Rain water harvesting

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CONTENT

Rainwater harvesting

1.0 Introduction:

At the rate in which Indian population is increasing. It has high rate consumption of most valuable natural resource "Water" is resulting in augmentation of pressures on the permitted freshwater resources. In order to conserve and meet our daily demand of water requirement, we need to think of alterative cost effective and relatively easier technological methods of conserving water.

Rainwater harvesting is one of the best methods fulfilling those requirements, rainwater harvesting is the accumulation and deposition of rainwater for reuse before it reaches the aquifer. Uses include water for garden, water for livestock, water for irrigation, etc. in many places the water collected is just redirected to a deep pit with percolation. The harvested water can be used as drinking water as well as for storage and other purpose like irrigation. A sufficient, clean water supply is essential to life.

1.1 Objectives:

1. Reducing loss of water by its running-off
2. Avoiding flooding of roads
3. Meeting the demands of increasing the water
4. Increase ground water table
5. Soilerosion will be reduce

1.2 Literature:

we are collect the information about rain water harvesting how many persons are make the project about rain water harvesting and which type of method which type of method they are adopted & we collect the information about who done rain water harvesting already and he is Mr.BaniaraplangSyiemiong. He is student of Mizoram university and he makes M.SC forestry, so lastly he has given very short cut about rainwater harvesting i.e.

Rainwater harvesting is use for direct usage or for recharging aquifers. It is most important to ensure that rain water caught is free from pollutants and finally he said it helps to quality of water improves and soil erosion will be reduced and also saving of energy per well for lifting of ground water.

2.0 LITERATURE REVIEW SUMMARY

Conservation, stormwater runoff volume, and pollutant load reduction; code and adThe literature review conducted focused on the impacts of rainwater harvesting in the areas of water ministration; and cost factors. The review included relevant information for a range of system sizes and complexities from small, passive systems (e.g. rain barrels) to larger systems with fitted pumps, controls, and treatment systems (e.g. active systems or cisterns). For each assessment topic, the primary considerations for literature review were as follows: Technical – The scientific, engineering, and design elements associated with each topic and how the technical components of a rainwater harvesting system affect performance, compliance, and cost.

• Operation and Maintenance – The practical, day-to-day, and periodic activities and costs associated with effectively operating a rainwater harvesting system.

• Programmatic – The current regulatory environment related to rainwater harvesting, including examples of code modifications, incentive programs, and public outreach.

• Predictability – Reliability of present and future performance of rainwater harvesting systems relative to each assessment topic. The results of the literature review for each assessment topic are summarized in the following sections.

2.1 Water Conservation

Throughout history, rainwater harvesting has been viewed primarily as a fresh water supply or water conservation practice. In the western United States, conservation continues to serve as a primary driver for rainwater harvesting as the region struggles to meet the water demands of its burgeoning population. This section provides a basic technical description of the two main types of rainwater harvesting systems (passive and active) and outlines the basic maintenance requirements of each. Examples of code requirements and the need for predictability of water demand are also discussed.

2.1.1 Technical

Passive harvesting systems (e.g. rain barrels) are typically small volume (50-100 gallon) systems designed to capture rooftop runoff. Rain barrels are commonly used in residential applications where flow from rain gutter downspouts is easily captured for outdoor uses such as garden and landscape irrigation or car washing. Due to their smaller sizes and ease of siting, passive systems are generally installed at grade, making impact from sunlight on the stored water a consideration. Direct and indirect sunlight will act as a catalyst for algae growth in the cistern, so exposure to sunlight should be limited where possible. Most above-ground cisterns are available in opaque colors or made from opaque materials, and are recommended. Cisterns made of translucent materials such as light colored plastics should be avoided. Water is extracted from the rain barrels through a spigot typically with no connections to internal or external plumbing. Due to the small volumes and lack of additional treatment, the water collected in rain barrels is not used indoors (even for non-potable uses), and most state and local 3 regulations require clear markings indicating that the water is non-potable..

Need for rain water harvesting

Water is one of the most essential requirement for existence of living beings. Surface water and ground water are two major sources of water. Due to over population and higher usage levels of water in urban areas, water supply agencies are unable to cope up demand from surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tube wells by house owners. Even water supply agencies have resorted to ground water sources by digging tube-wells in order to augment the water supply. Replenishment of ground water is drastically reduced due to paving of open areas. Indiscriminate exploitation of ground water results in lowering of water table rendering many bore-wells dry. To over come this situation bore wells are drilled to greater depths. This further lowers the water table and in some areas this leads to higher concentration of hazardous chemicals such as fluorides, nitrates and arsenic. In coastal areas like Chennai, over exploitation of ground water resulted in seawater intrusion thereby rendering ground water bodies saline. In rural areas also, government policies on subsidized power supply for agricultural pumps and piped water supply through bore wells are resulting into decline in ground water table. The solution to all these problems is to replenish ground water bodies with rain water by man made means.

Rain water harvesting methods

There are three methods of harvesting rain water as given below :

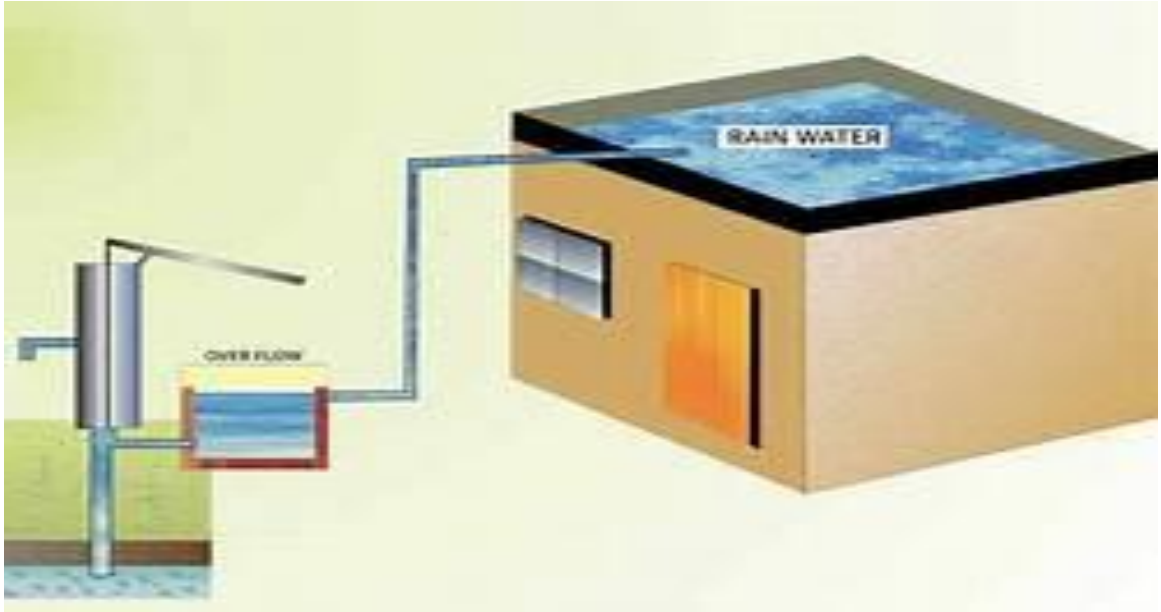
(a) Storing rain water for direct use (Fig. 2.1) (b)
(b) Recharging ground water aquifers, from roof top run off (Fig. 2.2)
(c) Recharging ground water aquifers with runoff from ground area (Fig. 2.3)

2.1.1 Storing rain water for direct use

In place where the rains occur throughout the year, rain water can be stored in tanks (Fig. 2.1). However, at places where rains are for 2 to 3 months, huge volume of storage tanks would have to be provided. In such places, it will be more appropriate to use rain water to recharge ground water aquifers rather than to go for storage. If the strata is impermeable, then storing rain water in storage tanks for direct use is a better method. Similarly, if the ground water is saline/unfit for human consumption or ground water table is very deep, this method of rain water harvesting is preferable.

2.1.2. Recharging ground water aquifers from roof top run off

Rain water that is collected on the roof top of the building may be diverted by drain pipes to a filtration tank (for bore well, through settlement tank) from which it flows into the recharge well, as shown in Fig.2.2. The recharge well should preferably be shallower than the water table. This method of rain water harvesting is preferable in the areas where the rainfall occurs only for a short period in a year and water table is at a shallow depth.



Components of rain water harvesting

The rain water harvesting system consists of following basic components –

(a) Catchment area

(b) Coarse mesh / leaf screen

(c) Gutter

(d) Down spout or conduit

(e) First flushing device

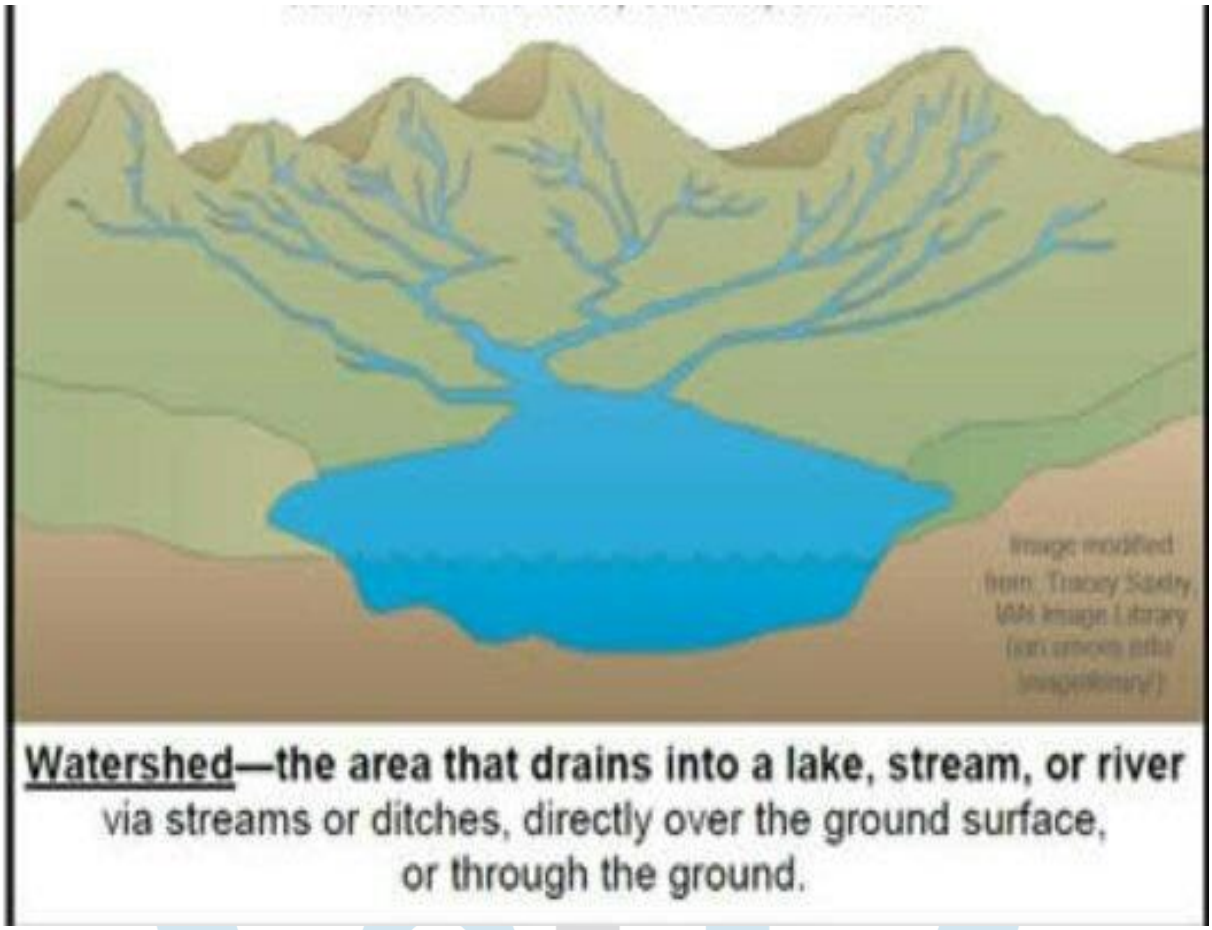
(f) Filter

(g) Storage tank

(h) Recharge structure

1. Catchment

Area The catchment area is the surface on which the rain water falls. This may be a roof top or open area around the building. The quality of water collected from roof top is comparatively much better than collection from the ground. Rain water harvested from catchment surfaces along the ground should be used for lawn watering, flushing etc., because of increased risk of contamination. This water can also be used for recharging ground aquifers after proper filtration. The rain water yield varies with the size and texture of the catchment area. A smooth, cleaner and more improvised roofing material contributes to better water quality and greater quantity with higher value of runoff coefficient. (refer table 1.3 for runoff coefficient) When roof of the house is used as the catchment for collecting the rain water, the type of roof and the construction material affect the runoff coefficient and quality of collected water. Roofs made of RCC, GI sheets, corrugated sheets, tiles etc. are preferable for roof top collection. But thatched roofs are not preferred as these add colour and dissolved impurities to water. Water to be used for drinking purpose should not be collected from roof with damaged AC sheets or from roofs covered with asphalt and lead flashing or lead based paints as the lead contamination may occur in the collected water.



2.Coarse mesh / leaf screen

To prevent the entry of leaves and other debris in the system, the coarse mesh should be provided at the mouth of inflow pipe for flat roofs as shown in Fig. 2.4. 12 For slope in roofs where gutters are provided to collect and divert the rain water to downspout or conduits, the gutters should have a continuous leaf screen, made of ¼ inch wire mesh in a metal frame, installed along their entire length, and a screen or wire basket at the head of the downspout.

2.2.3 Gutter

Gutter is required to be used for collecting water from sloping roof and to divert it to downspout. These are the channels all around the edge of a sloping roof to collect and transport rain water to the storage tank. Gutters can be of semi-circular, rectangular or trapezoidal shape. Gutters must be properly sized, sloped and installed in order to maximize the quantity of harvested rain. Gutter can be made using any of the following materials:

(a) Galvanized iron sheet
(b) Aluminum sheet
(c) Semi-circular gutters of PVC material which can be readily prepared by cutting these pipes into two equal semi-circular channels
(d) Bamboo or betel trunks cut vertically in half (for low-cost housing projects) The size of the gutter should be according to the flow during the highest intensity rain. The capacity of the gutters should be 10 to 15% higher. The gutters should be supported properly so that they do not sag or fall off when loaded with water. The connection of gutters and down spouts should be done very carefully to avoid any leakage of water and to maximize the yield. For jointing of gutters, the lead-based materials should not be used, as it will affect the quality of water.

2.2.4 Down Spout / Conduit

The rain water collected on the roof top is transported down to storage facility through down spouts / conduits. Conduits can be of any material like PVC, GI or cast iron. The conduits should be free of lead and any other treatment which could contaminate the water. Table 2.1 gives an idea about the diameter of pipe required for draining out rain water based on rainfall intensity and roof area.
First flushing device

Roof washing or the collection and disposal of the first flush of water from a roof, is very important if the collected rain water is to be used directly for human consumption. All the debris, dirt and other contaminants especially bird dropping etc. accumulated on the roof during dry season are washed by the first rain and if this water will enter into storage tank or recharge system it will contaminate the water. Therefore, to avoid this contamination a first flush system is incorporated in the roof top rain water harvesting system. The first flushing device, dispose off the first spell of rain water so that it does not enter the system. If the roof is of sloping type, then the simplest system consists of a pipe and a gutter down spout located ahead of the down spout from the gutter to the storage tank.

2.6 First flushing device

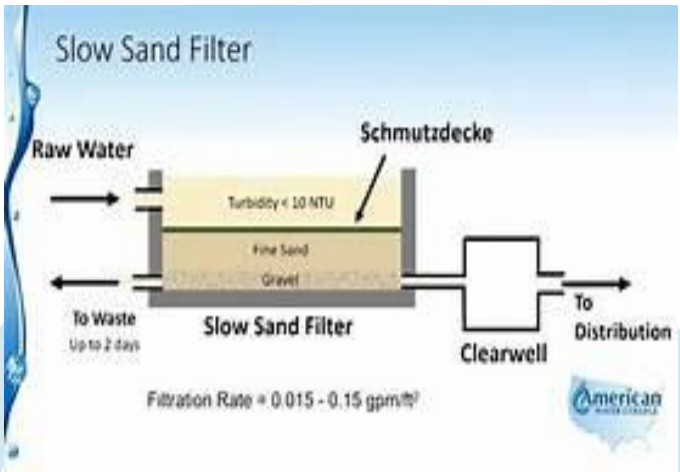
The pipe is usually 6 or 8 inch PVC pipe which has a valve and cleanout at the bottom, most of these devices extend from the gutter to the ground where they are supported. The gutter down spout and top of the pipe are fitted and sealed so that water will not flow out of the top. Once the pipe has filled, the rest of the water flows to the downspout connected to storage tank. The alternate scheme for sloping roof is shown in Fig. 2.7. This involves a very simple device which is required to be operated manually. In down take pipe at the bottom one plug/ valve is provided. When the rainy season start, this plug should be removed, and initial collection of roof top water should be allowed to drain. After 15 – 20 minutes, plug / valve should be closed so that collected rain water can be diverted to storage tank. 16 GUTTER PIPE FOR FLUSHING DEVICE FILTER STORAGE TANK DOWN TAKE PIPE FOR STORAGE TANK Channel Downtake pipe Plug Storage container.

2.2.6 Filter

If the collected water from roof top is to be used for human consumption directly, a filter unit is required to be Diversion valve To recharge/ storage To drain 17 installed in RWH system before storage tank. The filter is used to remove suspended pollutants from rain water collected over roof. The filter unit is basically a chamber filled with filtering media such as fiber, coarse sand and gravel layers to remove debris and dirt from water before it enters the storage tank. The filter unit should be placed after first flush device but before storage tank. There are various type of filters which have been developed all over the country. The type and selection of filters is governed by the final use of harvested rain water and economy. Depending upon the filtering media used and its arrangements, various types of filters available are described below.

2.2.6.1 Sand filter

In the sand filters, the main filtering media is commonly available sand sandwitched between two layers of gravels. The filter can be constructed in a galvanized iron or ferro cement tank. This is a simple type of filter which is easy to construct and maintain. The sand fillers are very effective in removing turbidity, colour and microorganism. In a simple sand filter that can be constructed domestically, filter media are placed.



2.2.6.3 Dewas filter

This filter was developed by officials of Rural Engineering Services of Dewas. In Dewas, the main source of water supply is wells which are used to extract ground water for supply of water. Because of regular extraction of ground water, the water table is going down rapidly. To recharge the ground water, all the water collected from the roof top is collected and passed through a filter system called the Dewas filter(Fig. 2.10). The filtered water is finally put into service tube well for recharging the well. The filter consists of a PVC pipe 140mm in diameter and 1.2m long. There are three chambers. The first purification chamber has pebbles of size varying between 2-6 mm, the second chamber has slightly larger pebbles between 6 to 12 mm and the third chamber has largest 12 – 20mm pebbles. There is a mesh on the out flow side, through which clean water

2.2.6.2 Charcoal water filter

This is almost similar to sand filter except that a 10-15 cm thick charcoal layer placed above the sand layer. Charcoal layer inside the filter result into better filtration and purification of water. The commonly used charcoal water filter is shown in

2.2.6.4 Varun

This filter has been developed by Shri S.Viswanath, a Bangalore based water harvesting expert. “Varun” is made from 90 lit. High Density Poly Ethylene (HDPE) drum. The lid is turned over and holes are punched in it.(Fig. 2.11) The punched lid acts as a sieve which keeps out large leaves, twigs etc. Rain water coming out of the lid sieve then passes through three layers of sponge and 150mm thick layer of coarse sand. Because of sponge layers, the cleaning of filter becomes very easy. The first layer of sponge can be removed and cleaned very easily in a bucket of water. Because of the layers of sponge, the sand layer does not get contaminated and does not require any back washing / cleaning. This filter can handle about 50mm per hour intensity rain fall from a 50 sqm roof area.

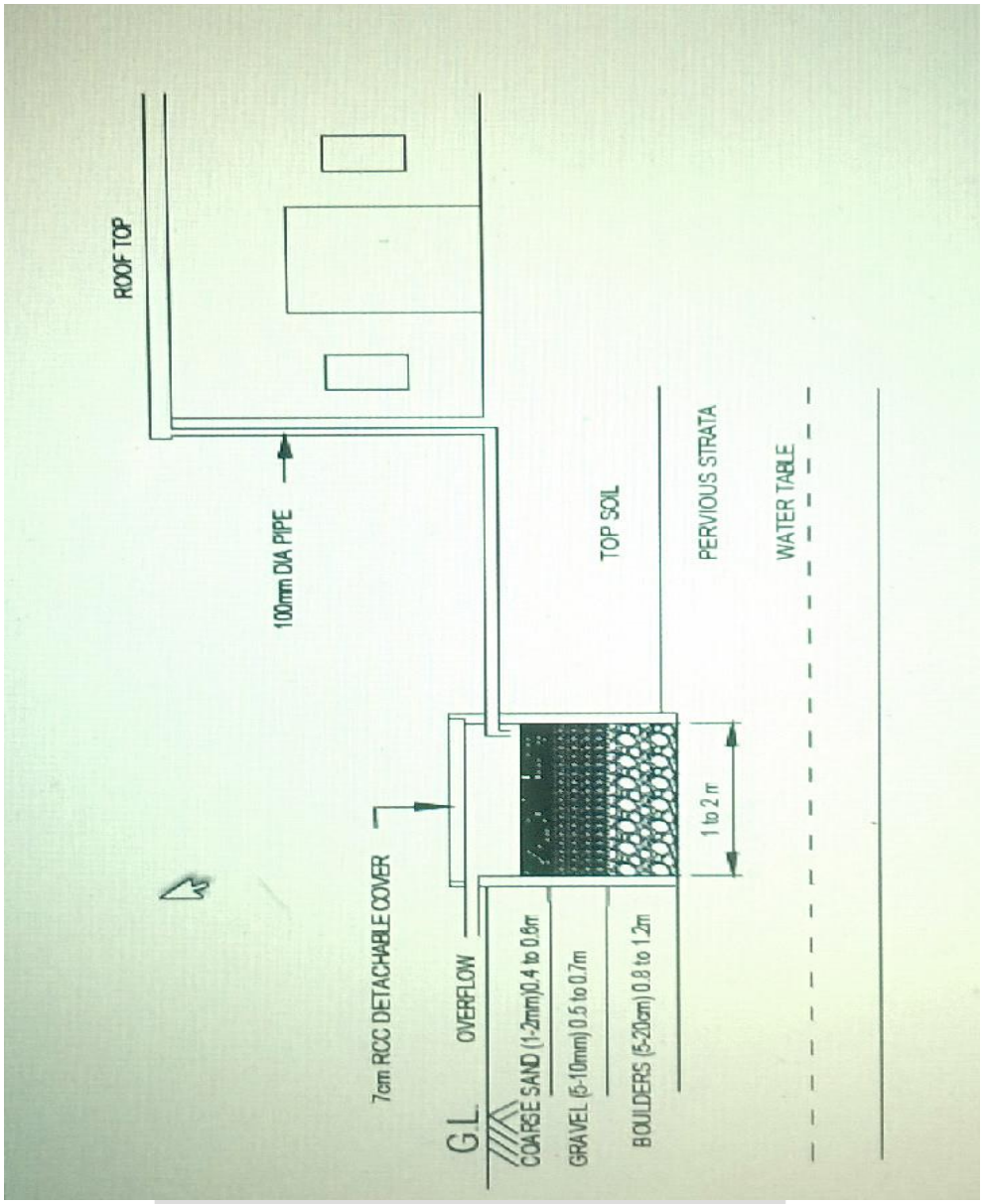
Methods of recharging subsurface aquifers

The various methods of recharging subsurface aquifers are

1. Through recharge pit.
2. Recharge through abandoned hand pump.
3. Recharge through abandoned dug well/open well
4. Through recharge trench.
5. Recharge through shaft.
6. Recharge trench with bore.

3.1.1 Through recharge pit

This method is suitable where permeable strata is available at shallow depth. It is adopted for buildings having roof area up to 100 sqm. Recharge pit of any shape is constructed generally 1-2 m wide and 2-3 m deep. The pit is filled with boulders, gravel and sand for filtration of rain water. Water entering in to RWH structure should be silt free. Top layer of sand of filter should be cleaned periodically for better ingression of rain water in to the sub soil. Details are shown in Fig. 3.1.



3.1.2 Recharge through abandoned hand pump

In this method, an abandoned hand pump is used as recharging structure. It is suitable for building having roof top area up to 150 sqm . Roof top rain water is fed to the hand pump through 100 mm dia. pipe as shown in Fig. 3.2. Water fed in the Rain water harvesting structure should be silt free. Water from first rain should be diverted to drain through suitable arrangement. If water is not clear then filter should be provided.

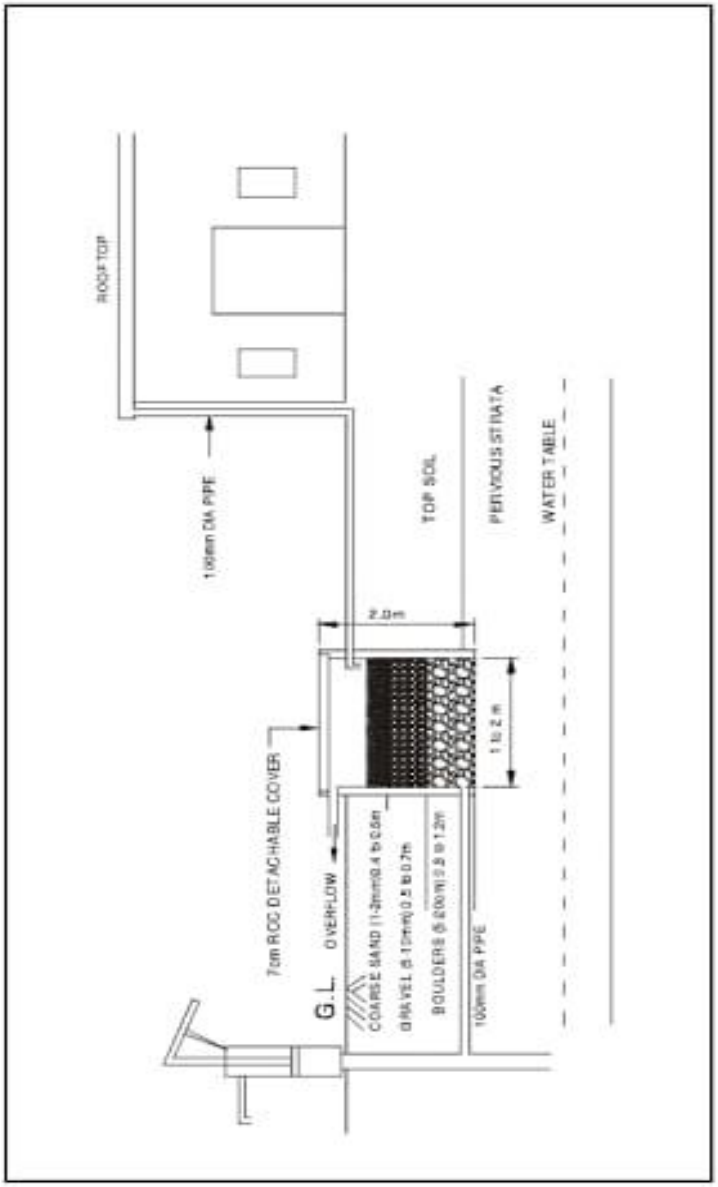


Fig. 3.2 Recharge through abandoned hand pump

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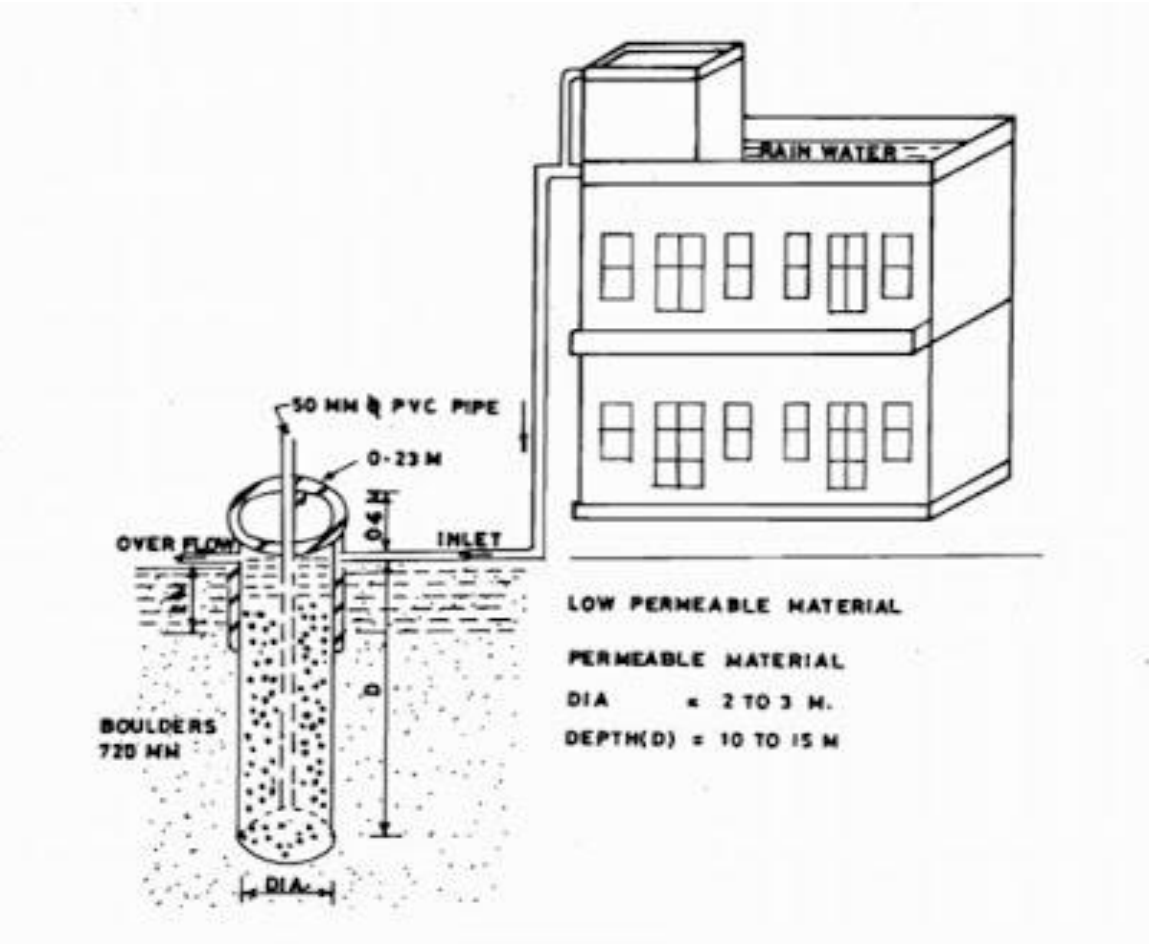
3.1.3 Recharge through abandoned dug well / open well

In this method, a dry / unused dug well can be used as a recharge structure. It is suitable for buildings having a roof top 29 area more then 100 sqm . Recharge water is guided through a pipe of 100 mm to the bottom of the well as shown in Fig. 3.3. Well cleaning and desilting is imperative before using it. Recharge water guided should be silt free, otherwise filter should be provided as shown in Fig. 3.3. Well should be cleaned periodically and chlorinated to control bacteriological contamination.



3.1.4 Through recharge trench

This method is used where permeable strata is available at shallow depth. It is suitable for buildings having roof top area between 200 & 300 sqm. In this method, trench of 0.5-1.0 m wide, 1-1.5 m deep and of adequate length depending upon roof top area and soil/subsoil characteristics should be constructed and filled with boulders, gravel and sand as shown in Fig. 3.4. Cleaning of filter media should be done periodically.

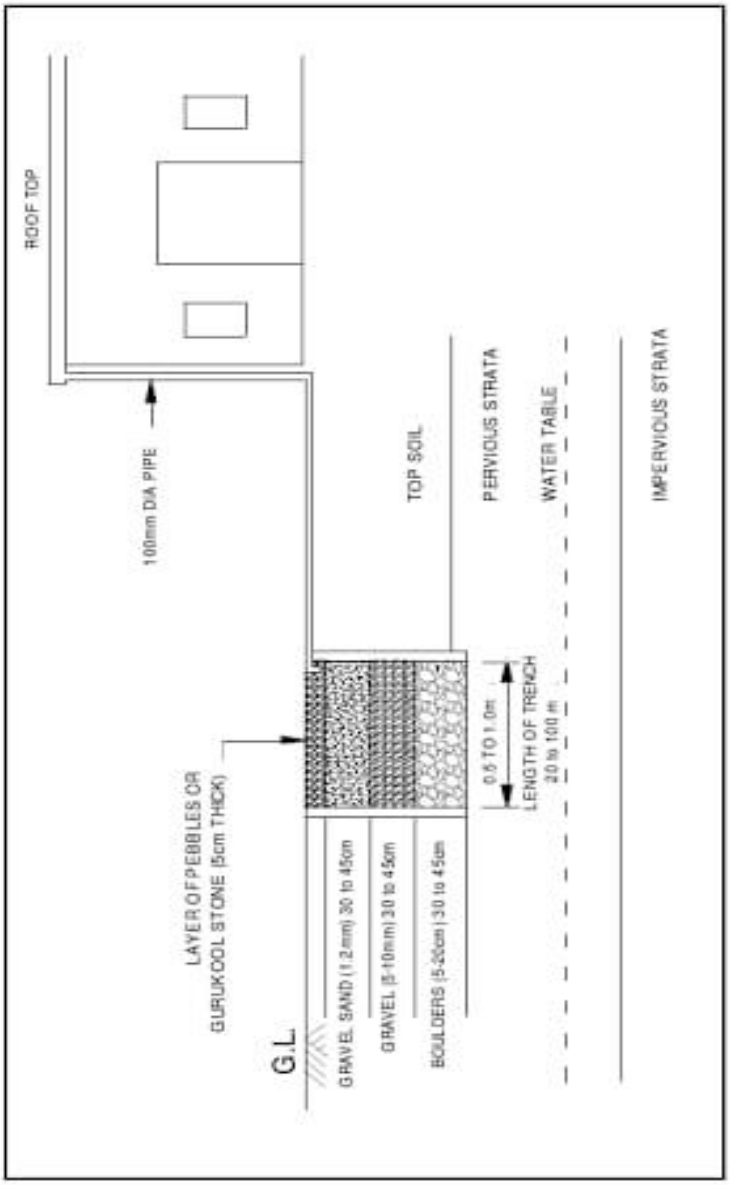


Fig. 3.4 Through recharge trench

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3.1.5 Recharge through shafts

This method is suitable where shallow aquifer is located below clayey surface. It is used for buildings having roof top area between 2000 &5000 sqm. Recharge shaft of diameter 0.5-3 m and 10-15 m deep is excavated mechanically. The shaft should end in impermeable strata. The shaft should be filled with boulders, gravel and sand for filtration of recharge water. Top sand layer should be cleaned periodically. Recharge shaft should be constructed 10-15 m away from the buildings for the safety of the buildings. The details are given in Fig.

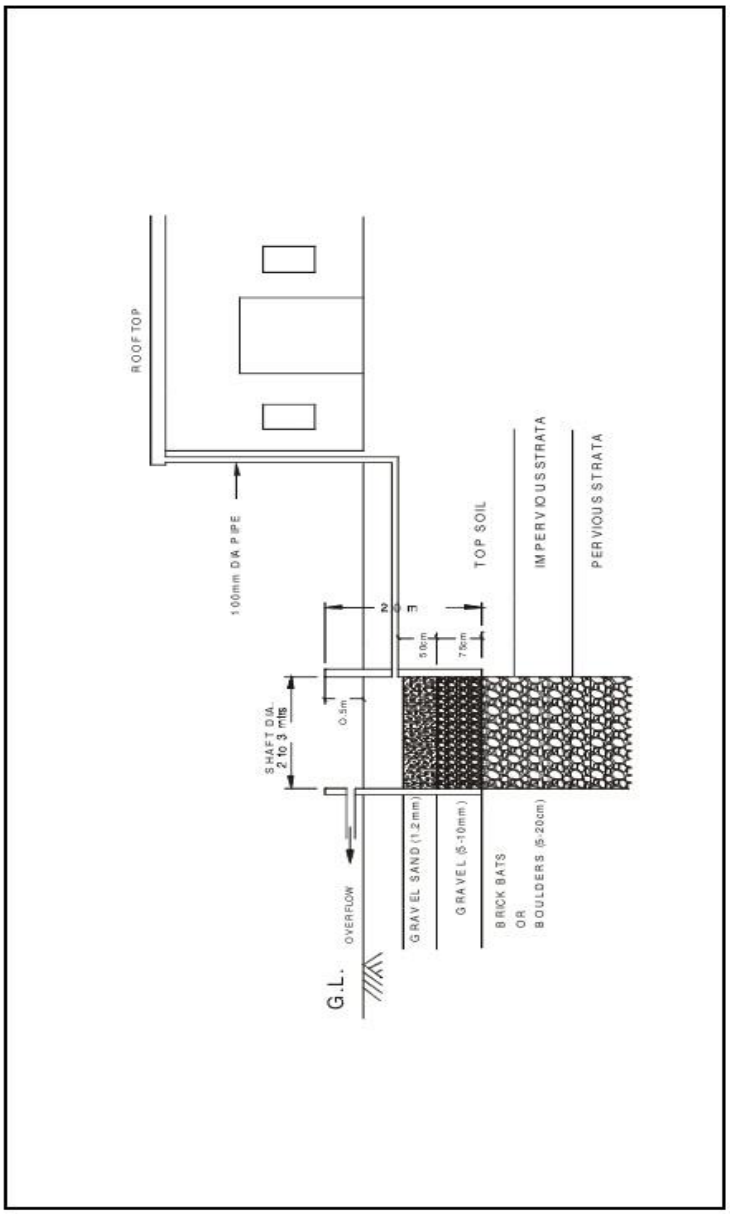

Fig. 3.5 Recharge through shaft

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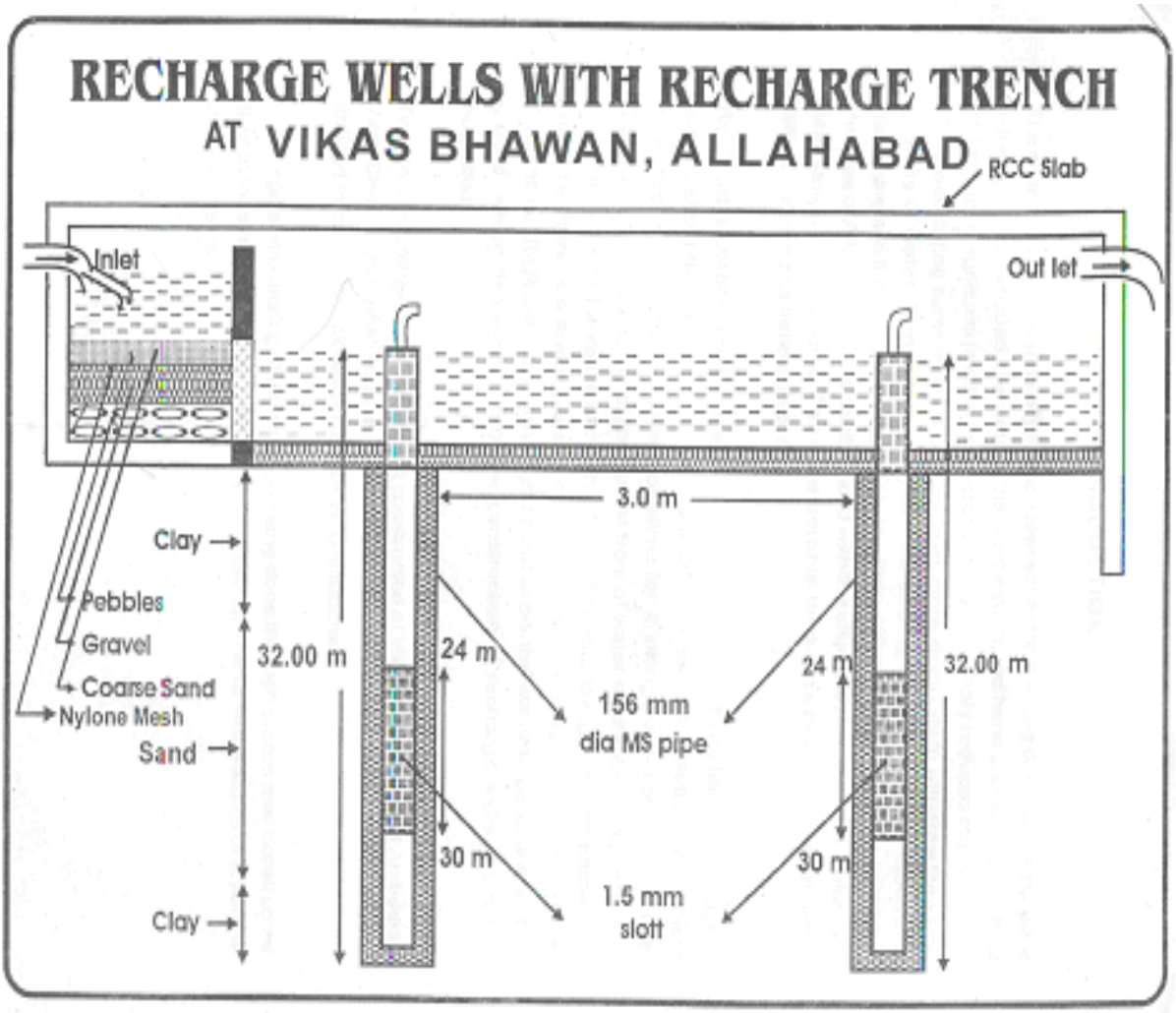
3.5. 3.1.6 Recharge trench with bore

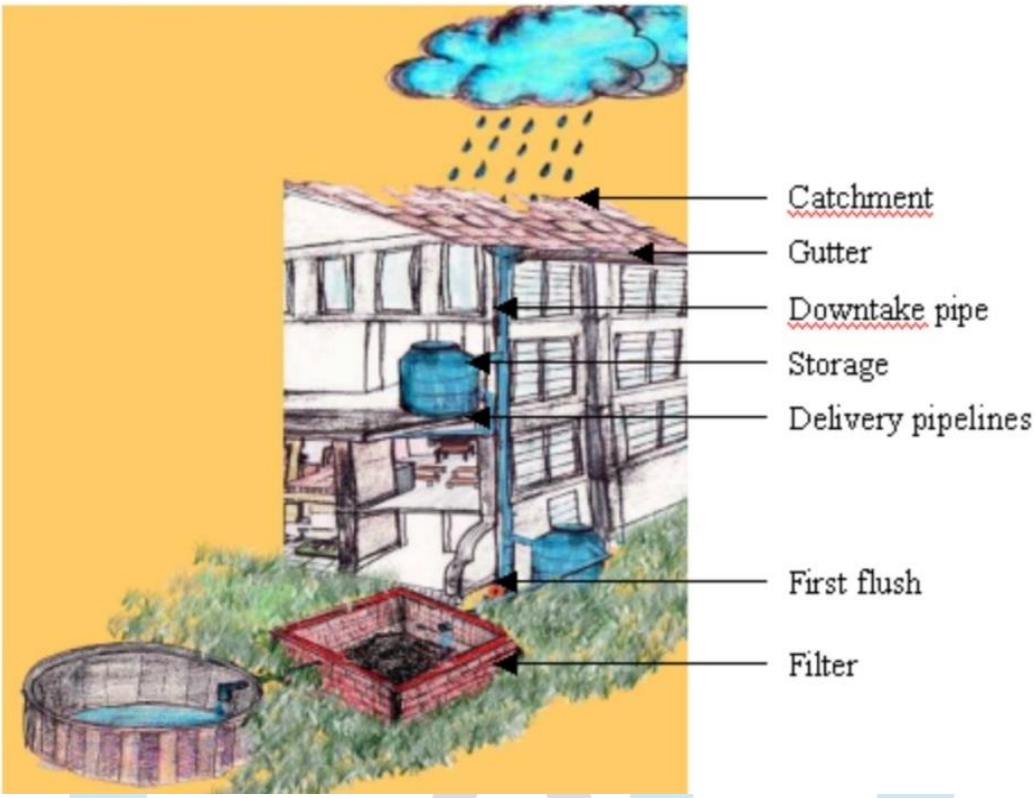
This method is used where sub-soil is impervious and large quantity of roof water/ surface run off is available. In this, trench is made 1.5-3 m wide and 10-30 m length depending upon water availability. Wells of 150-300 mm dia. and 3-5 m deep (below pervious layer) are constructed in the trench. Numbers of wells to be dug are decided in accordance to water availability and rate of ingression. Trench is filled with filtration media as shown in Fig. 3.6. A suitable silt chamber is also inserted with grating for water diverting arrangements as shown in the figure.



Methodsof rainwater harvesting:

1. Surface runoff harvesting
2. Roof top rainwater harvesting

"We are adoptthe roof top rainwater harvesting"



Methodology:

Catchment

Any surface or the paved areas can be treated as catchment. Even the footpaths and roads can act as the catchment, as these areas to receive the direct rainfall.

Conveyance

Conveyance system basically includes rain gutters and down pipeswhich collects the rainwater from catchment to the storage tank.

Storage

The storage system is designed according to the amount of water that is to be stored. The design and site of the storage or the recharge system should be properly chosen.

Components:

1. Catchment
2. Gutter and down take pipe
3. Filters and first flush devices
4. Storage tanks
5. Delivery pipelines

CASE STUDY

Introduction

The various method of rain water harvesting explained in previous chapters are equally applicable for the single building or structure which is having builtup area. Since the principals of rain water harvesting are universal, the same can be applied for rain water harvesting in big colonies/establishment with some minor modifications. The basic components of any rain water harvesting system remain the same but the number and size may very depending upon the catchments area.

If the rain water harvesting has to be implemented in a large area i.e. an office complex or big residential complex, the area can be subdivided into smaller parts. The runoff from each smaller part can be harvested through recharge structures constructed nearby while the runoff from open areas can be channelised through storm water drains into recharge structures.

QUALITY OF WATER

The rain water is one of purest form of water and does not contain suspended / dissolved impurities. However when this water is collected through rain water harvesting, it gets contaminated because of contact with roof surface/ground and some of the impurities get mixed in it. These impurities are required to be removed before collecting the harvested rain water in storage tank or diverting it or recharging of ground water aquifers

Following precautions should be taken to ensure quality of water:

1. Roof over which water falls, should be cleaned before rain fall.

2. The suitable type of first flushing device to be installed and initial 10 to 15 minutes of runoff should be diverted

3. The water collected from roof top only, should be stored in storage tank for direct use.

4. The runoff from surface/ground should be preferably be used for recharging ground water aquifers after proper filtration

. 5. The rain water collected from roof top should pass through suitable type of filter and only then it should be stored in storage tank / used for recharging ground water aquifers.

The harvested rain water may contain some toxic substances which may affect our health. The water collected from roof top after filtration can be used directly for lawn watering, washing etc. But if this water has to be used directly for drinking purpose, then quality of water must be ascertained before use. The water used for drinking should comply with the provisions of IS-10500:1991 i.e. Indian Standard "DRINKING WATER – SPECIFICATION (First Revision)". The important test characteristics for drinking water as given in Table 1 of IS10500:1991 are reproduced in Table 5.1 for ready reference.

Rainwater Harvesting [STRATEGY]

This could include groundwater, which has high solids or natural contaminants (arsenic and fluoride are common issues).

- Installations striving to increase water resilience by implementing net zero water goals.

- Areas with regulatory requirements to reduce peak flows, lessening the erosive forces of storm water runoff due to sensitive environmental receptors, such as the Chesapeake Bay area.
- Situations in which ponded surface water contributes to insect or algaeproblems. Capturing rainwater will reduce surface water available for ponding.

Rainwater can be harvested for a number of uses:

- Non-potable uses, such as toilet flushing, irrigation, dust control, andvehicle washing. Some of these applications may require specialized plumbing.
- Potable water uses including drinking water, food preparation, showering, and washing. These applications would likely require treatment to ensure that the water meets state and federal requirements for potable uses.

Design Notes

Rainwater Harvesting Components:

- **Rooftop collection** systems are common, taking advantage of drainage and gutter systems. Metal roofs are ideal for rainwater collection. They are easy to keep clean and maintain a high level of rainwater quality. Some roof materials, such as asphalt, may limit water uses to non-potable ones.
- **Conveyance systems** via gutters, channels, and pipe systems are used to carry collected water to storage and areas of use.
- **Storage systems** keep collected rainwater for later use. These are typically tanks, either on the surface or below ground. Open ponds may also be used, particularly for decorative effect.
- **Treatmen**t will be required for most potable uses and possibly for some non-potable uses. Treatment typically includes filtration to remove particulate matter in the collection and conveyance of the rainwater. Simple disinfection (chlorination, ultraviolet - UV, solar) may be required to control microbial growth in various systems, including storage systems.

Collection and use of rainwater:

- Rainwater collection systems are typically designed to be gravity fed. Storage areas are typically lower elevation, so a pumping system is generally required for intended reuse.
- Since collected rainwater is generally used close to its capture, the energy needed to convey the water tends to be minimal.
- Compared to conveyance from other supplied sources of water (groundwater, conveyed surface water, shipped water), rainwater harvesting would likely have lower energy costs.

Maintenance:

- Systems are simple and tend to be robust. Monitoring and maintenance require additional effort. This includes maintenance of roofs used as collection areas, cleaning of gutters, maintenance of storage tanks and vaults, pumps and maintenance of water treatment systems (when installed).

- Water Savings How much can rainwater harvesting provide?

- A reasonable goal for an aggressive rooftop collection for a custom building could be to reduce domestic water supply by 40 to 50% for that building; this would then allow the building to meet LEED goals for sewage reduction (see reference [1]). A lower level may be expected for a retrofitted system.

- An installation could be thought of as a small city. Liaw and Chaing5 estimated a maximized rooftop collection approach could supply about 32% of needs. However, they also estimated a 10% goal would be reasonable from an economic standpoint.

Rainwater collection has mostly positive impacts:

- Simple treatments use little to no chemicals and resources as compared to large-scale potable water systems.

- Rainwater harvesting generally has a minimal impact on the overall water balance, but larger operations may impact downstream surface water or groundwater resources where water is limited. Regulations in those environments will identify this as an issue early in the process.

- Reduce environmental impact due to decreased demand for fossil fuels needed to handle and treat potable water at central water treatment plants as well as energy needed to distribute water

Benefits of Rainwater Harvesting

The collection of rainwater and harvesting it for everyday use has an ample number of exciting benefits. Let's take a look and discover some of those benefits.

Provides backup source of water

There are many uncertainties in water supply systems. Droughts may lead to shortage of water. Destruction of water supply systems may occur at specific locations. Major repairs and maintenance in water companies happen sporadically. All these variables lead to unavailability of water in your home. So, installing rainwater harvesting system is the best course of action to continue enjoying water supply in case any of the above variables occur.

The collected rainwater can be used for many different purposes around the home. This includes laundry, washing dishes and more. This would prevent groundwater depletion and augment ground water table.

Ecological benefit

The ecological benefits of rainwater harvesting are immense. An activity like flushing the toilet, for instance, attributes to about 35% of home water usage. Add up the amount of water used to irrigate the lawn, do laundry, wash cars and the total amount water used is simply astronomical. For businesses, more so hospitality establishments that accommodate a big number of guests in a single location, require a lot of water to satisfy customers. Rainwater harvesting will simply help to fill this gap.

The ecological benefit rainwater harvesting systems bring is that there will be a significant reduction in the amount of water used from the mains. This, ideally, means that water companies will not have to artificially pump in water from rivers and lakes. This will help minimize the possibility of rivers drying up. Another great

ecological benefit of rainwater harvesting systems is that they help reduced the load placed upon drainage systems, minimizing the impacts of flooding by funneling the runoff water into large tanks for recycling.

Easy to maintain

Rainwater harvesting systems are considerably easy to maintain since they are not utilized for drinking, cooking or other sensitive uses. This means that they will not need installation of purification systems, which are usually expensive.

Rainwater harvesting systems are cost effective, provide high quality water, reduce dependence on wells. The surplus rainwater can also be used to recharge ground water aquifer through artificial recharge techniques.

Reduces erosion and flooding around buildings

Most buildings that utilize rainwater harvesting systems have a built-in catchment area on top of the roof, which is capable of collecting vast amounts of water in case of rain storms. It helps to reduce soil erosion as by capturing rainwater, the flow of storm water is reduced which can also prevent urban flooding. If the water were not collected efficiently, it could have resulted in serious soil erosion and flooding around the house.

Requires low upfront capital investment

Installation of rainwater harvesting system is not that expensive, plus it's a one-time installation, and that's it. The only routine maintenance required is cleaning out the tank. You will probably hire an expert technician to install the system for you. The technician won't quote a high price, plus he will offer free advice on the best rainwater system to buy. He will also help out when buying the system to ensure you get the best quality rainwater harvesting system. When you sum up the overall cost of installing the system, you'll find that it's actually manageable.

Once you begin using rainwater you will also appreciate a reduced amount of water consumption in the home, thus all of your utility bills will greatly shrink in size. How incredible would it be to slash as much as 50 to 60% off of your water bill each month? No complaints with having additional money in the pocket each and every month.

USES OF RAIN WATER HARVESTING

Agriculture

In regards to Urban agriculture rainwater harvesting in urban areas reduces the impact of runoff and flooding. The combination of urban 'green' rooftops with rainwater catchments have been found to reduce building temperatures by more than 1.3 degrees Celsius.[1] Rainwater harvesting in conjunction with urban agriculture would be a viable way to help meet the United Nations Sustainable Development Goals for cleaner and sustainable cities, health and wellbeing, and food and water security. The technology is available, however, needs to be remodeled in order to use water more efficiently, especially in an urban setting.

Kenya has already been successfully harvesting rainwater for toilets, laundry, and irrigation and areas in Australia use harvested rainwater for cooking and drinking.Studies done by Stout et al researching the

feasibility in India found RWH was most beneficial used for small scale irrigation, which provides income with the sales of produce, and overflow used for groundwater recharge.

Missions to five Caribbean countries have shown that the capture and storage of rainwater runoff for later use is able to significantly reduce the risk of losing some or all of the year's harvest because of soil or water scarcity. In addition, the risks associated with flooding and soil erosion during high rainfall seasons would decrease. Small farmers, especially those farming on hillsides, could benefit the most from rainwater harvesting because they are able to capture runoff and decrease the effects of soil erosion.

Many countries, especially those with arid environments, use rainwater harvesting as a cheap and reliable source of clean water. To enhance irrigation in arid environments, ridges of soil are constructed to trap and prevent rainwater from running down hills and slopes. Even in periods of low rainfall, enough water is collected for crops to grow.Water can be collected from roofs, dams and ponds can be constructed to hold large quantities of rainwater so that even on days when little to no rainfall occurs, enough is available to irrigate crops.

Domestic use

- In China, Argentina, and Brazil, rooftop rainwater harvesting is used to provide drinking water, domestic water, water for livestock, water for small irrigation, and a way to replenish groundwater levels. Gansu province in China and semiarid northeast Brazil have the largest rooftop rainwater harvesting projects going on.

- About 40% of Thailand's rural population utilizes rainwater harvesting. Rainwater harvesting was promoted heavily by the government in the 1950s. In the 1990s, after government funding for the collection tanks ran out, the private sector stepped in and provided several million tanks to private households, many of which continue to be used today.[1] This is one of the largest examples of self-supply of water worldwide.
- Rainwater harvesting is mandatory for new homes built in Santa Fe, New Mexico.
- Texas offers a sales tax exemption for the purchase of rainwater harvesting equipment.
- Both Texas[1] and Ohio allow rainwater harvesting to be used even for potable purposes.
- Oklahoma passed the Water for 2060 Act in 2012, to promote pilot projects for rainwater and graywater use among other water-saving techniques.
- In the United Kingdom, water butts are often found in domestic gardens and on allotments to collect rainwater, which is then used to water the garden.

Industry [

Frankfurt Airport has the biggest rainwater harvesting system in Germany. The system helps save approximately 1 million cubic meters of water per year. The cost of the system was 1.5 million dm (US$63,000) in 1993. This system collects water from roofs of the new terminal which has an area of 26,800 square metres. The water is collected in the basement of the airport in six tanks with a storage capacity of 100

cubic meters. The water is mainly used for toilet flushing, watering plants and cleaning the air conditioning system.

Rainwater harvesting was adopted at The Velodrome – The London Olympic Park – in order to increase the sustainability of the facility. A 73% decrease in potable water demand by the park was estimated. Despite this, it was deemed that rainwater harvesting was a less efficient use of financial resources to increase sustainability than the park's blackwater recycling program.

Advantages of Rainwater Harvesting

1. Water For Domestic Use:

Rainwater harvesting is beneficial because it provides a source of water for domestic use. The collected water can be used for house cleaning purposes, washing laundry and for cooking. When treated, rainwater is good for drinking. It is an easy way of obtaining water for use in the home.

2. Water For Industrial Use:

Industries can also harvest rainwater for use in some of their processes. Rainwater meant for industrial use is normally harvested in large scale. Such companies can construct their own dams or have underground tanks to store rainwater.

3. Supplementary Water Source:

Many areas experience water shortages during summer due to lack of rain and as a result of the high rate of evaporation. It can be difficult to get a reliable source of water during these periods. Those who sell water may also increase their prices because of the high demand and short supply. Harvesting rainwater is therefore seen as a way of preparing for the sunny days when water is scarce.

4. Cost Effective:

We basically harvest rainwater for free because it is naturally occurring. If you store enough water during the rainy season, you may never have to pay for water services again because you'll have enough supply to last you through the summer. This saves you money by cutting down your monthly expenditure on water bills.

5. Reliable Flow of Harvested Water:

Even though harvesting of rainwater depends on rainfall, once stored, the supply of the available quantity is guaranteed. You can have an uninterrupted flow of water from the place of storage as long as the amount harvested has not been exhausted. The same cannot be said when you depend on an outside source to supply your water. There is also the benefit of locational-suitability because the source of water is in your place of stay.

6. Mitigates/Reduces The Impacts of Floods:

Harvesting rainwater plays a key role in mitigating or reducing the impacts of floods. When rainwater is directed to farms through trenches or collected in dams, its movement is controlled. This prevents the accumulation of water in one area, something that often causes flooding. Rivers can also overflow and cause flooding in the adjacent areas. The negative impacts of floods are too many and costly. Harvesting rainwater is, therefore, an effective way of reducing the impacts of this natural disaster.

7. Building and Construction:

Collected rainwater can be used for building and construction. The process of building a house requires a lot of water. Harvesting rainwater would thus avail water for this activity.

8. Helps In Preventing Water Pollution:

Rainwater flowing on the ground surface can carry with it a lot of impurities and toxic substances. When it drains into water bodies,it pollutes them because of these impurities. Harvesting rainwater, therefore, prevents pollution of water bodies.

9. Irrigation:

Rainwater is good for farming because once harvested, it can be used for irrigation especially during the summer. One can, therefore, have a thriving farm and realize a bumper harvest.

10. Saves Potable Water:

Instead of using clean and treated water for other purposes such as washing and in the toilet, rainwater can be used. This saves potable water which would then be used for drinking and cooking only.

Precautions

1. Pre-filtration to remove impurities would make the harvested water safer.
2. The harvested rainwater can also be boiled to kill any germs before drinking it.
3. Rainwater should be collected in containers that do not give out toxins when exposed to sunlight.
4. Set up the collection points before it starts raining because you can fall ill when you run around in the rain.

Disadvantages of Harvesting Rainwater

1. Additional Expenditure:

Treating rainwater to make it fit for human consumption will see you incurring additional expenses. This would not happen when you use water supplied to you by the local council because it's already treated.

2. Huge Efforts and Resources Required:

Constructing a dam or an underground tank is no mean fete. Before you begin harvesting rainwater, you'll have spent a considerable amount of resources. There are other cheap means but then you'll not collect a reasonable amount of water.

3. Dependent On Rainfall:

You can't harvest rainwater when it does not rain. This process is therefore solely dependent on the availability of rain which can sometimes be very unreliable. What then happens when the dry spell is prolonged and you don't have an alternative source of water?

4. Limited Storage:

Even if it rains for three months straight, you cannot harvest all that water even if you wanted to. This is because there is limited storage to keep the rainwater.

5. Risk of Contamination:

If not preserved with care, rainwater can be contaminated. This can cause several health problems especially when the water is used without first being treated. Waterborne diseases are so many and treating them is very costly.

6. Cleaning and Maintenance:

The storage facilities have to be occasionally cleaned and maintained. Cleaning an underground water tank is not easy and maintaining a dam is very expensive. This makes the thought of harvesting rainwater unattractive.

7. Dual Cost:

You'll incur expenses twice because of paying your normal water bills and installing and maintaining the rainwater harvesting system. This will set you back financially in a way.

8.Roof Tops That Contain Chemicals:

Some rooftops contain chemicals and impurities that mix with the rainwater. When consumed, this water can affect human health by causing illnesses and other health conditions.

9. Acidic Rain:

Due to pollution, sometimes the rain that falls is acidic. Harvesting this type of rainwater is dangerous because of the chemicals contained. Using acidic rain for irrigation can also cause the death of crops because it erodes the quality of soil and creates conditions that are not conducive for plant germination. When the soil has a high pH, plants do not grow properly.

11. Lack of Water for Wildlife:

Wild animals get their drinking water from natural sources such as seasonal streams and rivers. They also use them for cooling in the hot weather. Harvesting rainwater reduces the amount of water that flows into these streams and rivers. This affects the ecosystem because some animals are likely to die due to the harsh conditions.

Conclusion

Rainfall is a very important weather phenomenon. It is a source of water and is very critical for the growth of crops and farming. Harvesting rainwater is a practice that has been going on for a while. Many people actually engage in it without even realizing that they are doing so. Because of weather changes, water sources can dry up and in the process impact animal, human, and plant life negatively. Rainwater harvesting is a smart way of preparing for such times because even when the conventional water sources dry up, we can still use the stored water for many purposes. The best part is that this type of water is naturally occurring. Some of the setbacks can be avoided by taking precautionary measures. When we employ innovation and technology, we can come up with better ways of rainwater harvesting and increase the storage capacity.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