Chapter 3: Harvesting rainwater for landscape use

Topics to be covered in this chapter

I. Why harvest rainwater?
II. Creating a rainwater harvesting system
III. Types of rainwater harvesting systems
IV. Components of a rainwater harvesting system
V. General considerations

Definitions

Catchment area: is any area from which water can be harvested, such as rooftops, paved areas, and driveways.
Drip line: an imaginary line that defines the area beyond the outer edge of the plant's foliage.
Water harvesting: capturing rainfall for use in irrigation and for different domestic uses.

Introduction

Harvested rainwater is a renewable source of clean water that is ideal for landscape use. Water harvesting systems provide flexible solutions that can effectively meet the needs of new and existing, as well as of small and large sites. Using a water harvesting system is an ongoing process that can be developed over time.

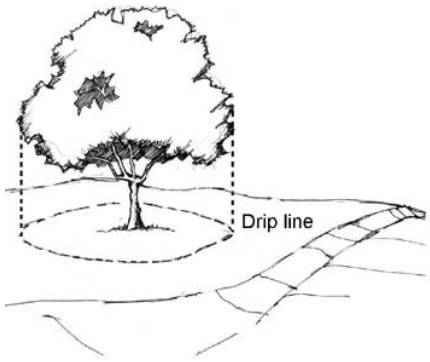
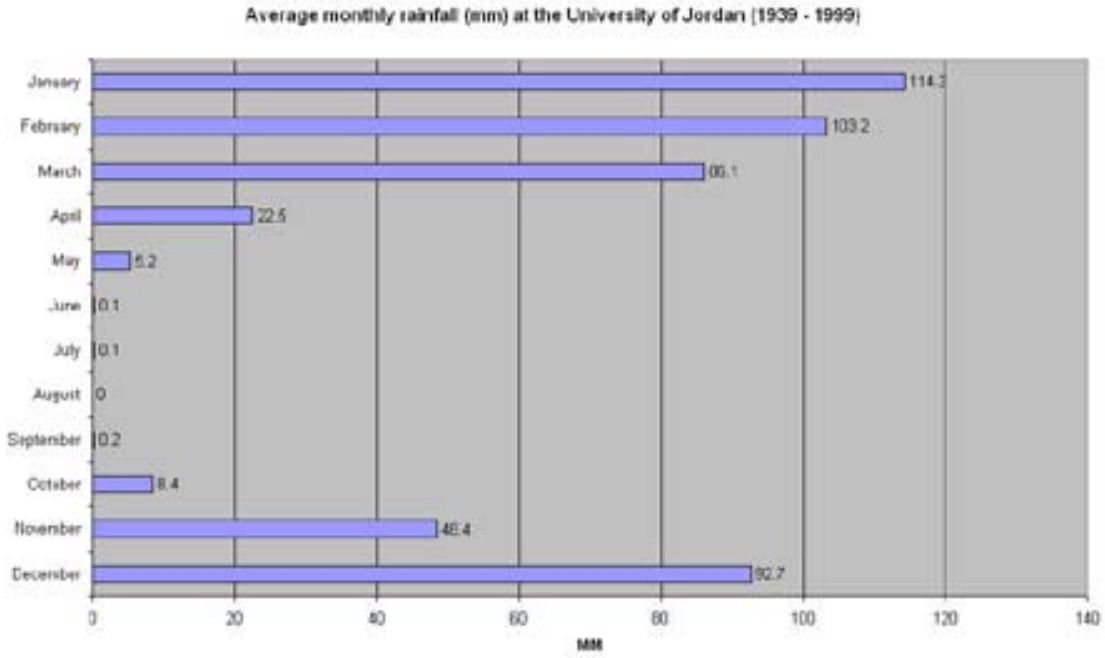


Fig. 3.1: Most of the plant's feeder roots are concentrated near the drip line, beneath the outer edge of the plant's foliage.

I. Why harvest rainwater?

- To save water for the long dry season: The average rainfall in Amman during January may exceed 115mm, but goes down to zero during the three months of June, July, and August. Harvesting rainwater makes it possible to save the excess winter rainwater for use during the dry summer months.
- To save money: Harvesting rainwater can reduce your dependence on municipal water supplies and consequently result in considerable savings in your water bills.
- To reduce off-site flooding and erosion by holding rainwater on the site.
- To provide a source of water that is ideal for plants, since it is clean, salt-free, and has a hardness of zero.

- To reduce salt accumulation in the soil (when using passive rainwater harvesting; see following section). Rainwater percolates into the soil and forces salts down and away from the root zone area (a process called leaching). This allows for greater root growth and water uptake, and eventually increases the drought tolerance of plants.



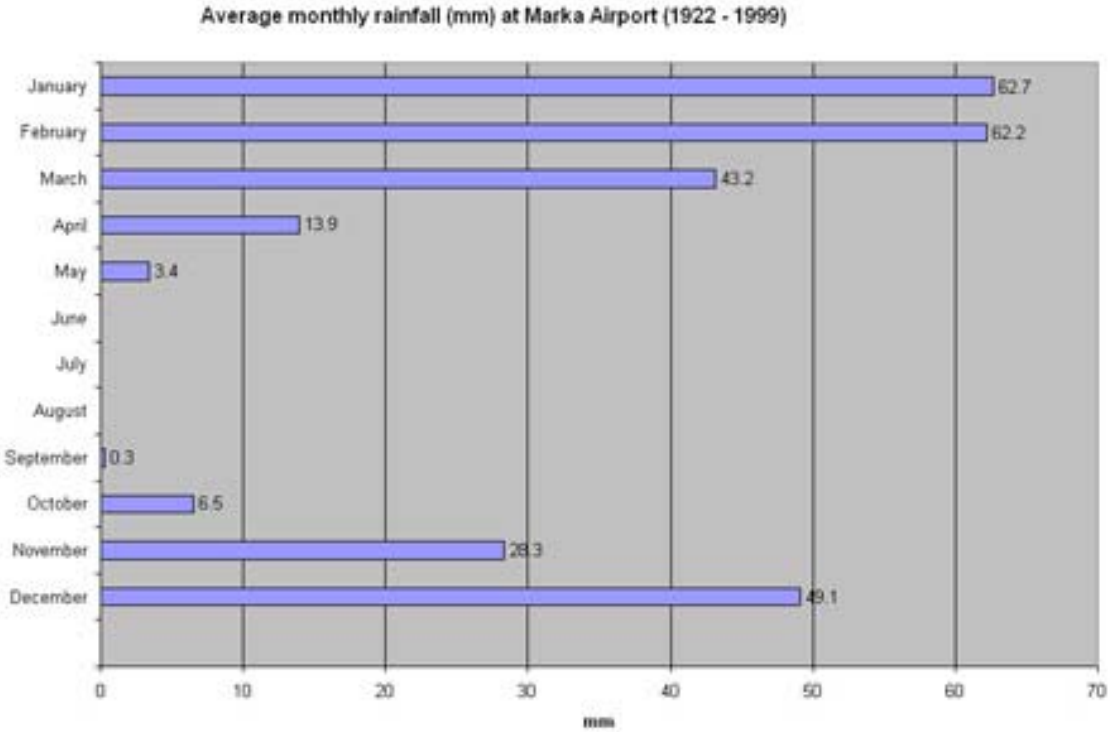


Fig. 3.2: Monthly mean precipitation charts for the University of Jordan and Marka, Amman. (Source: Jordan Meteorological Department, Amman.)

Jordan overview

Historically, rainwater harvesting was used in Jordan to provide water that is suitable for various domestic and irrigation uses. A number of distinctive historical examples that incorporate effective water harvesting systems survive in the country. These include the cut-stone reservoirs of the Nabatean city of Petra, as well as the underground cisterns found in the country's Umayyad desert palaces, Crusader period castles, and traditional village houses.

Fig. 3.3: A historical example of water harvesting at the Amman Citadel. Water collected from the roof is directed through channels towards water storage areas.

II. Creating a rainwater harvesting system

- Carefully observe and analyze the site during a rainfall period to be able to harvest water from it in the most efficient possible manner.

Gardener's checklist
Analyzing a rainwater harvesting site

- Identify high and low rainwater areas.
- Identify drainage patterns and gravity flow.
- Identify catchment areas.
- Study the site's natural topography.
- Study the type of soil on the site.
- Study existing plants on the site and their water requirements.

- A water harvesting system can provide an attractive landscaping and architectural design element that is functionally and aesthetically integrated within the site.
- Developing a water harvesting system is an on-going process that can be improved upon and expanded over time.

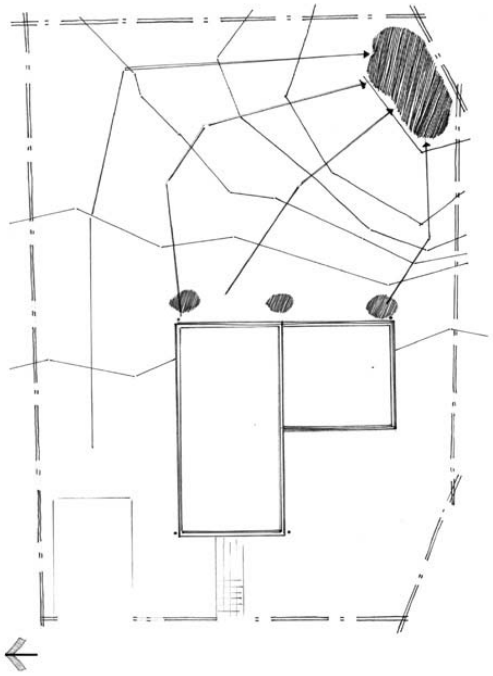


Fig 3.4: A site plan showing an analysis of rainfall drainage.

III. Types of rainwater harvesting systems

1. <u>Passive rainwater harvesting systems:</u>

No storage containers are used, and rainwater can be diverted from roof areas or paved surfaces in the garden immediately to the soil (or to the "landscape holding" areas) in the site, for direct use by the plants.

- Make sure that the soil in the landscape-holding areas is not compacted, because this inhibits water from moving through the soil. After planting, apply a layer of mulch to reduce evaporation and to control erosion. If the soil is compacted, loosen it by tilling. If the soil is too sandy, add organic matter to increase the soil's moisture-holding potential.
- Be careful in the selection of plants for the low-lying landscape-holding areas. These areas can get saturated with water for extended periods of time, and some plants may not be able to survive such conditions.
- For new plantings, locate the plants at the upper edge of concave holding areas, to encourage extensive rooting and to prevent soil erosion.
- To take advantage of water falling freely from roofs, plant large sturdy plants where the water falls. Also, use rocks or other hard material, or hang a large

chain from the downspout to the ground, to disperse and slow down the water, and also to prevent erosion.

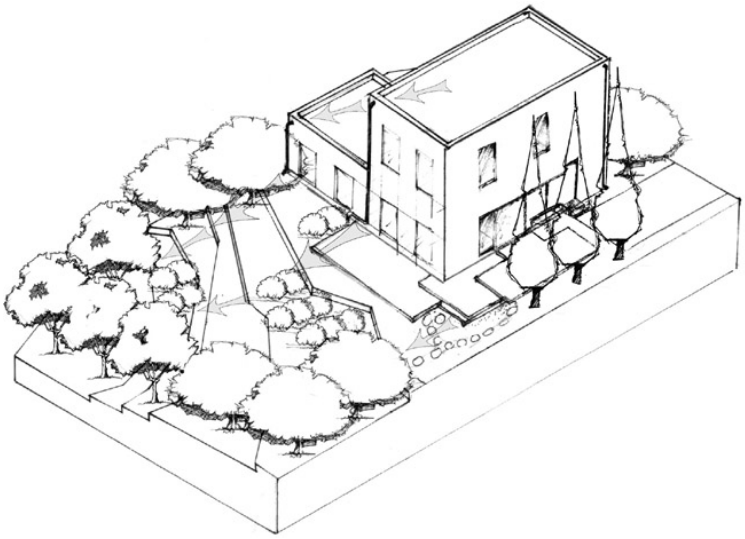


Fig. 3.5: A site plan showing an analysis of rainfall drainage.

Creating landscape holding areas

- Locate and identify existing landscape holding areas on the site. If you do not find such areas, create them. They may consist of concave depressions that are dug out with the extra soil berming them, or flat areas supported with berms, moats, or soil terracing.
- Extend these areas beyond the drip line of the plants to accommodate and encourage the growth of extensive root systems. Do not dig such areas around existing plants, but construct berms or moats on the existing surface, to avoid damaging plant roots.
- If the site is sloped, create large connected and descending holding areas, to avoid flooding.

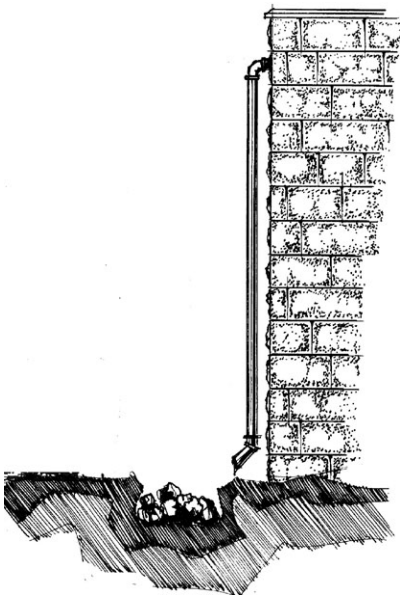


Fig. 3.6: Rocks may be used to disperse water coming out of a downspout.

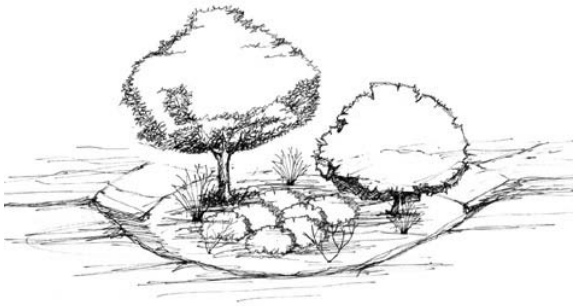


Fig. 3.7: Landscape holding areas may be concave depressions that hold rainwater passing through the site, thus allowing plants to better benefit from that rainwater.

2. <u>Active rainwater harvesting systems:</u>

All or some of the rainwater falling on the catchment areas is not used immediately, but is stored in containers for the dry season. (The sections below provide details regarding the creation of an active water harvesting system).

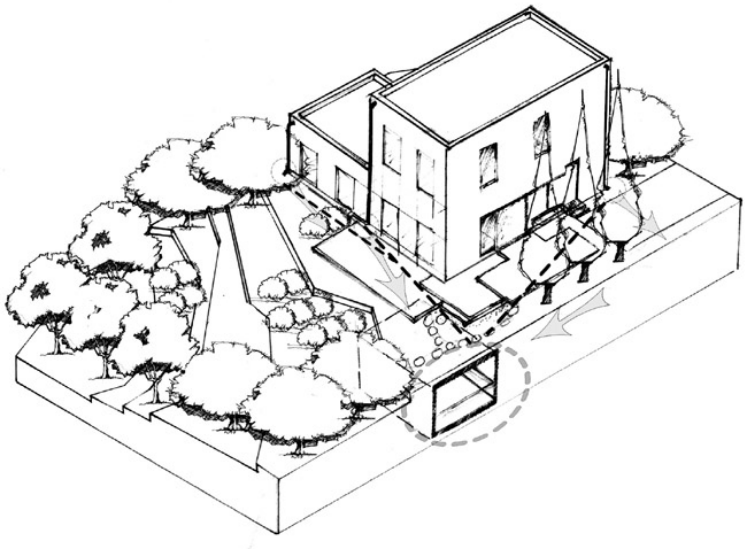


Fig. 3.8: An active rainwater harvesting system.

IV. Components of a rainwater harvesting system

A rainwater harvesting system depends on four elements:

1. Catchment area.
2. Water storage container.
3. Conduits connecting the catchment area to the water storage container.
4. Conduits distributing the water from the storage area to the landscape.

A passive water system will only include the catchment area, and might also include simple conduits; but an active system incorporates all of the above-mentioned elements.

1. Catchment area:

- Hard, smooth surfaces are the most suitable for catchment areas. While ten square meters of smooth concrete may harvest up to 4.75 cubic meters of water in the wetter parts of Jordan (depending on the microclimate), an equivalent area of flat sandy surface may harvest only 0.25 cubic meters.
- If the surface is impervious, runoff occurs immediately; but if the surface is pervious, runoff will not occur until the surface is saturated.
- Do not paint catchment areas with potentially toxic materials, especially if the water is to be used to irrigate vegetables and herbs.

How much rainwater will you be able to harvest?

QUANTITY OF HARVESTED RAINWATER (CUBIC METERS) = RAINFALL (METERS) X CATCHMENT AREA (SQUARE METERS) X RUNOFF COEFFICIENT *

* The runoff coefficient is the percentage of the rainfall that can be harvested from a specific material. It varies from 0.95 - 0.90 for asphalt and smooth concrete to 0.10 - 0.05 for flat, sandy soil.

2. <u>Water storage containers:</u>

Water can be stored in many different types of containers; the choice of these containers depends on your needs, preferred materials, placement, capacity, and cost.

- Locate water storage containers as close as possible to the points of collection and use, and far away from contamination sources, such as septic tanks and sewage networks.
- When collecting water from a high-level catchment area such as a roof, place containers at an elevated level to take advantage of gravity flow. This will put less stress on pumps and will conserve electricity.
- Place the containers at the high end of the property, to facilitate gravity flow.
- Connect the water storage containers to the municipal water supply and make them accessible to water trucks, so as to be able to replenish them if the amounts of harvested rainwater become scarce during the dry season.
- Seal the water container to keep out organic materials and sunlight. This will prevent evaporation and bacterial growth.
- Provide the inlet for the water storage tank with a filtering device (which could simply consist of a window screen), to stop leaves and debris from making their way into the tank. The level of filtration depends on the irrigation system used. For example, drip irrigation requires finer filtering, in comparison to irrigation with a hose.
- Divert the first part of the rainfall away from the storage area, so as to wash away the dust and debris that collect on the catchment area during the dry

period, and to prevent the dust and debris from accumulating in the storage containers.

- In some cases, it is more useful to locate several smaller water containers where water is required. These might be easier to handle and to hide, but they will increase installation costs.

Underground vs. aboveground water storage containers

- Underground water storage areas, or cisterns, are expensive to build. However, they are visually unobtrusive and occupy almost no space in the garden.
- Swimming pools, unused septic tanks, and culverts can be used as underground cisterns.
- New underground cisterns can be built of concrete block, cast-in-place concrete, building rock, or steel.
- Aboveground water storage containers are less expensive to install than cisterns, but occupy space in the garden.
- Aboveground large water storage containers can be made of reinforced concrete blocks, stone, steel, or polyethylene. One can also use prefabricated smaller containers made of steel, polyethylene, or clay.
- When using aboveground water containers, consider placing them vertically, rather than horizontally. This way, they will occupy less space and will provide for additional gravity flow.

3. Water conduits connecting catchment areas to water storage containers:

A great variety of alternatives exists for water conduits. These include gutters, downspouts, channels, and ditches. Proper sizing of these elements is important to efficiently direct the harvested rainwater.

- Gutters and downspouts can be either concealed inside the wall, or attached to the exterior of the building. Exterior gutters and downspouts have the potential of forming distinguishing architectural elements. They can also be added at any time to the outside of the building.
- To maximize the efficiency of water collection, space downspouts a minimum of 6 meters, and a maximum of 15 meters, apart.
- Provide 7 square centimeters of downspout area for every 10 square meter of roof area.
- To insure the proper flow of water, provide the gutters with a minimum slope of 2%.
- When using outside gutters, provide them with supporting hooks at one-meter intervals.
- Do not paint water conduits with potentially toxic materials, especially if the harvested rainwater is to be used to irrigate vegetables and herbs.

4. Water distribution:

Water can be distributed from storage containers to the planted areas through a variety of conduits, including hoses or solid or perforated pipes.

Drip irrigation systems are the most effective, in terms of achieving significant water savings. Constructed channels can provide a unique aesthetic value to the landscape, and also are durable and almost maintenance-free.

If gravity flow is not possible, an electric pump would be needed to distribute water.

V. General considerations

- When adding a water harvesting system to an existing garden, compare your water bills before and after installing the system - to accurately assess its effectiveness.
- Observe and test your system during the rainy season and implement the necessary adjustments to increase its efficiency.
- Inspect your system before and after each rainy season.
- Make sure that no water escapes your property. This way you not only save water, but also contribute to preventing urban flooding and the overflow of the municipal storm water system.

Maintenance tips

- Keep holding areas, gutters, and downspouts free of debris.
- Clean and maintain the storage containers as well as the different conduits of your water harvesting system such as gutters, downspouts, channels, and filters.
- Control and prevent erosion. Block erosion trails.