Promoting Rainwater Harvesting in Caribbean Small Island Developing States

Sensitization and Planning Workshop

Pilot Project funded by

The United Nations Environment Programme

Executed by

The Caribbean Environmental Health Institute

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Grenada & Carriacou

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Outline

- **PART 1**
  - Background
  - RWH in Caribbean
  - Why invest in rainwater harvesting?
- **PART 2**
  - System configurations
  - System maintenance
  - Quality standards
  - Costs

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PART 1

Overview of Rainwater Harvesting Systems

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Background

- *Rain water harvesting (**RWH**) is the capture of rainwater and storage for subsequent use*
- Among the oldest forms of access to water; practiced for more than 4000 years
  - Technology is simple to use and meets all the demands of a safe water supply
- Of high importance in water-stressed areas of the world
  - Water stress – lowered availability of freshwater resources; both in terms of quality and quantity
  - Australia: 13% of all households are using rainwater as the main source of drinking water.

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Background

The Global Situation

- General trend towards increased water scarcity, particularly in developing countries
  - Increasing populations
  - Increasing competing uses
    - Human consumption
    - Industry
    - Agriculture
  - Over-exploitation of ground and surface waters
  - Increasing pollution
    - Every year, 25 million people still die due to consumption of polluted water
  - Climate change
    - Risk to existing supply

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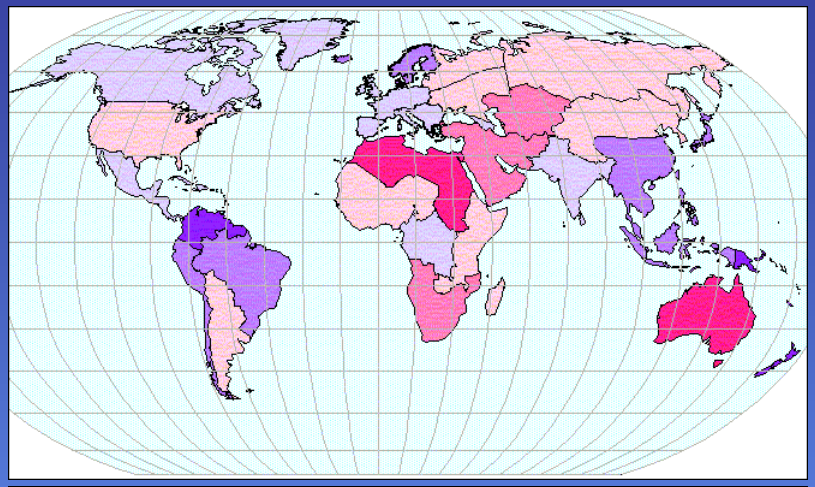
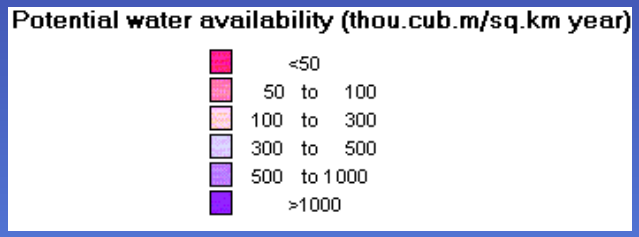
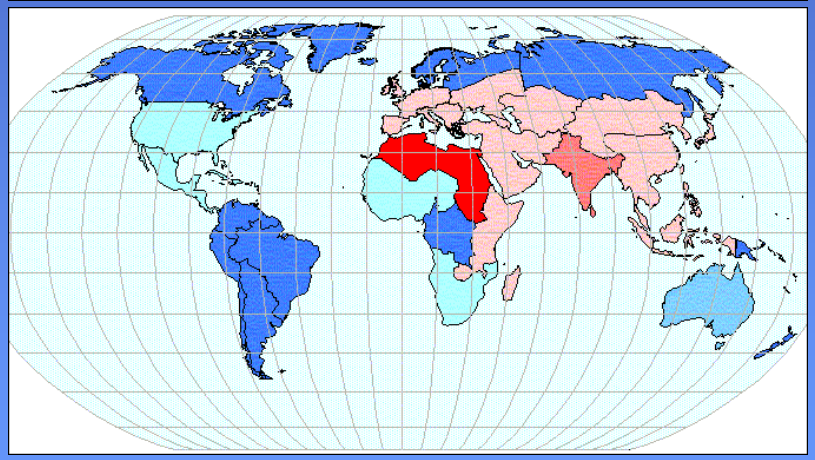
Background

The Global Situation - Water Availability

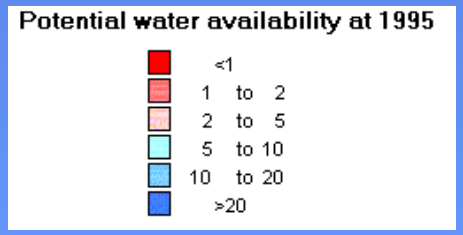


Potential water availability (thou.m^3/km^2 per year) by natural-economic regions of the world





Potential water availability (thou.m^3/year ***per capita***) by natural-economic regions of the world (at 1995).



Source: State Hydrological Institute, St.-Petersburg, Russia

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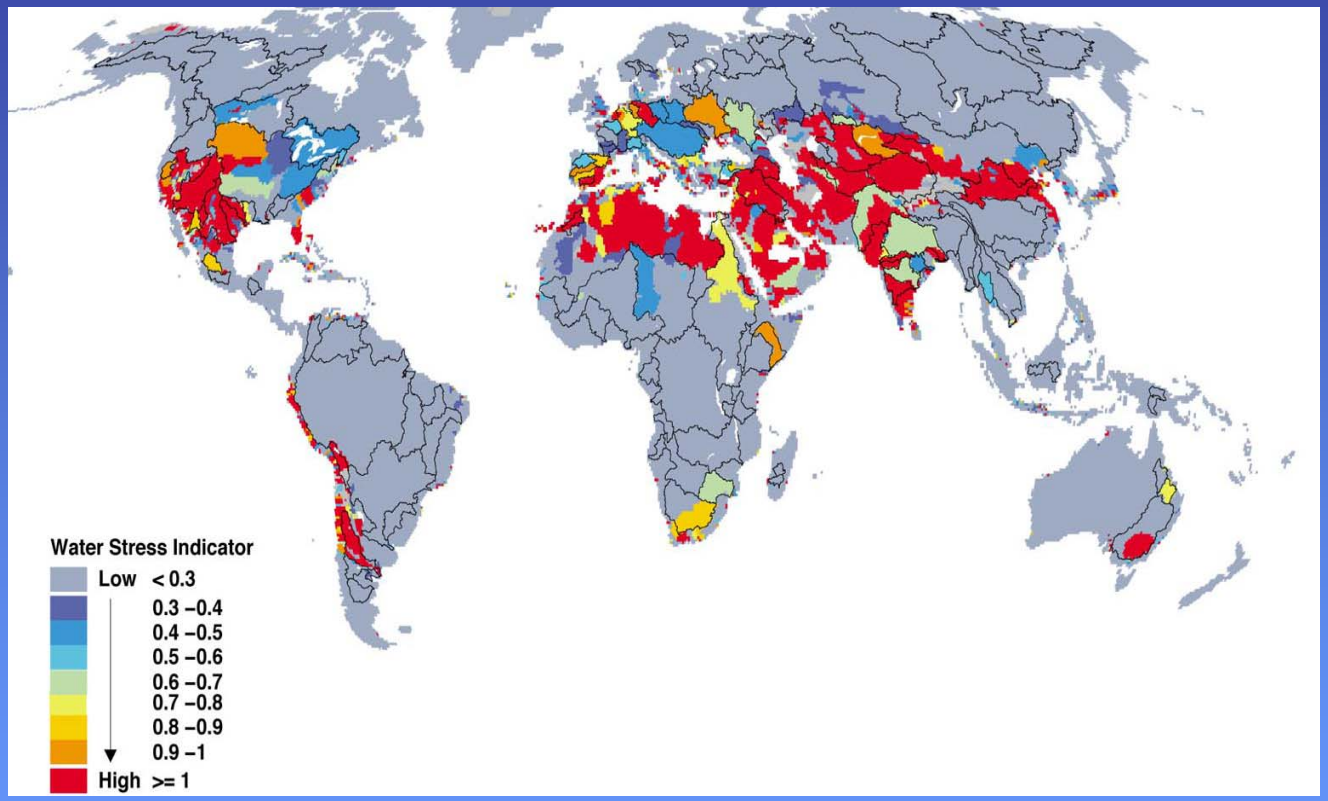
Background

The Global Situation - Environmental water scarcity



Water stress indicator expression of extent to which the quantity of water removed from the system puts the ecosystem at risk (by tapping into water environmental demand)

Source: Water Resources eAtlas, IUCN, IWMI, Ramsar, WRI

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RWH in the Caribbean

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

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RWH in the Caribbean

Examples – policy and practices

- Bahamas: Whale Cay has a piped distribution system based on rooftop-collected water
- Turks and Caicos: Government regulations make it mandatory for all homes to have storage capacity of (at least) 400 litres per m^2 roof area
- Grenadines:Carriacou and Petit Martinique are mostly reliant on RWH, 33 communal catchments and 78 public storage systems

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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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Why invest in RWH?

Main selling points

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

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Why invest in RWH?

Stakeholder benefits

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

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PART 2

Configuration and operation of Rainwater Harvesting Systems

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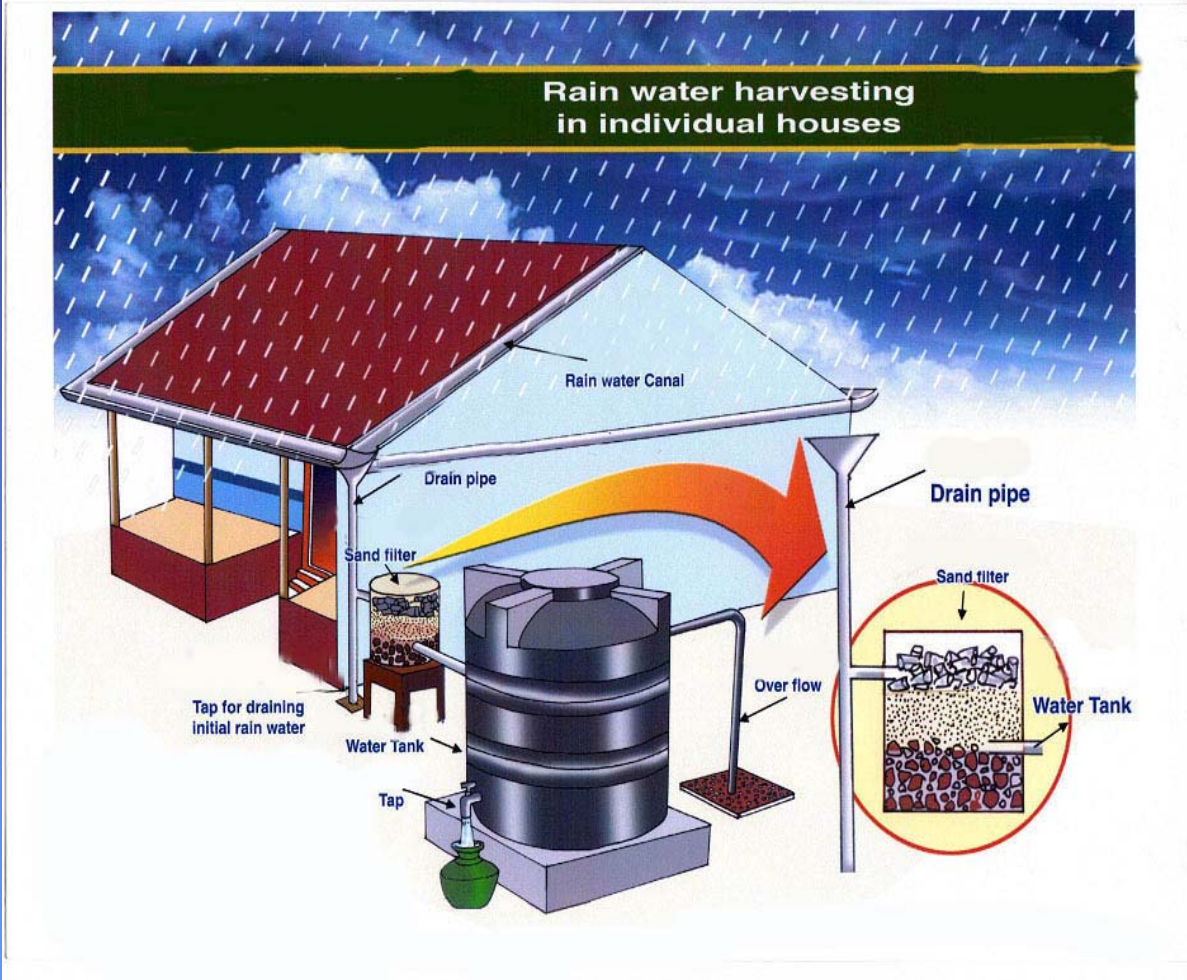
System configuration

General

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



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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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System configuration

Catchment

- Calculating the potential yield from a catchment surface:
  - *Supply (litres/year) = rainfall (mm/year) x area (m^2) 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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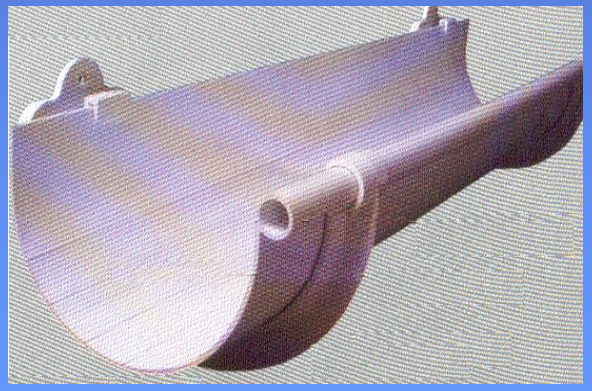
System configuration

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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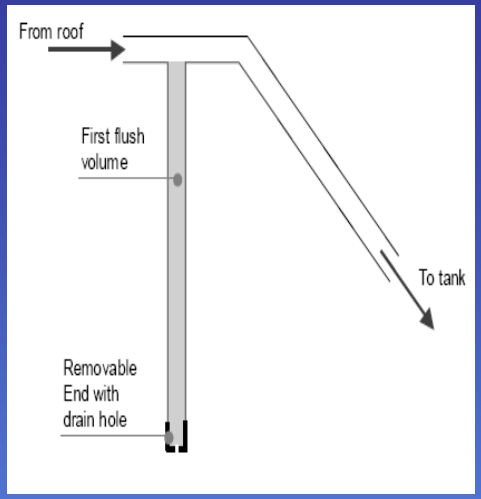
System configuration

Delivery system

- Foreign object exclusion
  - First flush arrangement: Entrapment of the first runoff containing dirt, 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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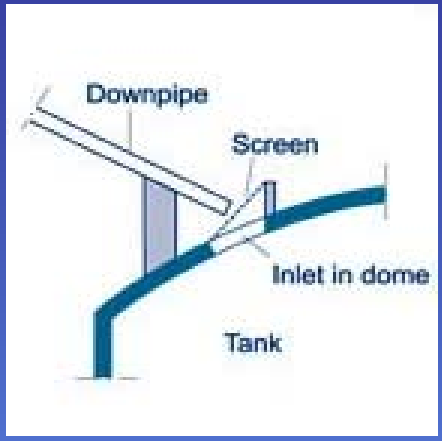
System configuration

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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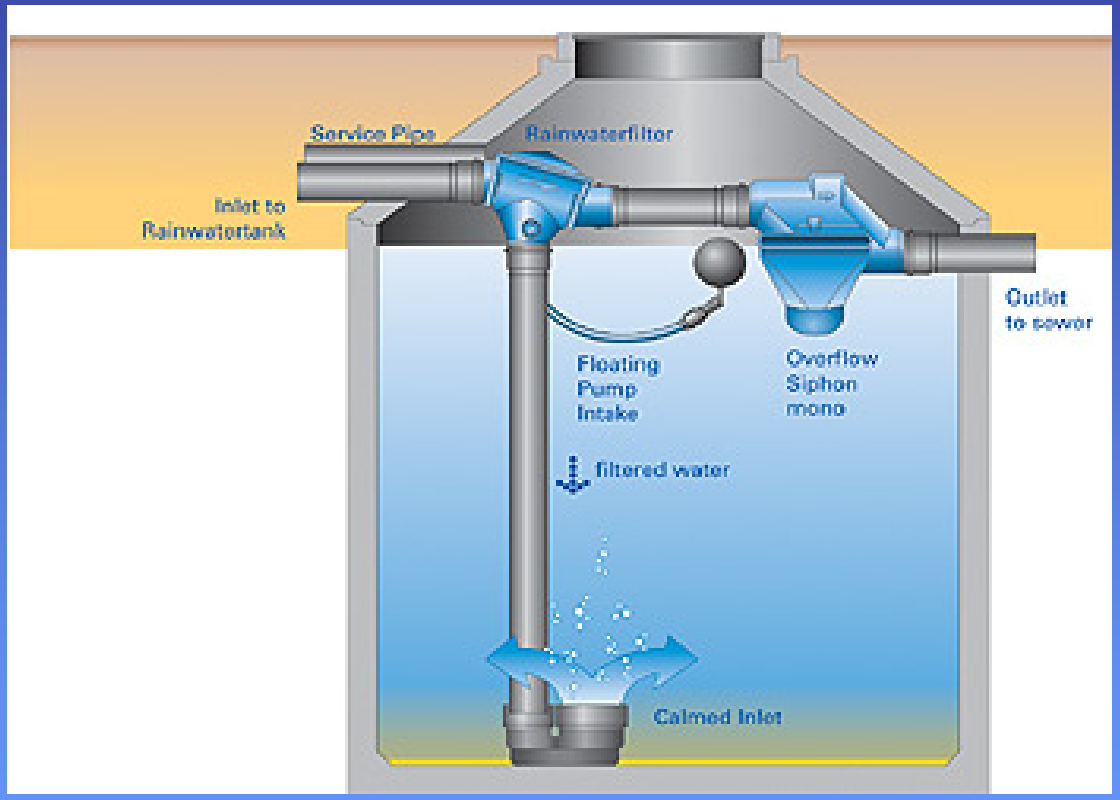
System configuration

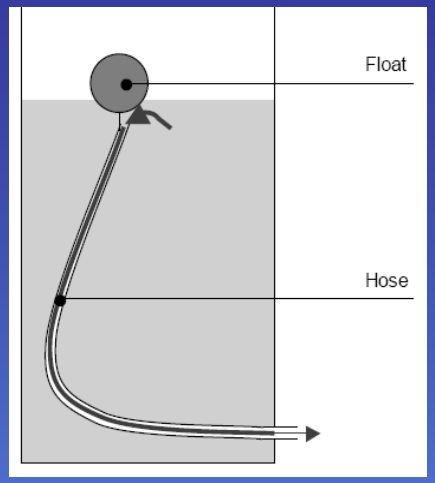
Storage systems

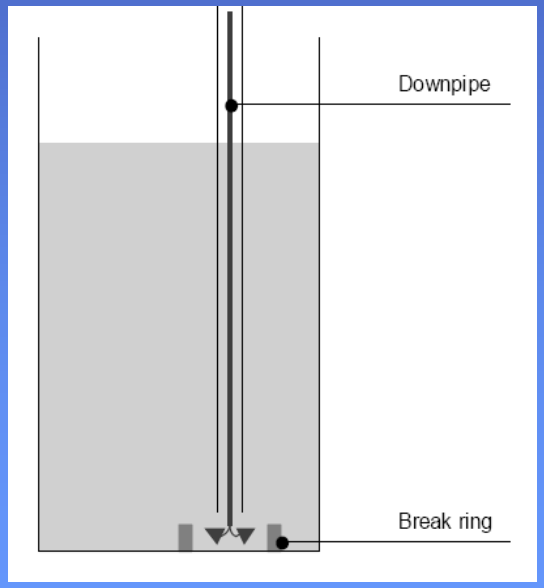
- ***Storage systems* - *reservoir***
- Several options:
  - Below ground cisterns – typically built below building structure footprint; require pump. Costly depending on capacity
  - Above ground cisterns – may be built to permit gravity flow (although will typically require a pump), avoid possible contamination by polluted ground water
  - Plastic (PVC) tanks – common, low cost alternative; capacity limited to number of tanks used

System configuration

Storage systems







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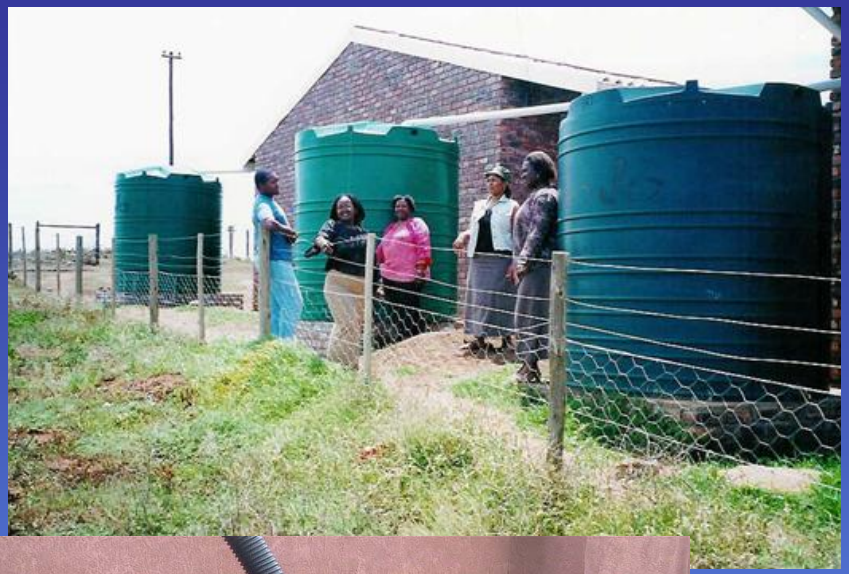

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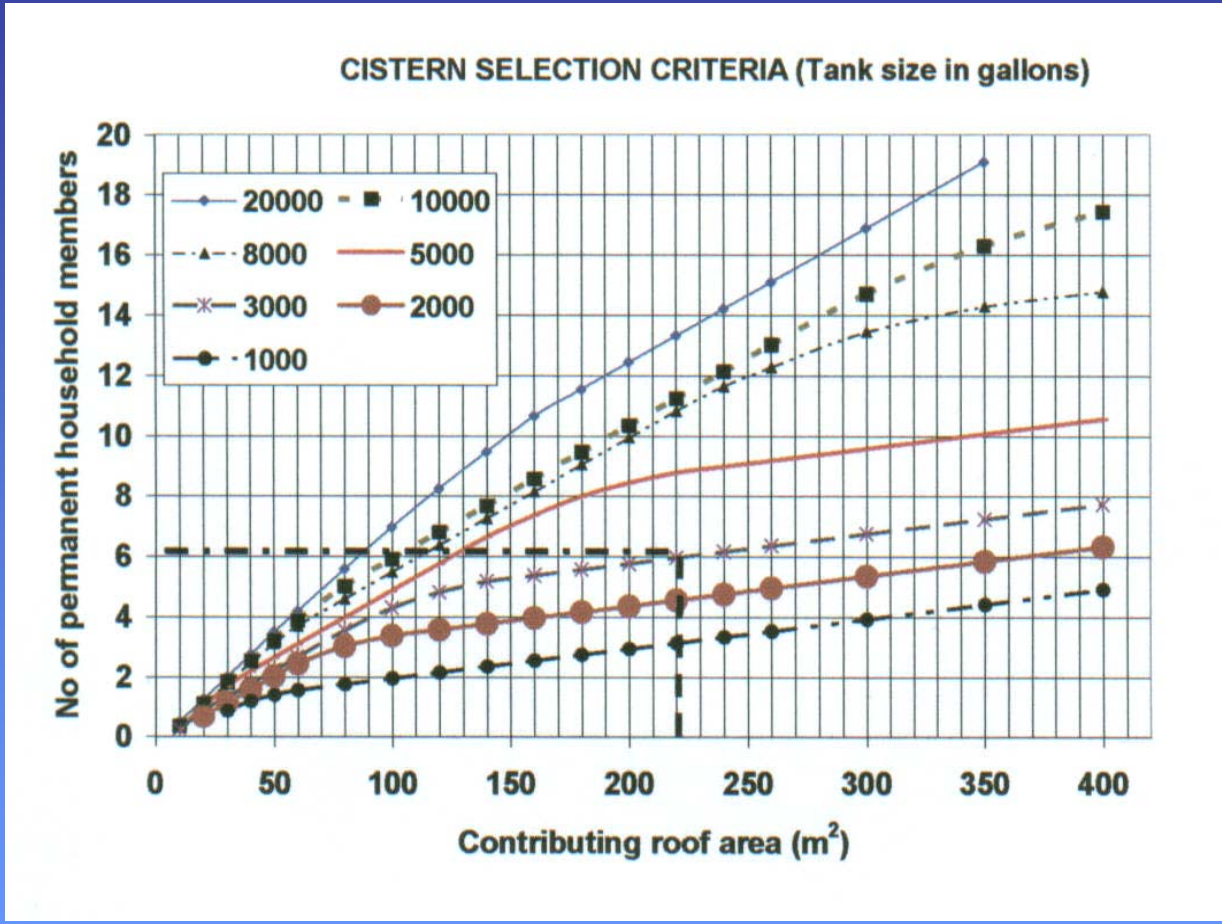
System configuration

Storage systems

- Sizing storage systems
- **Illustration:**

Six person household with a 225 m^2 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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Thank You!

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