



Methods of Rainwater Harvesting [PDF]: Components, Transport and Storage

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Broadly there are two ways of harvesting rainwater, namely; surface runoff harvesting and rooftop rainwater harvesting. Rainwater harvesting is the collection and storage of rain for reuse on-site, rather than allowing it to run off. The stored water is used for various purposes, such as gardening, irrigation, etc. This article discusses multiple methods of rainwater harvesting.

Methods of Rainwater Harvesting

1. Surface Runoff Harvesting

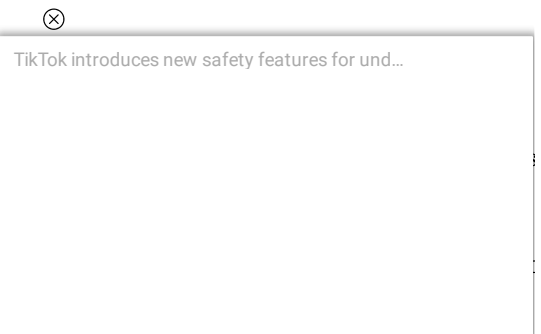
In urban areas, rainwater flows away as surface runoff. This runoff can be caught and used for recharging aquifers by adopting appropriate methods.

2. Rooftop Rainwater Harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the rainwater is collected from the roof of the house/building.

It can either be stored in a tank or diverted to an artificial recharge system. If implemented correctly, helps in augmenting the groundwater level of the area.

Components of the Rooftop Rainwater Harvesting



The illustrative design of the essential components of the rooftop rainwater harvesting system is given in the typical schema diagram shown in Fig 1. The system mainly constitutes of following sub-components:

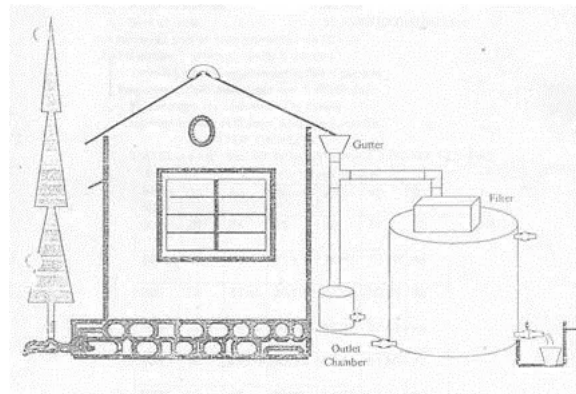


Fig 1: Components of Rainwater Harvesting

1. Catchment

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be a terrace, courtyard, or paved or unpaved open ground.

The terrace may be a flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system.

2. Transportation

Rainwater from the rooftop should be carried through down take water pipes or drains to the storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of the required capacity.



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Water from sloping roofs could be caught through gutters and down take the water. The gutters should have wire mesh to restrict floating material.

3. First Flush

The first flush is a device used to flush off the water received in the first shower. The first shower of rains needs to be flushed to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof.

It will also help in cleaning of silt and other material deposited on the roof during dry seasons. Provisions of first rain separator should be made at the outlet of each drainpipe.

4. Filter

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is a remote possibility of this fear coming true if the proper filter mechanism is not adopted.

Secondly, all care must be taken to see that underground sewer drains are not punctured, and no leakage is taking place in the vicinity.

Filters are used for the treatment of water to effectively remove turbidity, color, and microorganisms. After the first flushing rainfall, water should pass through filters.

A gravel, sand, and 'netlon' mesh filter is designed and placed on top of the storage tank. This filter is very important in keeping the rainwater in the storage tank clean. It removes silt, dust, leaves, and other organic matter from entering the storage tank.

The filter media should be cleaned daily after every rainfall event. Clogged filters prevent rainwater from easily entering the storage tank and the filter may overflow. The sand or gravel media should be taken out and washed before it is replaced in the filter. A typical photograph of filter is shown in Fig 2.



Fig 2: Photograph of Typical Filter in Rainwater Harvesting

There are different types of filters in practice, but the basic function is to purify the water. In the following section:

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1. Sand Gravel Filter

These are commonly used filters, constructed by brick masonry and filleted by pebbles, gravel, and sand. Each layer should be separated by wire mesh.

2. Charcoal Filter

Charcoal filters can be made in-situ or in a drum. Pebbles, gravel, sand, and charcoal as shown in the figure should fill the drum or chamber. Each layer should be separated by wire mesh. The thin layer of charcoal is used to absorb odor if any.

3. PVC –Pipe filter

This filter can be made by PVC pipe of 1 to 1.20 m length; Diameter of pipe depends on the area of roof. Six inches dia. pipe is enough for a 1500 Sq. Ft. roof and 8 inches dia. pipe should be used for roofs more than 1500 Sq. Ft. Pipe is divided into three compartments by wire mesh.

Each component should be filled with gravel and sand alternatively as shown in the figure. A layer of charcoal could also be inserted between two layers.

Both ends of the filter should have a reduction of the required size to connect the inlet and outlet. This filter could be placed horizontally or vertically in the system. A schematic pipe filter is shown in Fig 3.

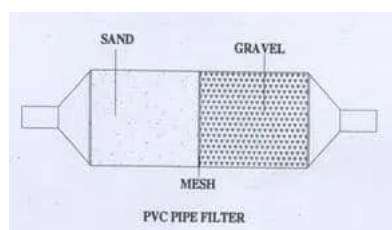


Fig 3: PVC-Pipe filter

4. Sponge Filter

It is a simple filter made from PVC drum having a layer of sponge in the middle of drum. It is the easiest and cheapest form of filter suitable for residential units. A typical figure of sponge filter is shown in Fig 6.



Fig 4: Sponge Filter

Methods of Rooftop Rainwater Harvesting

Various methods of using roof top rainwater harvesting are illustrated in this section.

1. Storage of Direct Use

In this method, rainwater collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall, and catchment availability.

Each drainpipe should have a mesh filter at the mouth and first flush device followed by a filtration system before connecting to the storage tank. Each tank should have an excess water overflow system.

Excess water could be diverted to the recharge system. Water from storage tanks can be used for secondary purposes such as washing and gardening etc. This is the most cost-effective way of rainwater harvesting.

The main advantage of collecting and using rainwater during the rainy season is not only to save water from conventional sources but also to save energy incurred on transportation and distribution of water at the doorstep. This also conserves groundwater, if it is being extracted to meet the demand when rains are on. Fig 5 shows a typical fig of a storage tank.



Fig 5: A storage tank on a platform painted white

2. Recharging Groundwater Aquifers

Groundwater aquifers can be recharged by various kinds of structures to ensure the percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are:-

- Recharging of bore wells
- Recharging of dug wells.
- Recharge pits
- Recharge Trenches
- Soakaways or Recharge Shafts
- Percolation Tanks

3. Recharging of Bore Wells

Rainwater collected from the rooftop of the building is diverted through drainage system, filtered water is diverted to bore wells to recharge deep aquifers and recharge.

Optimum capacity of the settlement tank/filtration tank can be designed based on the area of catchment, intensity of rainfall, and recharge rate. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure.

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The first one or two showers should be flushed out through rain separator to avoid contamination. Fig 6 indicates a schematic diagram of a filtration tank recharging to the bore well.

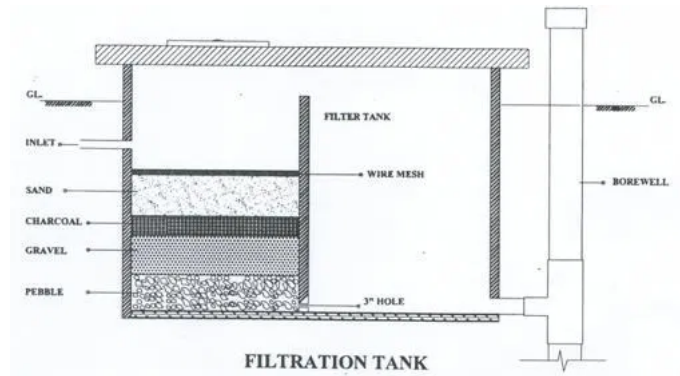


Fig 6 :Filtration Tank Recharging to Bore Well

4. Recharge Pits

Recharge pits are small pits of any shape rectangular, square, or circular constructed with brick or stone masonry wall with a hole at regular intervals. Top of the pit can be covered with perforated covers. The bottom of the pit should be filled with filter media.

The capacity of the pit can be designed based on the catchment area, rainfall intensity, and recharge rate of the soil. Usually, the dimensions of the pit may be of 1 to 2 m width and 2 to 3 m deep, depending on the depth of previous strata.

These pits are suitable for recharging of shallow aquifers, and small houses. A schematic diagram of the recharge pit is shown in Fig 7.

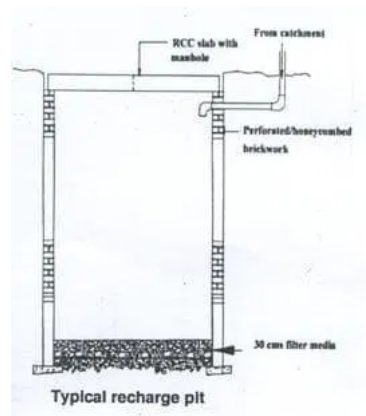
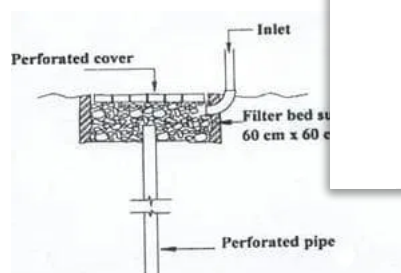


Fig 7: Recharge pit

5. Soakway or Recharge Shafts

Soak away, or recharge shafts are provided where the upper layer of soil is alluvial or less porous. These are the bored hole of 10 cm dia. up to 10 to 15 m deep, depending on the depth of the pervious layer. Bore should be lined with slotted/perforated PVC pipe to prevent the collapse of the vertical sides.

At the top of the soakaway, the required size sump is constructed to retain rainwater. The sump should be filled with filter media. A schematic diagram of the recharge shaft is shown in Fig 8.



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Fig 8 : Schematic Diagram of Recharge

shaft

6. Recharging of Dug Wells

Dug wells can be used as a recharge structure. Rainwater from the rooftop is diverted to drilled wells after passing it through a filtration bed. Cleaning and desalting of dug well should be done regularly to enhance the recharge rate. The filtration method suggested for bore well recharging could be used. Fig 9 shows a schematic diagram of recharging into dug well.

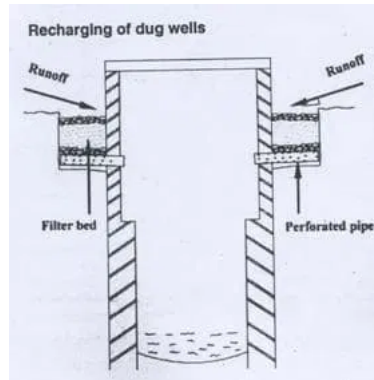


Fig 9: Schematic Diagram of Recharging
to Dug Well

7. Recharge Trenches

The recharge trench is provided where upper impervious layer of soil is shallow. The recharge trench is excavated on the ground and refilled with porous media like pebbles, boulders, or brickbats. It is usually made for harvesting the surface runoff. Bore-wells can also be provided inside the trench as recharge shafts to enhance percolation. The length of the trench is decided as per the amount of runoff expected.

This method is suitable for small houses, playgrounds, parks, and roadside drains. The recharge trench can be of size 0.50 to 1.0 m wide and 1.0 to 1.5 m deep. Fig. 10 presents a schematic diagram of recharging to trenches.

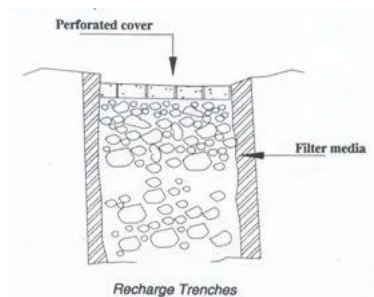


Fig 10: Recharging to Trenches

8. Percolation Tank

Percolation tanks are artificially created surface water bodies, submerging a land area with adequate permeability to facilitate sufficient percolation to recharge the groundwater. These can be built on big campuses where land is available, and topography is suitable.

Surface runoff and roof topwater can be diverted to this tank. Water accumulates in the tank and then percolates into the groundwater.

The stored water can be used directly for gardening and raw use. Percolation tanks are suitable for roadside greenbelts of urban areas.

FAQs on Methods of Rainwater Harvesting

?What are the methods of rainwater harvesting?

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There are two ways of harvesting rainwater, namely; surface runoff harvesting and rooftop rainwater harvesting.

?What is the rainwater harvesting?

Rainwater harvesting is the collection and storage of rain for reuse on-site, rather than allowing it to run off. These stored water are used for various purposes, such as gardening, irrigation, etc.

?What is surface runoff harvesting?

In urban areas, rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

?What is rooftop rainwater harvesting?

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building.

?What are the components of the rooftop rainwater harvesting?

1. Catchments
2. Transportation
3. First flush
4. Filter

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usually during the rains more water is collected by these systems than the capacity of your storage tank. Dig out a storage da say 20m x 10m x 2m deep. Use polythene membrane to cover its floor and walls, protect this water from sunlight to avoid alg growth. There you are, a simple, cost effective way to store 400,000 litres of water from the over flow of your tank. You can t farm during the dry season. No need for expensive boreholes etc. Receive what nature gives you, when it gives you!

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