

Capacity Building Workshop

Non-Conventional Water Resources Management: Local Solutions

Malta, 13-14 November 2019

**Rainwater Harvesting & Green-Blue
infrastructure: worldwide applications and case
studies in Malta & the Mediterranean Region**

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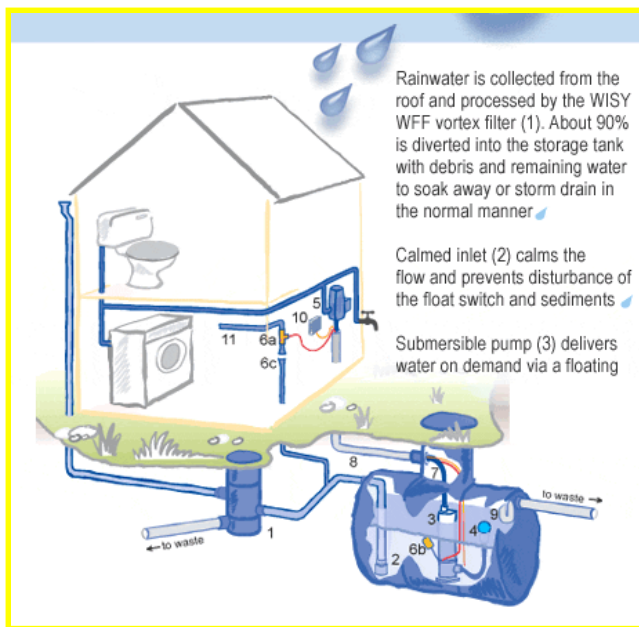
Benefits of harvesting rainwater

- Saving water resources
- Cutting down monthly expenses and costs
- Preventing soil erosion
- Reusing water for irrigation
- Ensuring a potable water resource
- Reducing flood events in urban areas

Rainwater – harvesting systems

- Typical simple or complex systems
- Systems for domestic, industrial or agricultural use

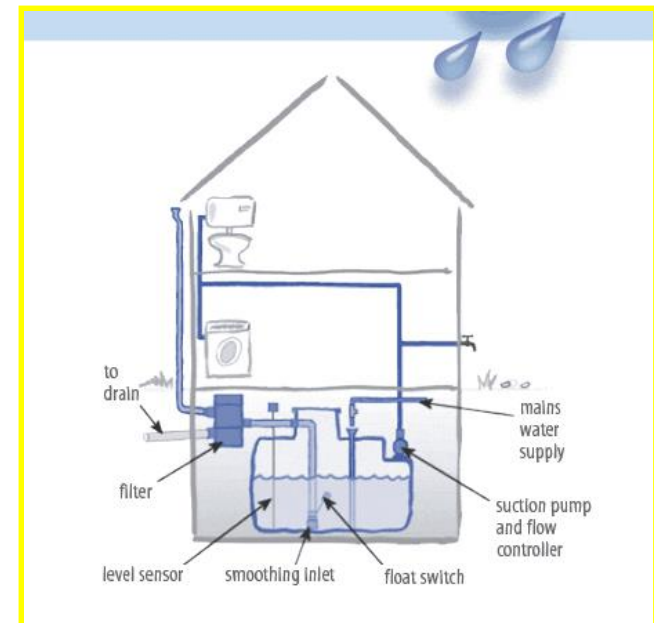
Typical system



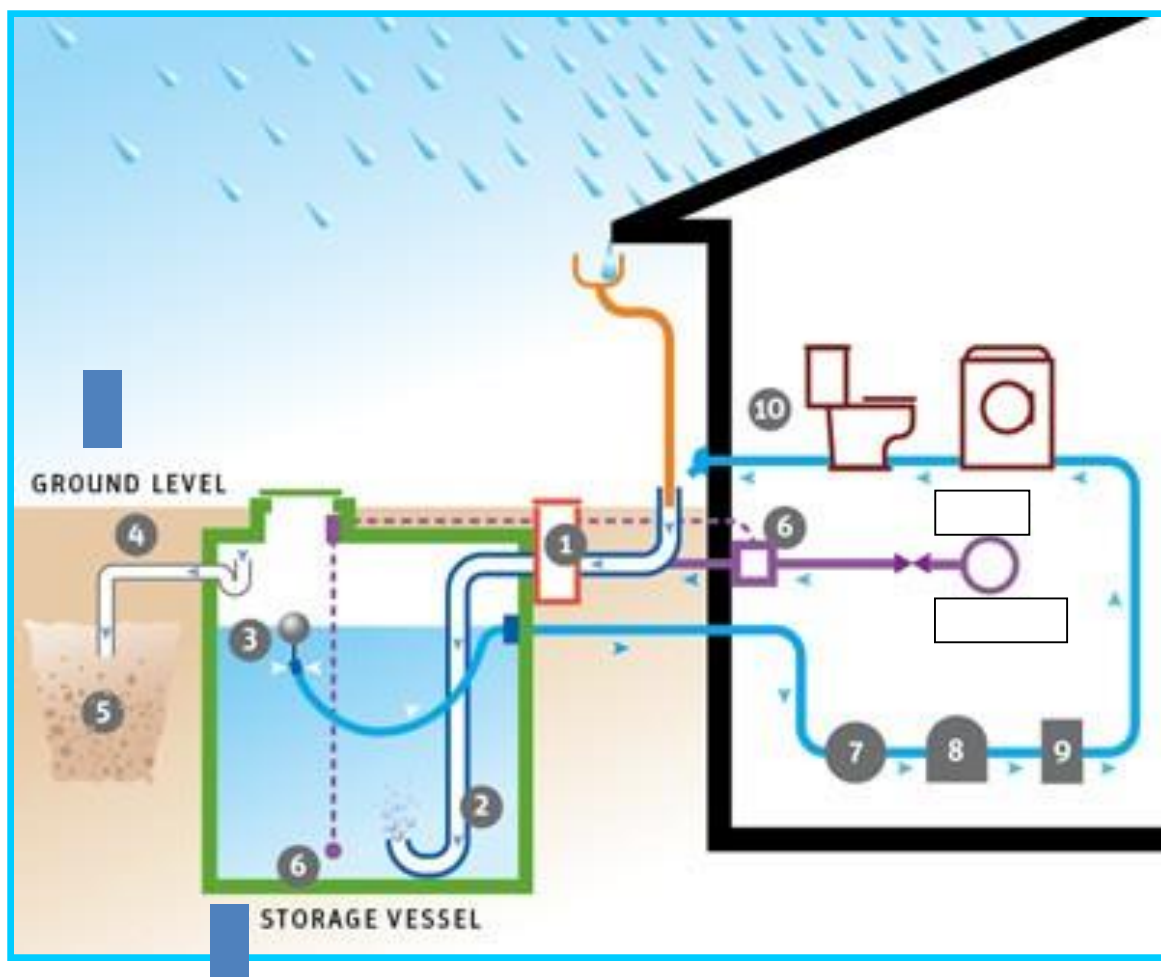
Garden system



Integrated system



Basic parts of a rainwater harvesting system



(1)

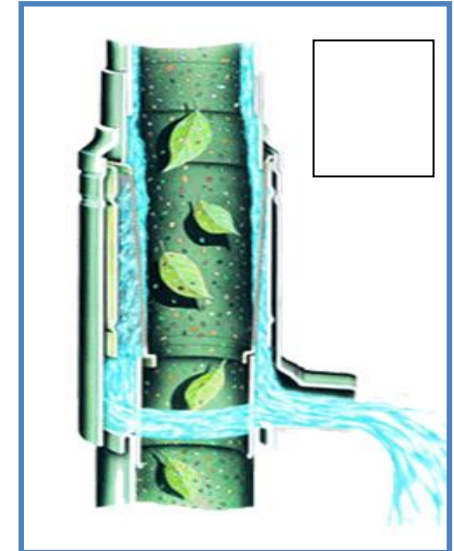
Water Collection Surface

- The size of the collection surface and building material affects the quantity and the quality of the harvested water.
- The water that is collected from any surface can be used for irrigation purposes.
- The water that is collected from roof tops and metal surfaces can be used as potable water.

(2)

Gutters, downspouts, outlet and inlets pipes

- The size and slope of the gutters affect the quantity of the harvested water.
- The preferable downspouts is aluminum- made or plastic.



(3)

Water tanks

- There are made in many sizes and different materials. The criteria selection:
 - Capacity
 - Usage
 - Costs
- Types of water harvesting tanks:
 - Concrete tanks
 - Polyethylene - Underground, Ground level
 - Metal tanks

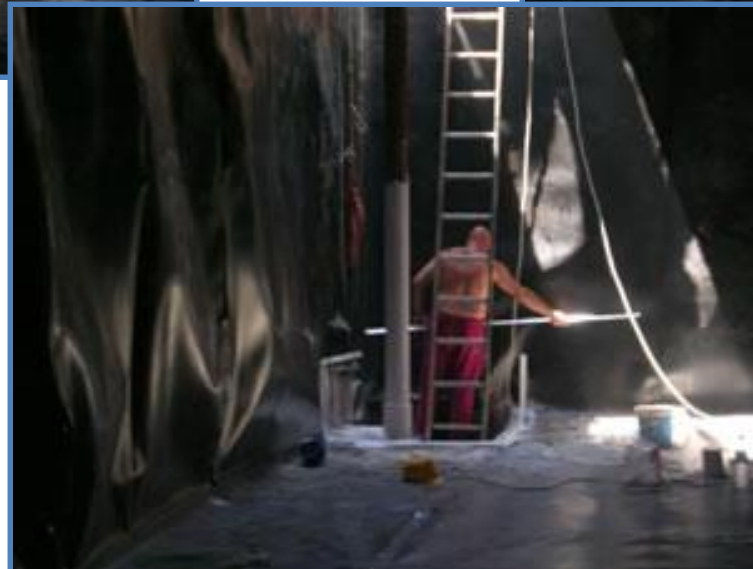
Concrete tanks



Concrete tanks



Concrete tanks



Advantages and disadvantages of concrete tanks

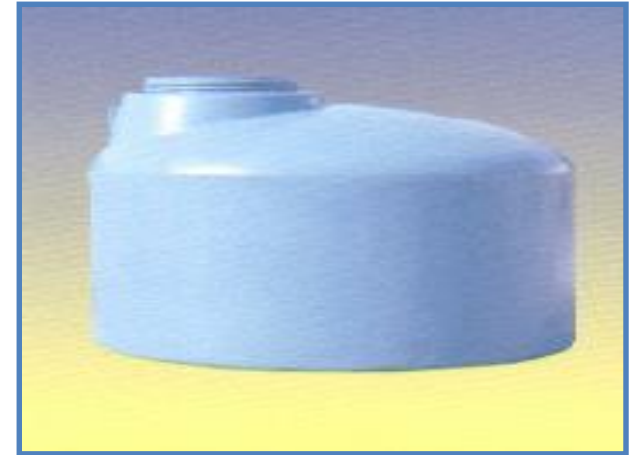
Advantages

- ✓ It can be build underground or on the surface
- ✓ Suitable for drinking water after processing
- ✓ It is built to meet the customers' requirements or specifications.

Disadvantages

- ✗ High Building costs
- ✗ Lengthy building times
- ✗ High maintenance costs
- ✗ Faulty building material-building miscarriage

Plastic tanks



They come in variant designs and colours



Advantages and disadvantages of plastic tanks

Advantages

- ✓ Light structures
- ✓ Low cost in small sizes
- ✓ Quick installation
- ✓ Easily transported
- ✓ Easily cleaned
- ✓ Suitable for drinking water

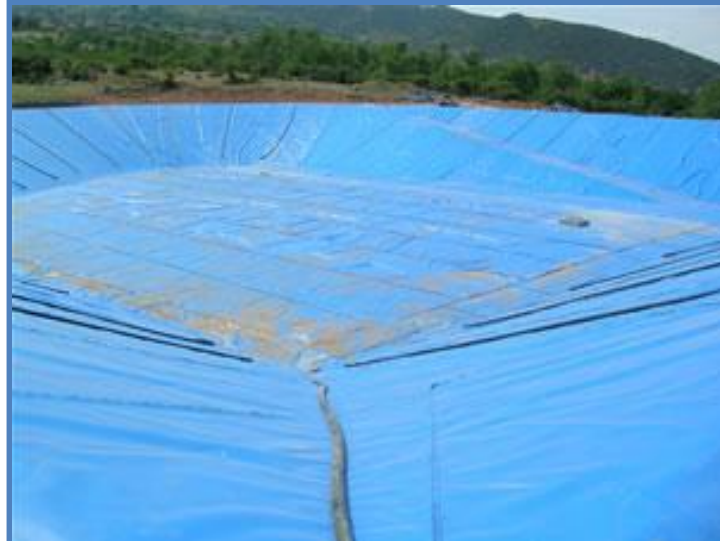
Disadvantages

- ✗ Fragile
- ✗ Stagnant water
- ✗ High costs in bigger sizes
- ✗ Tricky pipe connection

Failure of Plastic tanks



Open structures, artificial lakes, water reservoirs



Advantages and disadvantages of open structures, artificial lakes

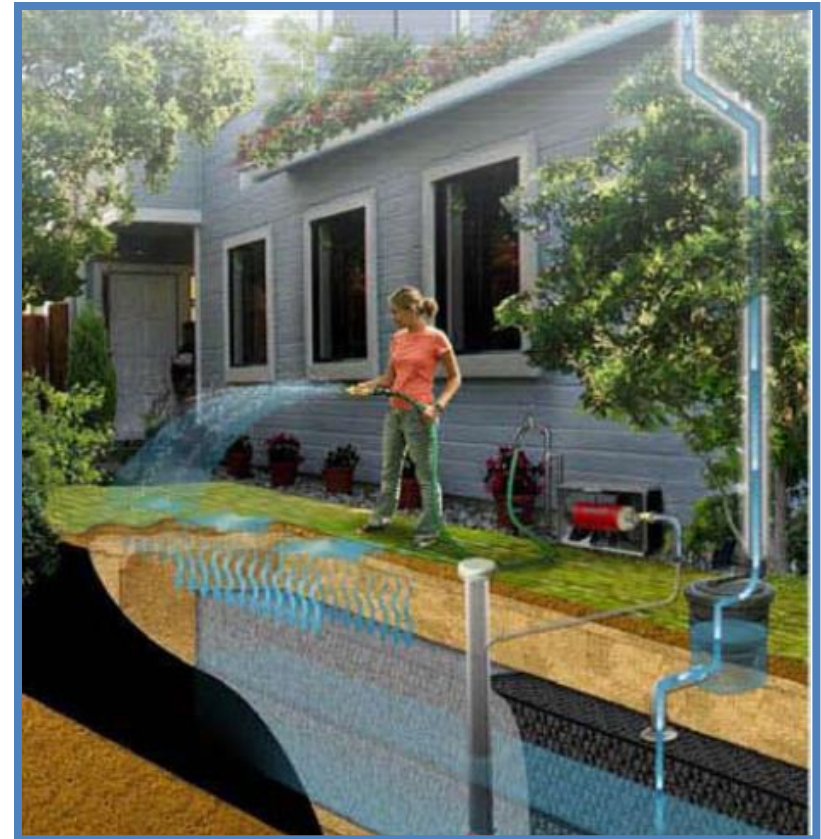
Advantages

- ✓ Easy to make
- ✓ Easy and quick installation
- ✓ Low costs
- ✓ Large dimensions
- ✓ Long lifespan
- ✓ Easy to maintain
- ✓ Easy to repair.

Disadvantages

- ✗ Evaporating of water
- ✗ Stagnating water
- ✗ Hosts viruses and bacteria
- ✗ Algae growth
- ✗ Difficult to find holes in the membrane.

Modular assembled tanks



Advantages and disadvantages of modular boxes

Advantages

- ✓ Easy transportation
- ✓ Easy and quick installation
- ✓ Low cost
- ✓ Variety of dimension and shapes that can be build
- ✓ Low maintains cost
- ✓ Easily cleaned
- ✓ Long lifespan

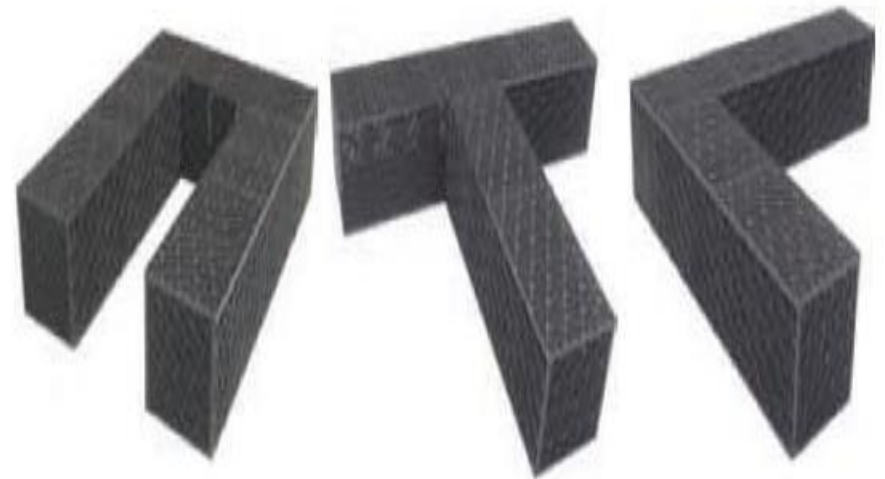
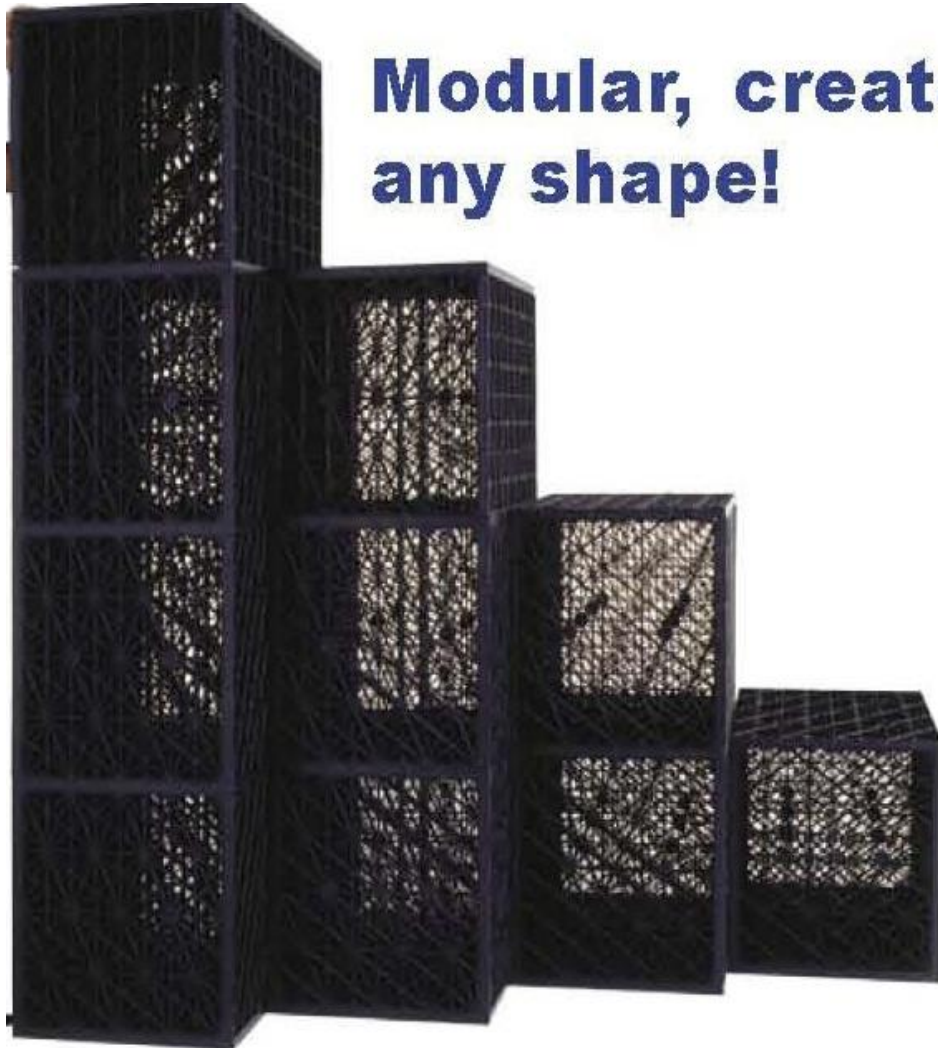
Disadvantages

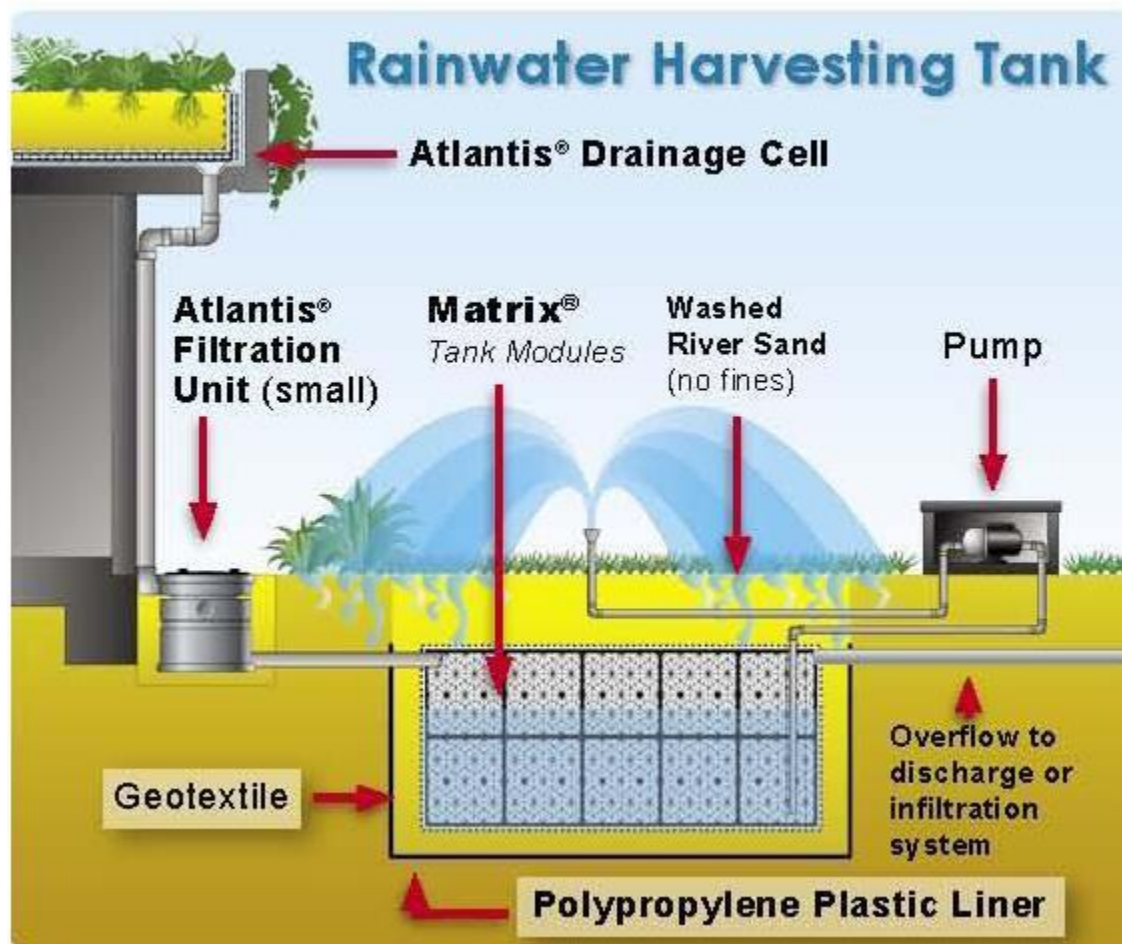
- ✗ Not easily accessible
- ✗ With problematic installation, it must be excavated again.

Underground tank with modular boxes



**Modular, create
any shape!**





Technical video

Sgourou School Project, Rhodes, Greece



www.youtube.com/watch?v=yC4kjEKYvv0

Metal Tanks



Advantages and disadvantages of metal tanks

Advantages

- ✓ Easy transportation
- ✓ Quick installation
- ✓ Good cost
- ✓ Variety of dimension
- ✓ Easy cleaning
- ✓ Easy maintenance
- ✓ Easy to repair

Disadvantages

- ✗ Evaporation of the water if not covered
- ✗ Stagnating water
- ✗ Near saltwater it must be maintained more often.
- ✗ Must always have water inside for weight.

(4)

Transport and purifications of rainwater

Transport

- With submersible pumps
- With outside pumps

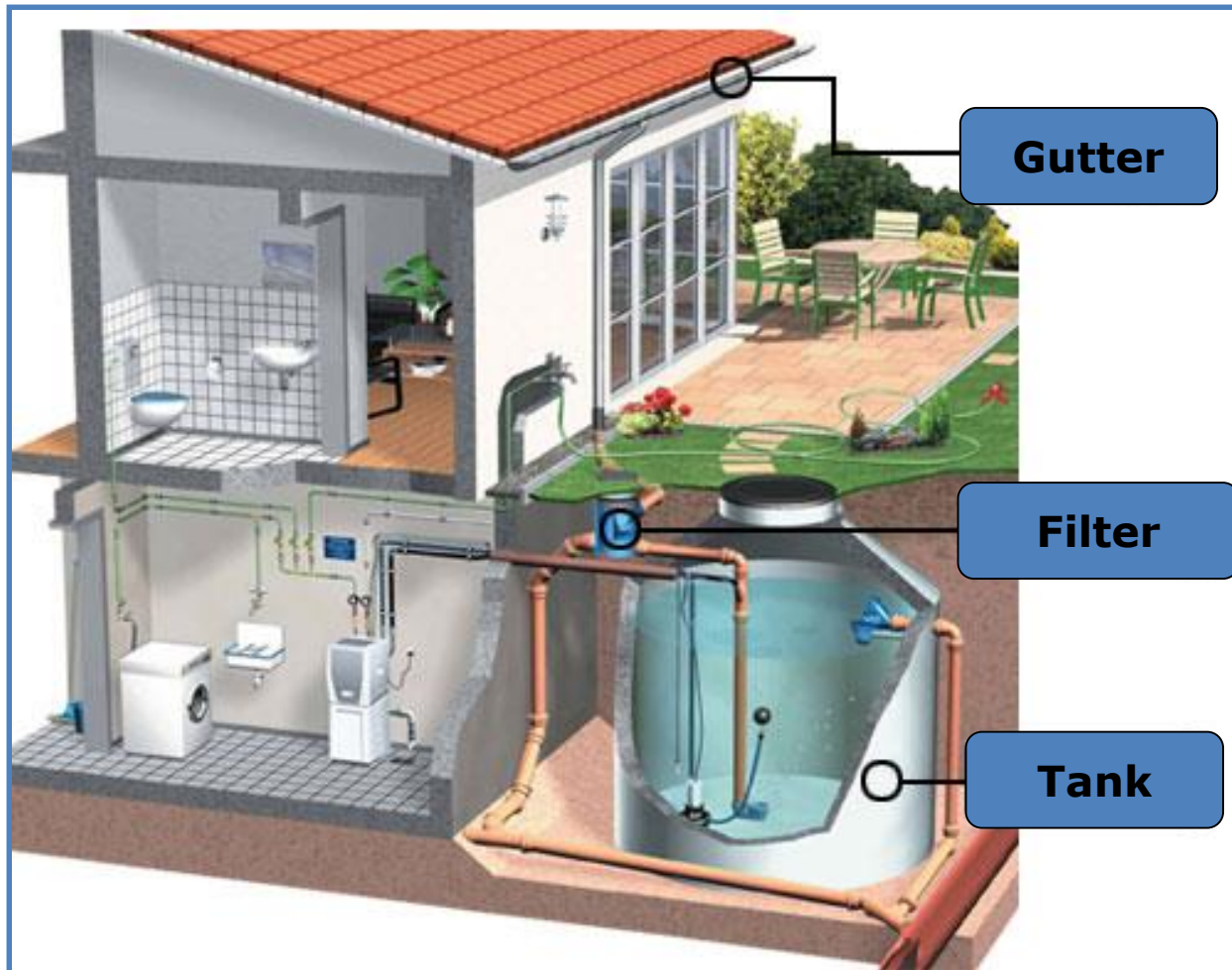
Cleaning water

- In case of drinking water a cleaning system must be applied.

Techniques:

- Manholes with sand or gravel filling
- Filters – for removing and collect debris and small parts
- infiltration
- Reverse osmosis

A typical rainwater harvesting system



Planning the installation process of the system

- Defining needs and uses rainfall study or knowledge
- Size of the tank
- Installation area
- Which kind of tank (Metal, concrete etc.)



Phase 1

Defining need and uses

The use determines the type of system

Basic questions

- Potable water or not?
- Quantity of water that is needed?
- For residential use or for watering?
- What kind of tank, (metal concrete, modular etc.)?

Phase 2

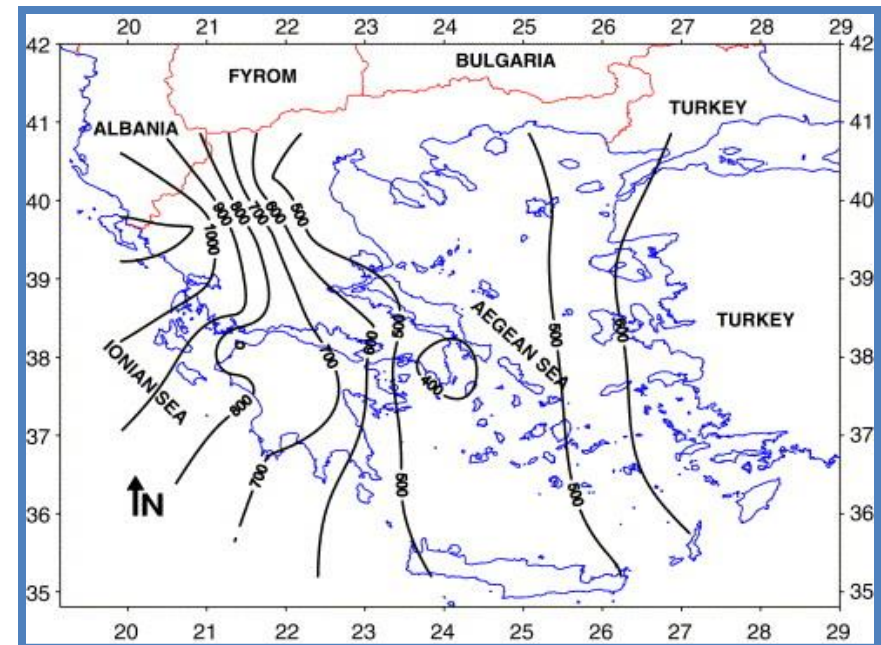
Rainfall data

The rainfall data provide information on the amount of water that can be collected and stored.

Calculations

- When does it rain?
- How much is it raining?

You need to know the average rainfall per year and per month.



Phase 3

Study rainfall data and calculations

Given the required amount of water and rainfall data, one can calculate the required surface that is needed to collect rainwater

Calculations

Surface area(m²) X Rainfall (mm) = Quantity of water(lt)

There are always losses of 10-25%

Phase 4

Selecting the size of the tank and the installation area

The capacity and the type of tank is defined by:

- From the amount of water desired to be collected
- The cost
- The characteristics of the installation area
- aesthetic requirements
- Preference for the cleaning and maintenance of the tank
- Water Distribution and aesthetics

Phase 5

Other parts of the system

What other parts is necessary?

- Gutters
- Outlet spout
- Cleaning system, infiltration, filters

Where to put everything?

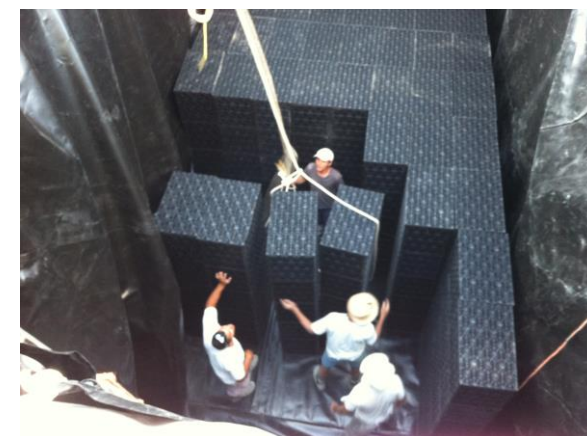
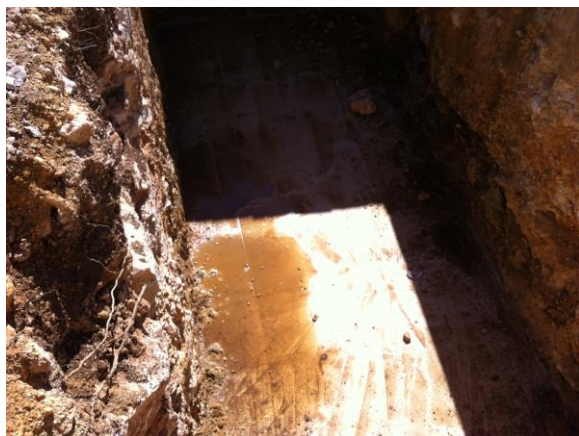
- Is there enough space?
- Is it easy to maintain it?
- What is the cost?

Phase 6

Recheck system requirements

- Do we meet the initial requirements?
- What is the expected cost?
- What is the impact on the existing infrastructure (aesthetics)?
- Study and review of the original design if necessary.

Rainwater harvesting reservoir At Zeebug School, Gozo





Rainwater harvesting reservoir At Ministry for Gozo





Rainwater harvesting reservoir at Syros island, Cyclades, Greece















What is green-blue infrastructure?

- **Green** landscape elements are hedgerows, copses, bushes, orchards, woodlands, natural grasslands and ecological parks.
- **Blue** landscape elements are linked to water. They can be pools, ponds and pond systems, wadis, artificial buffer basins or water courses. Together they form the **green-blue infrastructure**.

Benefits of green-blue infrastructure

- Reducing flood events in urban areas
- Utilizing additional water resources through rainwater harvesting and stormwater collection
- Saving water resources
- Increasing urban green without putting additional pressure to water resources
- Improving microclimate, energy efficiency, air quality and urban well-being

Green-blue infrastructure technologies



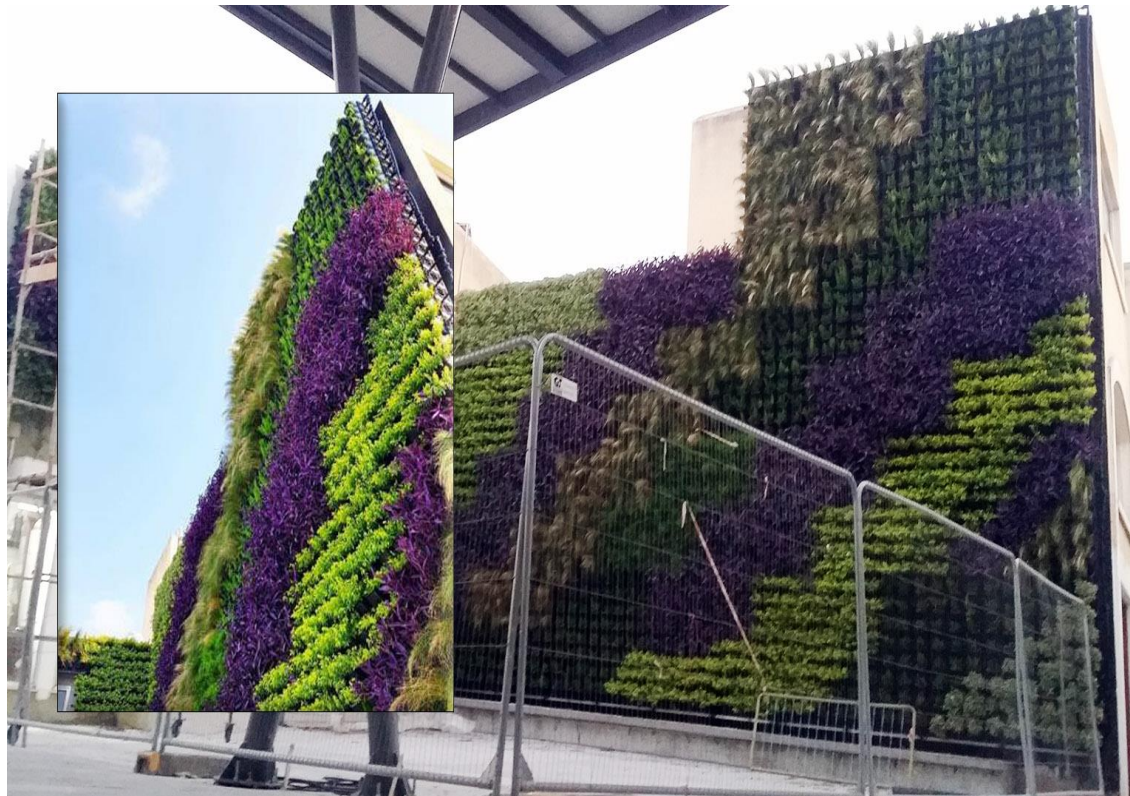
Green pavings

Can be combined with infiltration & underground storage



Green wall, Cyprus

Can be combined with rainwater harvesting or stormwater collection



Green wall in Thessaloniki, Greece

Rainwater harvesting & storage at the rooftop



Plants:

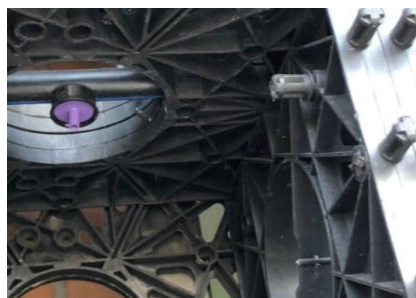
- *Pittosporum nana*
- *Nandina domestica nana*
- *Euonymus fortunei harlequin*
- *Rosmarinus officinalis prostratus*

Green wall coupled with a rainwater harvesting system:

- Collection of rainwater at the roof
- Storage in a tank at the roof; local pumping, small height
- Drip irrigation, including liquid fertilizer in small dosage

Multiple benefits:

- Increased energy efficiency at the building
- Upgraded urban landscape
- Improved microclimate
- Contribution to flood prevention





NCWR

NON CONVENTIONAL WATER RESOURCES
PROGRAMME IN THE MEDITERRANEAN