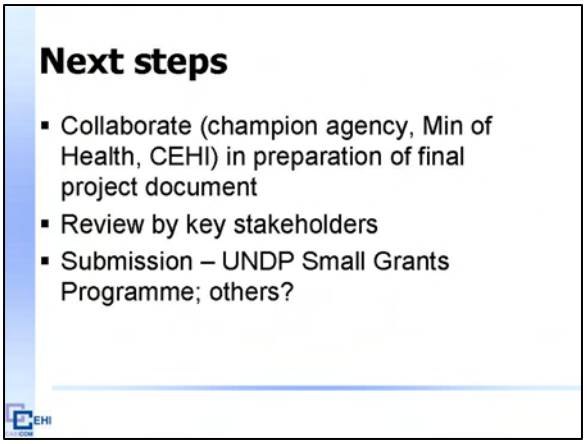


Logical Framework Analysis (LFA)

LFA is a means whereby a project may be structured and described in a clear and analytical manner; it is a development of the 'management by objectives' approach. It is a method which provides a structure for designing a project and a tool for project management and evaluation.

On-line source; posted on Poland Ministry of Environment website:
http://www.mos.gov.pl/mos/publikac/Raporty_opracowania/manual/glosry_1.html


Our exercise
Overall objectives
What are the overall broader objectives to which the action will contribute?
What are the key indicators related to the overall objectives?
Specific objective
What specific objective is the action intended to achieve to contribute to the overall objectives?
Which indicators clearly show that the objective of the action has been achieved?
Expected results
The results are the outputs envisaged to achieve the specific objective. What are the expected results? (enumerate them)
What are the indicators to measure whether and to what extent the action achieves the expected results?
Activities
What are the key activities to be carried out and in what sequence in order to produce the expected results? (group the activities by result)
CEHI


Next steps
Collaborate (champion agency, Min of Health, CEHI) in preparation of final project document
Review by key stakeholders
Submission – UNDP Small Grants Programme; others?
CEHI

Annex 4: Photos

P1. Carriacou workshop opening. Permanent Secretary (Acting) in the Ministry of Carriacou and Petit Martinique Affairs, ***Bernadette Lendore-Sylvester*** and ***Dr. Christopher Cox***, Senior Programme Officer, CEHI

P2. Grenada workshop opening. Permanent Secretary in the Ministry of Health, ***Gemma Bain-Thomas*** and ***Dr. Christopher Cox***, Senior Programme Officer, CEHI

P3 & 4. Carriacou workshop participants

P5. Grenada workshop participants

P6. ***Alphonsus Daniel***, technical advisor, during delivery.

P7. ***Alan Edwards***, Senior Environmental Health Officer, Ministry of Health, during delivery.

P8. ***Alan Neptune***, Production and Quality Manager, NAWASA

P9. ***Lyndon Robertson***, Senior Programme Officer, CEHI.

P10. Material on display at workshop.