RAIN WATER HARVESTING AND STORAGE

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ABSTRACT

Water scarcity is a serious problem throughout the world for both urban and rural community. Urbanization industrial development and increase in agricultural field and production as resulted in over exploitation of ground waterand surface water resources and resultant deterioration in water quality. The conventional water sources namely well, rivers and reservoirs etc., are inadequate to fulfill water demand due to unbalanced rainfall.

While the rainwater harvesting system investigate a new alternate water source. The process involves collection and storage of rainwater. This decreases runoff with help of artificially designed systems. The main purpose of the rainwater harvesting is to use the locally available rainwater to meet water requirement throughout the year in regions with limited water resources or frequent droughts. Without the need of huge capital expenditure.

Rainwater is preserved in various storage options, such as from rooftop, compounds redirected to a rain barrels, underground tanks, or above ground cisterns. It can begin with an analysis of the catchment area, typically where rainwater will be collected and Filtration mechanisms are incorporated to remove debris and contaminants, ensuring the stored water's quality. It has been used to provide drinking water, water for livestock, water for irrigation, as well as other typical uses given to water.

The project includes a detailed evaluation of the system's performance, including measurements of water collection efficiency, storage capacity, and water quality

To finding a contribute to the understanding and promotion of rainwater harvesting and storage as a sustainable water management practice. The results can be utilized by individuals, communities, and organizations seeking to implement similar systems, fostering water conservation and reducing the strain on existing water resources.

Keywords: - Rainwater harvesting, water scarcity, sustainable, Filtration, conventional, Urbanization and cost effectiveness.

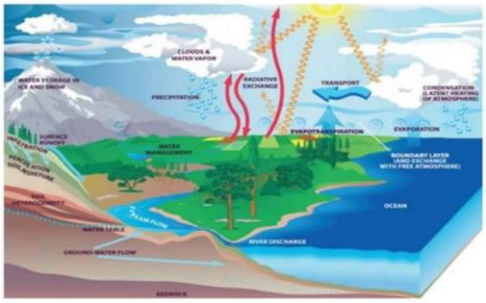
1.0 INTRODUCTION

Rainwater is a source of high quality water that is available every rainy season and has the potential to reduce the pressure on the use of fresh water resources. The concept of rainwater harvesting (RWH) is a technology that has been long enough and can be used to supply water, reducing the burden of the aquifer and surface water and prevent flooding. Several years ago, RWH is only used as an alternative to compliance in areas of water shortage. Along with technological advances and increasing environmental awareness of the human will, RWH concept began to be used as an alternative source of water to meet the needs of either the main or additional source of water. The concept of RWH can be applied to large or small catchment area scale. RWH is the gathering and storing of rainwater that falls from roofs, parks, roadways, and open spaces, among other places. This rainwater can be stored into the groundwater. This usually includes collecting rainwater from a roof. Rainwater will gather in gutters, which will then direct the water through downspouts and eventually into a storage container. Rainwater collection systems can range from the basic to the complex, capturing rainwater into massive water tanks to meet your complete household’s needs.

The rainwater harvesting system is one of the most effective and widely used ways for water conservation. Nowadays, a serious reason to worry is the lack of good quality water. However, rainwater that is pure and of excellent quality may be utilized for other cattle needs as well as irrigation, industrialization, cleaning, bathing, cooking and even as a source of drinking water after proper treatment. Rainwater harvesting helps conserve valuable freshwater resources, reduce storm water runoff, and promote self-sufficiency in water supply. It is a vital component of sustainable water management in both urban and rural settings.

Rain Water Harvesting: The concept of rainwater harvesting means, "Collecting Rain water when and wherever it falls for future use"...It is just like "bank account where you deposit the money when it is surplus & with draw when it is deficient". Rainwater harvesting is the technique of collection & storage of rainwater at surface or in subsurface acquifers. As most of rainfall water goes waste in form of surface run off to stream, river and sea, simple technique need to be developed to collect and store this water in storage tank or direct this water to recharge ground water acquifers (water bearing strata) to be tapped later on for use in dry periods.

Hydrologic Cycle The never-ending exchange of water from the atmosphere to the oceans and back is known as the hydrologic cycle. This cycle is the source of all forms of precipitation (hail, rain, sleet, and snow), and thus of all the water. Precipitation stored in streams, lakes and soil evaporates while water stored in plants transpires to form clouds, which store the water in the atmosphere. Currently, about 75% to 80% of conventional water supply is from lakes, rivers and wells. Making the most efficient use of these limited and precious resources is essential. Otherwise, scarcity of water will be faced by our future generations.



Hydrologic cycle

Advantages of Rain Water The rainwater's environmental advantage and purity over other water options makes it the first choice, even though the precipitation cycle may fluctuate from year to year.

Environmental Advantage Collecting the rain that falls on a building and using the same for various purposes is a simple concept. Since the rain you harvest is independent of any centralized system, you are promoting self-sufficiency and helping to foster an appreciation for this essential and precious resource. The collection of rain water not only leads to conservation of water but also energy since the energy input required to operate a centralized water system designed to treat and pump water over a vast service area is bypassed. Rainwater harvesting also lessens local erosion and flooding caused by runoff from impervious cover such as pavement and roofs.

Qualitative Advantage A compelling advantage of rainwater over other water sources is that it is one of the purest sources of water available. Indeed, the quality of rainwater is an overriding incentive for people to choose rainwater as their primary water source, or for specific uses such as watering houseplants and gardens. Rainwater quality usually exceeds that of ground or surface water as it does not come into contact with soil and rocks where it dissolves salts and minerals and it is not exposed to many of the pollutants that often are discharged into surface waters such as rivers, and can contaminate groundwater. Rainwater's purity also makes it an attractive water source for certain industries for which pure water is a requirement.

Rain Water Harvesting For our water requirement we entirely depend upon rivers, lakes and ground water. However rain is the ultimate source that feeds all these sources. Rainwater harvesting means to make optimum use of rainwater at the place where it falls i.e. conserve it 15 and not allow to drain away and cause floods elsewhere. The rainwater harvesting may be defined as the technique of collection and storage of rainwater at surface or in sub-surface aquifer before it is lost as surface run off.

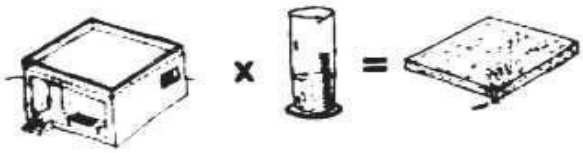
Advantages of Rain Water Harvesting

- Promotes adequacy of underground water
- Mitigates the effect of drought
- Reduces soil erosion as surface run-off is reduced
- Decreases load on storm water disposal system
- Reduces flood hazards
- Improves ground water quality / decreases salinity (by dilution)
- Prevents ingress of sea water in subsurface aquifers in coastal areas
- Improves ground water table, thus saving energy (to lift water)
- The cost of recharging subsurface aquifer is lower than surface reservoirs
- The subsurface aquifer also serves as storage and distribution system
- No land is wasted for storage purpose and no population displacement is involved
- Storing water underground is environment friendly
- Rainwater is bacteriological pure, free from organic matter and soft in nature Rainwater can be harnessed at place of need & time of need
- The infrastructures required for rainwater harvesting are simple & economical.

From Where to Harvest Rain Water

- Roof top to storage tank or Ground water recharging point
- Unpaved area direct seepage to ground water
- Water bodies like ponds, tanks and lakes
- Storm water drains directed to recharge ground water

Rain Water Harvesting Potential The total amount of water that is received in the form of rainfall over an area is called the rainwater endowment of that area. Out of this, the amount that can be effectively harvested is called rainwater-harvesting potential. All the water, which is falling over an area, cannot be effectively harvested, due to various losses on account of evaporation, spillage etc. Because of these factors, the quantity of rainwater which can effectively be harvested is always less than the rainwater endowment. The collection efficiency is mainly dependent on factors like runoff coefficient and first flush wastage etc. Runoff is the term applied to the water that flows away from catchments after falling on its surface in the form of rain. Runoff from a particular area is dependent on various factors i.e. rainfall pattern and quantity, catchment area characteristics etc. For determining rainfall quantity, the rainfall data preferably for a period of at least 10 years is required. This data can be collected from meteorological department



Area of catchment x Amount of rainfall = Rain water endowment

Components of Rainwater Harvesting Systems

Catchments The surface, which directly receives the rainfall and provides water to the system is called catchment area. It can be a paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground. A roof made of reinforced cement concrete (RCC), galvanized iron or corrugated sheets can also be used for water harvesting.

Gutters Channels, which surrounds edge of a sloping roof to collect and transport rainwater to the storage tank. Gutters can be semi - circular or rectangular and mostly made locally from plain galvanized iron sheet. Gutters need to be supported so they do not sag or fall off when loaded with water. The way in which gutters are fixed mainly depends on the construction of the house, mostly iron or timber brackets are fixed into the walls.

Gutters

Conduits Conduits are pipelines or drains that carry rainwater from the catchment or roof top area to the harvesting system. Commonly available conduits are made up of material like polyvinyl chloride (PVC) or galvanized iron (GI).

First-flushing A first flush device is a valve, which ensures flushing out of first spell of rain away from the storage tank that carries a relatively larger amount of pollutants from the air and catchment surface.

Filters The filter is used to remove suspended pollutants from rainwater collected from roof top water. The Various types of filters generally used for commercial purpose are Charcoal water filter, Sand filters, Horizontal roughing filter and slow sand filter.

Storage facility There are various options available for the construction of these tanks with respect to the shape, size, material of construction and the position of tank and they are: -Shape : Cylindrical, square and rectangular. Material of construction: Reinforced cement concrete (RCC), masonry, Ferro cement etc. Position of tank: Depending on land space availability, these tanks could be constructed above ground, underground or underground. Some maintenance measures like disinfection and cleaning are required to ensure the quality of water stored in the container. If harvested water is decided to recharge the underground aquifer/reservoir, then some of the structures mentioned below are used.

Recharge structures Rainwater Harvested can also be used for charging the groundwater aquifers through suitable structures like dug wells, bore wells, recharge trenches and recharge pits.

2.0 LITERATURE REVIEW

Appan et al., 1997 in his research stated that in the cities of developing countries, the need for clean water is required. Shortage of clean water can be replaced by rainwater.
In 2006, Roebuck and Ashley through his research finds a Rain Cycle model, which is a model that integrated the hydrological model to analyze the performance of RWH in school buildings in urban areas in Australia. Rain Cycle is a computer model based on yield after spillage concept. This study simulated the operational design for 100 years with the output result is a long-term financial savings; payback period and the percentage of water needs are met by the RWH system.
In terms of groundwater, N. Nagaraj et al. (2011) conducted a study to evaluate the effect of RWH structures in the process of groundwater recharge. Selected study sites in Kolar district, Karnataka India where there is exploitation of the excessive use of ground water. RWH system was built on a site in the village. From the results, it can be seen that after RWH systems implemented, groundwater in has increased. B. Alawneh et al. (2011) also conducted a study on the ground water RWH system and get similar results.
Aftab Bin Tallal et al. (2012), examines the quality of rainwater that is used as a Potable water use in Pakistan. From the research, in some cases, the quality of harvested rainwater is still not good (turbidity, pH, chemistry, biology) but can be improved with the filter, chlorine provision and maintenance of catchment area (roof). Quality of harvested rainwater average is still above the limit value of clean water standards issued by WHO.
M.Vargas-Violeta Parra et al. (2012) evaluated the RWH system based on energy consumption. The analysis is based on the consumption of materials and energy required by the system using multiple strategies (scenarios). RWH system applied to residential buildings with 2 levels of density, high-density and low-density in urban areas in Barcelona. Harvested rainwater is used for non-potable water use and the location of the storage tanks are divided into 3 locations: below the surface, under the roof, and distributed on the roof. Energy assessment system using life cycle approach. Calculated parameters consist of energy consumption and energy efficiency. The results showed that the model with a high density with a tank that placed on the roof provide the best energy efficiency.

3.0 METHODOLOGY

Methods Of Rain Water Harvesting 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.

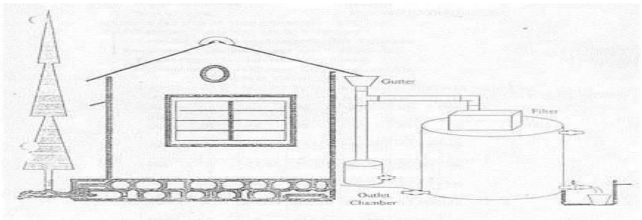
Surface Runoff Harvesting Surface runoff rainwater harvesting is a method of collecting rainwater flowing along the ground during the rains will be collected to a tank below the surface of the ground for irrigation and other purposes. During storage of rainwater, it is important to incorporate efficient and effective water conservation methods i.e. by reducing evaporation. It is a very easy to adopt technology and very profitable if used accordingly. The main objective

of surface runoff rainwater harvesting method is to meet the ever increasing demand of water, to reduce water pollution, soil erosion and flooding of roads.

Rooftop Rainwater Harvesting Rooftop rainwater harvesting is a method of collecting rain water where it falls and in which rain water is captured from the roof catchments of domestic houses or commercial buildings and stored in the tanks. Harvested rainwater can either be stored in a tank or diverted to artificial recharge system to meet the household/commercial needs through storage in tanks. This method is simple, eco-friendly, less expensive and truly effective. Rooftop rainwater harvesting method (RRH) involves diverting and recharging (or) storing rainwater that falls on the roof of a house/building. The main objective of rooftop rainwater harvesting is to make water available for future use, to improve quality of ground water etc.

Components of the Rooftop Rainwater Harvesting

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.



Components of the Rooftop Rainwater Harvesting

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

Water from sloping roofs could be caught through gutters and down take the pipe. At terraces, the mouth of each drain should have wire mesh to restrict floating material.

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-off 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 separators should be made at the outlet of each drainpipe.

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

Typical Filter

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.

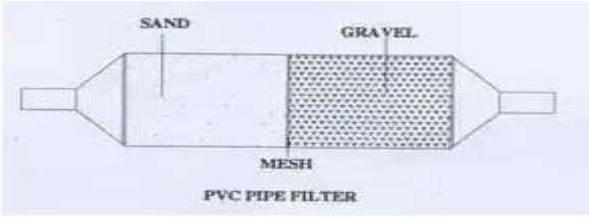
There are different types of filters in practice, but the basic function is to purify water. Different types of filters are described in the following section:

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.

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.



PVC Filter

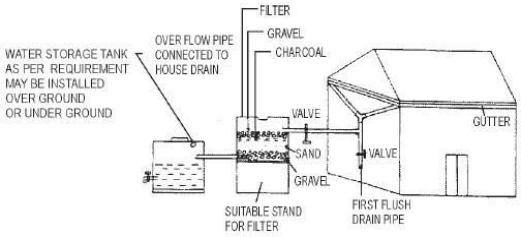
It is a simple filter made from PVC drum having a layer of sponge in the middle of drum. It is the easiest and cheapest form filter, suitable for residential units. A typical figure of sponge filter.

Methods of Rooftop Rainwater Harvesting Various methods of using roof top rainwater harvesting are illustrated in this section.

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 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.



Storing rain water for direct use method

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.

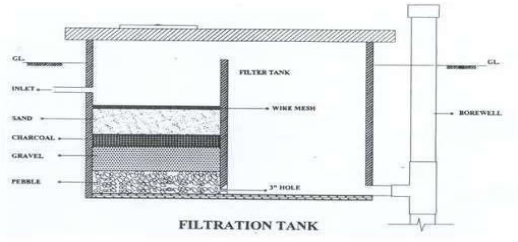
Recharging Groundwater Aquifers

Ensure the percolation of rainwater in the ground instead of draining away from the surface. Groundwater's aquifers can be recharged by various kinds of structures to commonly used recharging methods are-

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

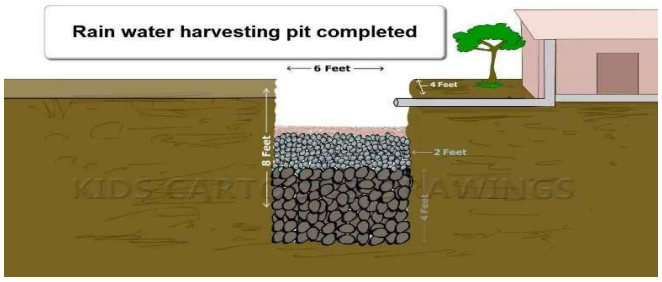
Recharging of Bore Wells

Rainwater collected from the rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement, filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for 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.



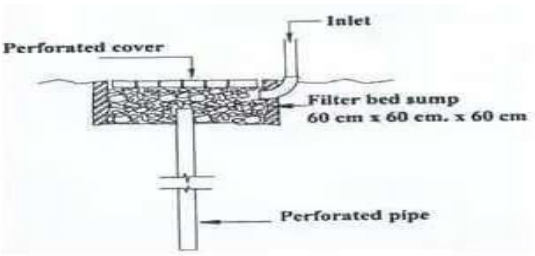
Recharging of Bore Wells

Recharge Pits Recharge pits are small pits of any shape rectangular, square, or circular contracted with brick or stone masonry wall with weep 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.



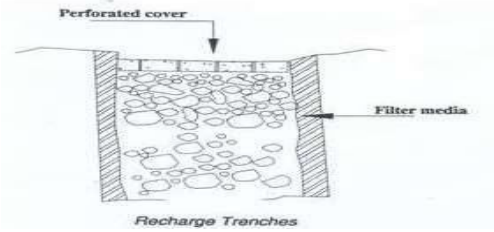
Recharge pit

Soak way 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 30 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/MS pipe to prevent the collapse of the vertical sides. At the top of the soak way, the required size sump is constructed to retain runoff before the filters through



the soak way. Sump should be filled with filter media.

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 the 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. The recharge trench is provided where upper impervious layer of soil is shallow. The recharge trench 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.



Recharging of Dug Wells

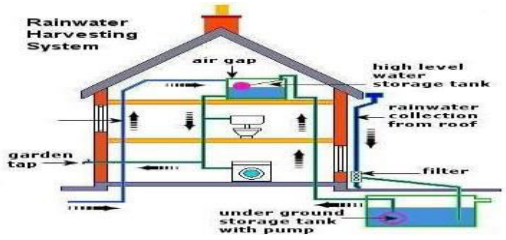
This method is suitable for small houses, playgrounds, parks, and roadside drains. The recharge trench can be of size 0.50 to 1.0 m wide and 1.0 to 1.5 m deep.

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 top water can be diverted to this tank. Water accumulating in the tank percolates in the solid to augment the groundwater.

Applications of rain water harvesting

Domestic use Rainwater harvesting is an effective and ecofriendly method of reducing water usage in your home, which will lead to reduced water charges. Switching to an ecofriendly rainwater harvesting system is neither complicated or time consuming and will result in a wide range of benefits for your home. Our rainwater harvesting systems can help home owners save from 50% - 80% of their main water usage. As with our commercial systems, domestic rainwater harvesting systems are available in two types of systems, direct and in-direct.



Domestic use

With a direct system, the harvested water is pumped directly to the appliances and with an in-direct system, the harvested water is pumped to a holding tank or header tank and gravity feeds the appliances.

We have a wide range of tanks to suit any application. We supply both under-ground and over-ground tanks, where they are one-piece tanks or a series of small tanks to fit into areas with limited space. Please refer to our Brochure to learn more about our underground & over ground range. The harvested water can be used for a number of appliances such as toilets, washing machines, showers, sinks, baths and gardening.

Agricultural Use

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 has been found to reduce building temperatures by more than 1.3 degrees Celsius. 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, it needs to be remodeled in order to use water more efficiently, especially in an urban setting.

Industrial Use The various processes of a factory or industry make a generous use of water resource. Some industries like power generation, textiles and garments, beverage, etc. Make more use of water than their other counterparts. Along with using water for production work, the offices and factories also need to provide enough water for the sanitation and drinking purposes, to their hundreds of employees. Since the main water source can provide the limited amount, these industries and offices must rely upon the alternate source of harnessing water, i.e., rainwater harvesting.

Industrial use

4.0 EXPERIMENTAL STUDY

Roof Top Rain Water Harvesting

Domestic Rain Water harvesting or roof top Rain Water harvesting is the technique through which Rain Water is captured from roof catchments and stored in tanks/ reservoirs/Ground Water acquifers. It consists of conservation of roof top Rain Water in urban areas and utilizing it to augment Ground Water storage by artificial recharge. It requires connecting the outlet pipe from rooftop to divert collected water to existing well/tube well bore well or a specially designed well.

Roof Top Rain Water Harvesting & Conserving Systems, both small and large are comprised of six basic components as described below:

(1) **Catchment Area/Root**: Surface upon which rain falls
(ii) **Gutters and Downspouts**: transport channels from catchment surface to storage
(iii) **Leaf Screens and Roof Washers**: Systems that remove contamination and debris.
(iv) **Cisterns or Storage Tanks**: where collected Rain Water is stored
(v) **Conveying:** the delivery system for treated Rain Water, either by gravity or pump
(vi) **Water Treatment:** Filters and equipment and additives to settle, filter and disinfect.

The system involves collecting water that falls on concrete roof of a house during rain storms, and conveying it by an aluminum, PVC wood collector to a nearby covered storage unit or cistern. Rain Water yield varies with the size and texture of the catchment area. A smoother cleaner and more impervious roofing material contributes to better water quality and greater quantity.

Design of Storage/Settlement Tanks

Design for Storage Tanks

The quantity of water stored in a water harvesting system depends on size of the catchment area and the size of the storage tanks. The storage tank has to be designed according to the water requirements, rain fall and catchment availability.

Basic Data

(1) Avg annual rainfall
(2) Size of catchment
(3) Drinking water requirements

The tank is provided with:

a) A manhole of 0.60 m x 0.60 m size with cover,
b) Vent pipe/overflow pipe of 100 mm diameter, and
c) Drain pipe of 100 mm diameter at bottom.

The withdrawal of water from the underground tank is done by installing a hand pump. In case of surface tank, taps may be provided. The overflow pipe should be connected to a drain/recharge pit

Before the tank is tank is put into use it should be thoroughly cleaned and disinfected with high dosage of chlorine.Since the water should remain stored for quite a long-time, periodical disinfection of stored water is essential in prevent growth of pathogenic bacteria.

Table No.1 Type of Roof catchments Coefficients

S NO.	Type of Roof catchments	Coefficients
1	Tiles	0.8 - 0.9
2	Corrugated metal sheets Ground surface coverings	0.7 - 0.9
3	Concrete	0.6 - 0.8
4	Brick pavement Untreated ground catchments	0.5 - 0.6
5	Soil on slopes less than 10%	0.0 - 0.3
6	Rocky natural catchments	0.2 - 0.5

Site Assessment Assessing the site conditions is the first step towards a sound system design.

- ✓ Availability of suitable roof catchment.
- ✓ Foundation characteristics of soil near the house, Location of trees, Estimated runoff to be captured per unit of the roof, and Availability and location of construction material.

General Design Features Roof top water harvesting systems can provide good quality potable water, if the design features outlined hallow are taken into account:

- The substances that go into the making of the roof should be non-toxic and chemically inert.
- Roof painting is not advisable since most paints contain toxic substances and may peel off.
- No overhanging trees should he left near the roof.

- Nesting of birds on the roof should be prevented.
- A hygienic soak away channel should be built at water outlets and a screened overflow pipe should be provided.
- There should be a reliable sanitary extraction device such as a gravity tap or a hand pump to avoid contamination of the water in the tank.
- There should be no possibility of contaminated wastewater flowing into the tank (especially for tanks installed at ground level).
- Water from other sources, unless it is a reliable source, should not be emptied into the tank through pipe connections or manhole cover.

To calculate the maximum amount of rainfall that can be harvested from roof top ATRI

Area of Rooftop from '**D**' Block:- **12.9m*18.5m =238.65m^2**

Runoff co-efficient for concrete surface:- **0.75m**

Annual water harvesting potential roof top = (Area of roof top) x (Annual rain falls in meter) x (Run off coefficient) x (Constant co-efficient)

$$V=238.65*0.731*0.75 \rightarrow 130.83m^3$$

or

$$V=130830 \text{ lit.}$$

Estimating the Size of the Required System

The size of the catchment area and tank should be enough to supply sufficient water for the users during the dry period. Assuming a full tank at the beginning of the dry season (and knowing the average length of the dry season and the average water use), the volume of the tank can be calculated by the following formula:-

$$V = t \times n \times q$$

Where **V**= volume of tank, in liters **t** = length of the dry season (days) **n** = number of people using the tank; and **q** = consumption in liters per capita per day.

$$V= 100*150*10 = 150 \text{ cubic meters}$$

5.0 CASE STUDY

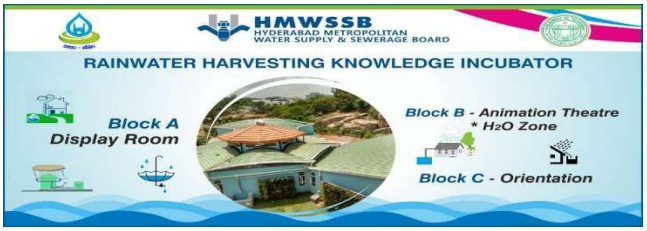
HMWSSB (Rainwater Harvesting Theme park)

It was with an aim to preserve each drop of rainwater for the benefit of future generations that the Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) established the Rainwater Harvesting Theme Park at Road No. 51 in Jubilee Hills, Hyderabad. Now, it has started enlightening scores of visitors with various methods for water conservation through rainwater harvesting system (RWHS) structures to recharge the groundwater levels, apart from storing it for future use.

The Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) could have initiated a Rainwater Harvesting Theme Park to promote awareness and educate the public about rainwater harvesting practices and its benefits. Such a park might include:

Educational Exhibits: Informative displays and exhibits explaining the principles and benefits of rainwater harvesting, including its environmental impact and water conservation advantages.

Rainwater harvesting knowledge incubator fig



Display Gallery

- Consisting of display charts on Water conservation,
- Rainwater Harvesting,
- Groundwater Recharge,
- Water Treatment and Sewerage Treatment
- Live Weather monitoring Station etc.

Rainwater harvesting knowledge incubator

Auditorium Short films on Water Drop Journey on 2D and Rainwater Harvesting etc

Rainwater Harvesting Theme Park Visit – Instructions

Do's

- Free entry for the students of all Government and Private Schools, citizens and Senior citizens etc., who are interested to know about Water conservation / Rainwater Harvesting to the RWH Theme Park.
- Register on line to take permission to visit to RWH Theme park and book slot duly furnishing all required information.
- Every Sunday is working day and Monday is holiday to the park.
- Timings of RWH Theme Park are 10.00AM to 12.00Noon and 2.00PM to 4.00PM.
- Each batch should consist of 50members and lesser than it.

Dont's

- Don't spoil the plants by plucking the leaves or flowers in the park
- No eatables are allowed inside and don't throw waste inside the park.
- Don't walk and sit in the Lawns.
- Spitting of Pan / Chewing Gum or any unwanted material and smoking are strictly prohibited in the park area.

CONCLUSION

Small-scale rainwater harvesting using both traditional and modern rainwater harvesting structures is being implemented in India to alleviate declining groundwater stores, but there is a need for a better understanding of the impacts of many small rainwater harvesting structures and their broader role in water resources management. Field data was collected during this study in the monsoon

periods of 2019 and 2020. There were many challenges working in a resource-poor setting and the field data set is not fully comprehensive, but nevertheless the study has highlighted the importance of these traditional structures in the regions.

As we conclusion, rainwater harvesting for rooftop is a promising solution to water and can provide numerous benefits to household communities. It can significantly reduce water bills, help conserve water resources, and reduce the demand on municipal water supply. The rooftop water harvesting system every year huge amount of water will be saved and huge expenditure on percentage of water will be reduced. The huge amount of precipitation occurring on the ground can be harvested and utilized for different purpose, if proper collection system is provide. As so many parts of the world facing the problems of water crises, one must understanding the importance of water, and should made optimum use of water and adopt efficient methods of collecting and saving rainwater.

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