Calculating the Water Poverty Index in Carriacou

Presented by Candi T. Hosein

Aim

- Explore the water situation in Carriacou, Grenada using the Water Poverty Index (WPI) Approach
- WPI can provide an assessment of various facets of water vulnerability by considering:
  - Water availability
  - Access to water
  - People's ability to manage water
  - Environmental health
- This study is a first of its kind in the Caribbean
- It allows for a better understanding of water related problems facing SIDS
- And an improved understanding of the factors shaping water security at both the household and community level
- This study form part of the Water-aCCSiS Project

Why assess water vulnerability?

- Small Island Developing States
- Limited resources
- Limited space for development
- Increasing population
- Relatively small watersheds
- Increased threats to freshwater supplies
- Projections suggests that there may be a drying across the Caribbean basin with expected decreases in rainfall ranging from 25%-50% (ECLAC, 2011)
- Carriacou in particular lacks a formal water supply system- they rely heavily in rainwater harvesting (RWH) for both domestic and agricultural needs

Water Poverty Index (WPI)

- “a multi-dimensional approach which examines all the various components which affect water availability including: environmental conditions, social factors, capacity of users to pay and lobby for water services and the various uses of water by communities” (Agrawal and Agrawal, 2011; Mlote, Sullivan and Meigh, 2002).
- Its main aim being to create a holistic policy tool comprising both the physical and social sciences which could be applied globally to identify the physical, social and economic drivers of poverty (Sullivan, 2002)

Benefits of the WPI Approach

- Formulated upon the Human Development Index
- Makes use of a participatory approach
- Allows for community empowerment
- It can act as a monitoring tool for improvements
- Linkages between cross-sectoral themes
- Politically it can provide an opportunity for people to evaluate the effectiveness of resource allocation decisions

The WPI Approach in Carriacou

- A WPI assessment has the ability to highlight shortcomings in the current water situation within a community
- It can also provide a base upon which further work can be carried out as it relates to improvement
- Can contribute to a better understanding of problems facing small islands such as Carriacou in terms of climate change

Five main Component of the WPI Approach

- Resource
  - Physical availability of surface and groundwater
- Access
  - The extent of access to this water for human use
- Capacity
  - The effectiveness of people's ability to manage their water resources
- Use
  - Different ways in which water is used for different purposes
- Environment
  - The need to allocate water for ecological services

Location


Windward
Bogles
Hillsborough
3.56 km
© 2013 Google
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2013 DigitalGlobe
Google earth
Imagery Date: 7/16/2005 12°28'30.25" N 61°27'28.50" W elev 31 m eye alt 16.08 km

Background on Carriacou

- Water provision services have changed very little in the last 50 years with the majority of the inhabitants still relying on rainwater and rainwater harvesting. Hillsborough is still the only community with a pipeline system where residents have access to borehole water with approximately 27 connections (90 residents) (NAWASA, 2013).
- Although some residents in Hillsborough are connected to the borehole supply they explained that they never use this water for cooking, bathing, cleaning or washing. They described the water as being “heavy in salts” and thus unfit for their use. As a result many of these residents have had their connections shut off due to the high cost of this water and its limited treatment.

Background

- Desalination Plant provided water to residents in Hillsborough. It operated from 2000 up to April 2006 with a total of 365 operating hours

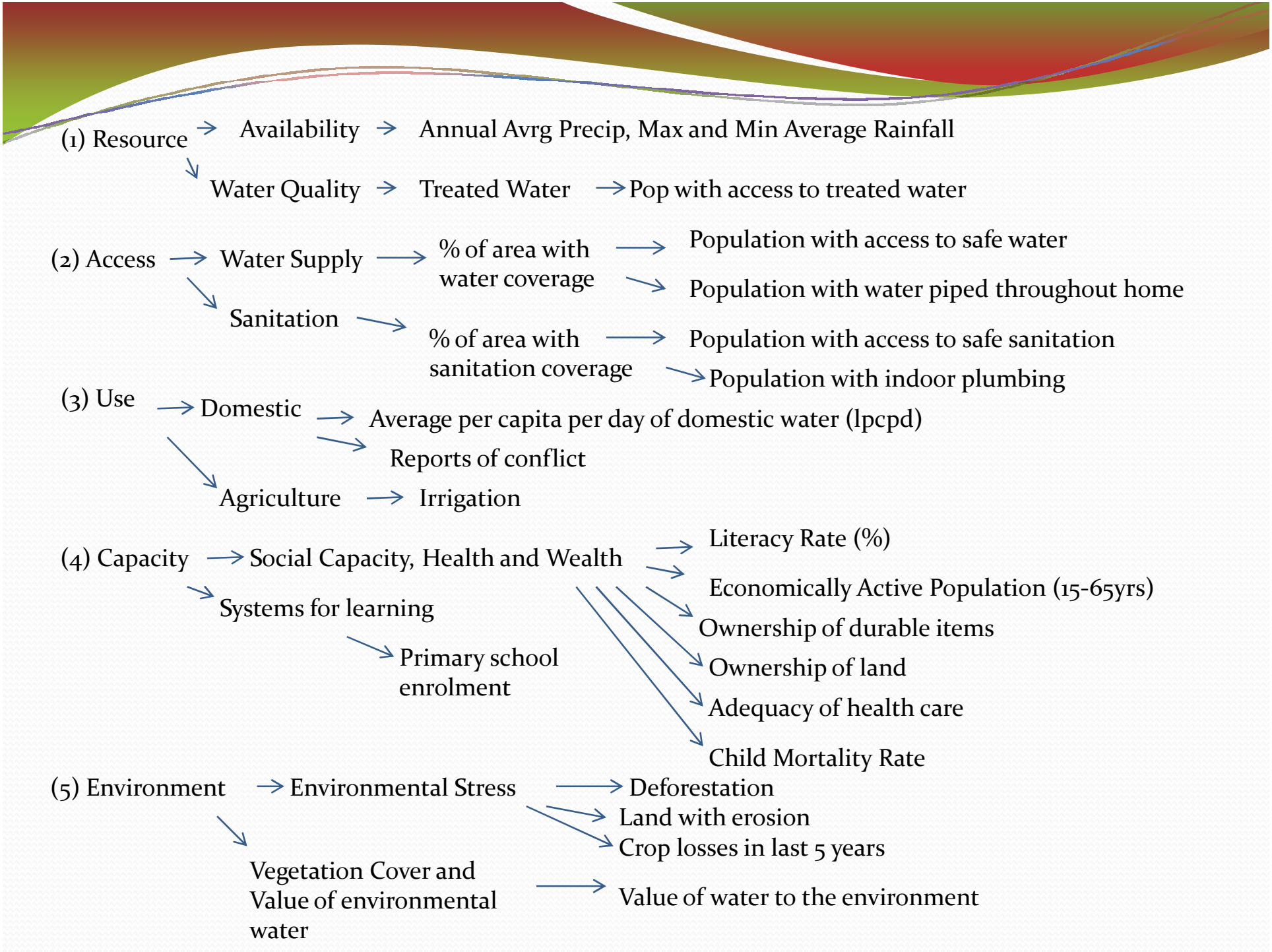
- Its capacity was 455m^3 per day (100, 000 gallons but was only operated intermittently due to several problems. These included a lack of a pipe network system to distribute water from the plant to all consumers in and around Hillsborough; lack of storage tanks to hold the processed water; and frequent mechanical breakdowns (NAWASA, 2013).

Data Collection

- Household surveys (questionnaires) within a 2 week period
- Population figures, total number of households; average household size from CSO, Grenada
- Land use data- Ministry of Agriculture, Land Use Division
- Rainfall data, Grenada Meteorological Office
- Data on water provision services from NAWASA

Method

- The five components used in this study were those outlined by Mlote, Sullivan and Meigh, (2002); Sullivan et al. (2003); Sullivan, Meigh and Lawrence (2006); and Wilk and Jonsson (2012). They are Resource, Access, Use, Capacity and Environment. Each component was then divided into several sup-components


(1) Resource
Availability
Annual Avrg Precip, Max and Min Average Rainfall
Water Quality
Treated Water
Pop with access to treated water
(2) Access
Water Supply
% of area with water coverage
Population with access to safe water
Population with water piped throughout home
Sanitation
% of area with sanitation coverage
Population with access to safe sanitation
Population with indoor plumbing
(3) Use
Domestic
Average per capita per day of domestic water (lpcpd)
Reports of conflict
Agriculture
Irrigation
(4) Capacity
Social Capacity, Health and Wealth
Literacy Rate (%)
Economically Active Population (15-65yrs)
Ownership of durable items
Ownership of land
Adequacy of health care
Child Mortality Rate
Systems for learning
Primary school enrolment
(5) Environment
Environmental Stress
Deforestation
Land with erosion
Crop losses in last 5 years
Vegetation Cover and Value of environmental water
Value of water to the environment

Component Normalization

- Surveys were conducted in relation to households rather than individuals and these surveys were assumed to be representative of the entire community.
- Thus for the community of Hillsborough a total of 25 (approximately 16%) households were interviewed and the results from these were then taken to be representative of the 152 households present.
- The same was done for Bogles where 16 out of 93 households were interviewed and for Windward where 25 out of 146 households were interviewed.
- Note: figures for the total number of households in each of the communities were based on 2001 Census data (2011 Census data was not yet available at the time of the study) from the Central Statistical Office (C.S.O.) located in Grenada.

Resource

- physical availability of water and was based on the maximum and minimum annual average rainfall for the island as well as the water quality of the supplies used for domestic and agricultural purposes.
- $R_1 = [(X_a - X_{min})/ (X_{max} - X_{min})]$ x 100 where X_a= annual average rainfall; X_{min} and X_{max} = average minimum and maximum rainfall
- $T_1 = (X_t / X)$ x 100 where X_t= population who treat their water supply; X= sample population; T_1= Proportion of population who treat their water supply

Access

- According to Manandhar et al., 2011 access considers a population's "reasonable access to an adequate amount of safe drinking water and sanitation".
- $A_1 = (X_w / X) \times 100$ where X_w= population with water supply; X= sample population; A_1= Access to safe water
- $A_2 = (X_p / X) \times 100$ where X_p= population with piped water supply throughout home; X= sample population; A_2= Proportion of population with piped water throughout home
- $A_3 = (X_s / X) \times 100$ where X_s= population with sanitation facilities; X= sample population; A_3= Access to sanitation
- $A_4 = (X_{is} / X) \times 100$ where X_{is}= population with indoor sanitation facilities; X= sample population; A_1= Proportion of population with indoor sanitation

Use

- describes the way in which the communities use water. In this study the three communities largely used water for domestic and agricultural purposes.
- $U_1 = (X_{wc}/ X) \times 100$ where X_{wc}= population who conserve water; X= sample population; U_1= Proportion of population who conserve water
- $U_2, U_4 = (X_c/ X) \times 100$ where X_c= reports of conflict; X= sample population; U_2, U_4= Proportion of population reporting conflict
- $U_3 = (X_{ir}/ X) \times 100$ where X_{ir}= population who practice irrigation (formal irrigation systems); X= sample population; U_1= Proportion of population who practice irrigation

Capacity

- This component deals with "the effectiveness of people's ability to manage water" (Manandhar et al., 2011). Capacity was divided into social capacity; health and wealth; and systems for learning.
- $C_1 = (X_{di}/ X) \times 100$ where X_{di}= population who own durable items; X= sample population; C_1= Proportion of population who own durable items
- $C_2 = (X_l/ X) \times 100$ where X_l= population with ownership of land; X= sample population; C_2= Proportion of population who own their own land
- $C_3 = (X_{hc}/ X) \times 100$ where X_{hc}= population who believe that health care on the island is adequate; X= sample population; C_3= Proportion of population who believe that health care on the island is adequate
- $C_4 = (X_e/ X) \times 100$ where X_e= population with at least a primary school education; X= sample population; C_4= Proportion of population with at least a primary school education

Environment

- correlates to environmental integrity which enables the environment to deal with water stresses while continuing to provide ecological good and services (Manandhar et al., 2011).
- $E_1 = (X_d / X) \times 100$ where X_d= population reporting deforestation; X= sample population; E_1= Proportion of population reporting deforestation
- $E_2 = (X_{se} / X) \times 100$ where X_{se}= population reporting soil erosion; X= sample population; E_2= Proportion of population experiencing soil erosion
- $E_3 = (X_{cl} / X) \times 100$ where X_{cl}= population reporting crop losses; X= sample population; E_3= Proportion of population reporting crop losses
- $E_4 = (X_{ew} / X) \times 100$ where X_{ew}= population who believe that water is equally important to themselves as it is to the environment; X= sample population; E_3= Proportion of population who believe that water is equally important for human use as well as for the environment

Weighting the Components

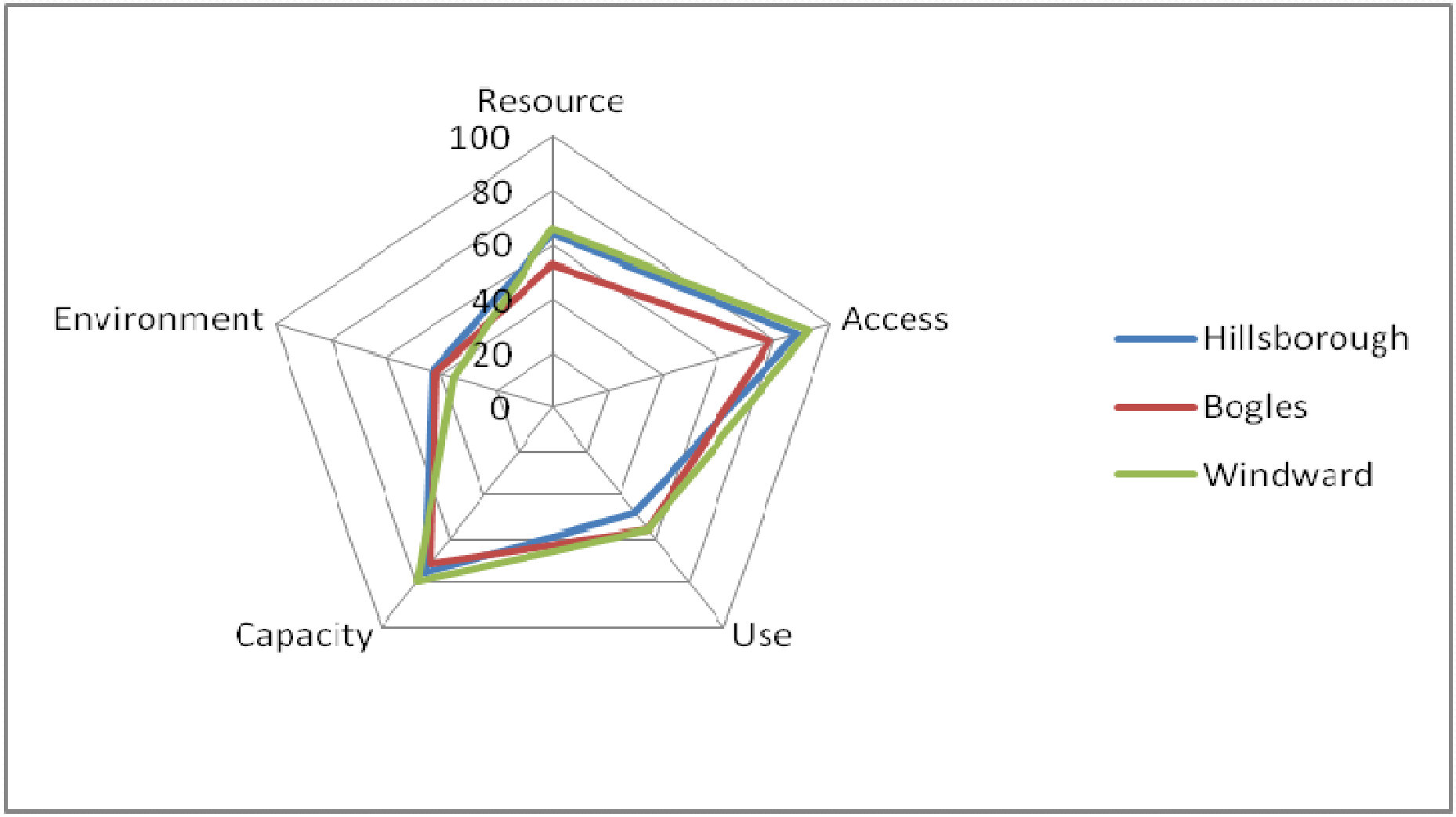
$$\sum wi = 1$$

- The balanced approach was used here
- All components were given equal weighting because
  - There is no criterion for placing more weight on one component over another
  - It is inappropriate to do so since all five components represent significant aspects of the WPI
- **WPI = 0.2 x Resource + 0.2 x Access + 0.2 x Use + 0.2 x Capacity + 0.2 x Environment**

Results

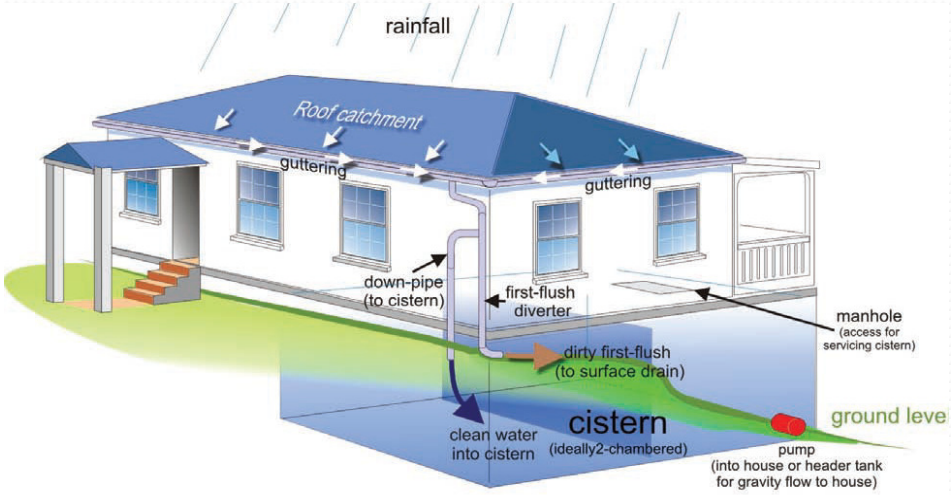
	Resource	Access	Capacity	Use	Environment	WPI
Hillsborough	64	88	75	48	43	64
Bogles	53	78	71	56	42	60
Windward	66	92	79	56	36	66

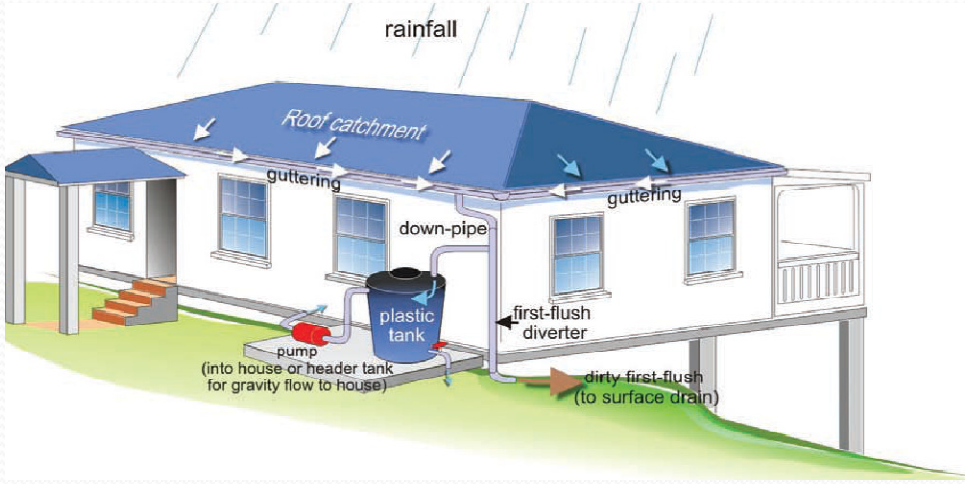
Pentagram presentation of the components of the WPI for Hillsborough, Bogles and Windward



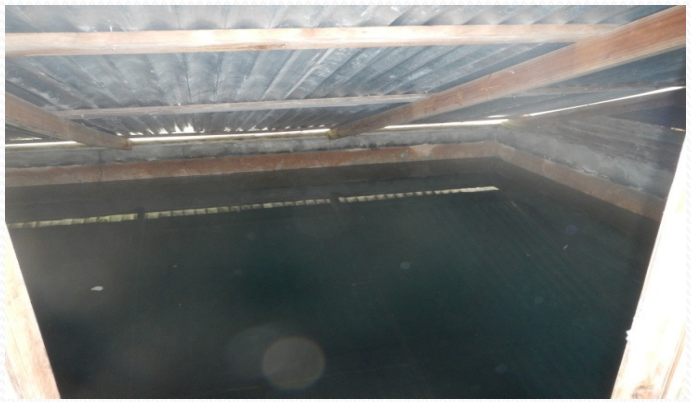
Discussion

- Typically residents rely on RWH to meet domestic and agricultural needs- they collect, they store it and they treat it themselves
- They use a combination of above and below ground cisterns (Source: CEHI/UNEP, 2009)





Typical Above ground and Underground Cisterns in Carriacou



Discussion

- In Hillsborough, many of the residents have explained that in times of low rainfall and drought they do not use the borehole water directly from the stand pipes instead they rely upon other people's cistern water.
- This however was contradictory since some churches with borehole supplies sometimes provide water to residents in need. In addition it was explained that a small proportion of the residents in the community live abroad and through verbal agreements in their absence other residents are allowed access to their cisterns. This water is transported via trucks and the cost attached to receiving truck born water is not for the water itself but for the truck service.

Discussion

- Methods employed by residents for treating domestic water
  - Guppies in cisterns (locally known as millions)
  - Chlorine tablets
  - Boiling
  - Some residents do not use any form of treatment
- Water Conservation is a huge deal in Carriacou

Difficulties

- An initial workshop for assessing the local conditions so that a locally relevant questionnaire could be designed was not included due to time and financial constraint
- Some residents were unwilling to divulge information
- The study was done in the wet season when water scarcity is not generally a problem
- Lack of data for annual rainfall, groundwater, water quality as well as a lack of data for a consistent period of time

Recommendations

- The use of an initial workshop
- Consistency in the data and the involvement of more governmental departments in collecting data related to water security will be beneficial to the process.
- A more in depth study into ways to better improve the water situation in terms of water supply options on this island needs to be investigated.
- Need for policies and regulations regarding the standardization of storage vessels, methods of treatment and maintenance of vessels especially for drinking water as long as rainwater harvesting remains the main water source for residents

Recommendations

- Encouraging data collection on the water situation in Carriacou at the school level by both teachers and students can allow for useful information to be acquired since schools are already required to pass along information to the C.S.O.
- Using a Water Prosperity Index
- Providing feedback to the communities

Conclusion

- The WPI approach is beneficial for evaluating the status of communities in terms of water security
- The five components investigated were Resource, Access, Capacity, Use and Environment
- The WPI of Hillsborough, Bogles and Windward was found to be 64, 60 and 66 respectively and the overall score for Carriacou was 63
- In terms of Resource, Access and Capacity each community also scored relatively high but the Use and Environment scores were much lower
- Although the main aim of this study was to calculate the WPI for Carriacou due to the prevailing difficulties outlined in the preceding section such as inconsistencies in the timeline of the data and a lack of current data this exercise resulted in a preliminary rather than a conclusive study. Consequently, more research is necessary in relation to WPI assessments in Carriacou.

Thank you

Questions?