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
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 built 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.
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**

\[
\text{Surface area (m}^2) \times \text{Rainfall (mm)} = \text{Quantity of water (lt)}
\]

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