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Rain Water Harvesting in A Residential Campus at Ghaziabad, UP.

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ABSTRACT:

The world's population is increasing by the day. As of today, the world's total population exceeds 800 million, and India has overtaken China as the world's most populous country, with over 142 million people.

Water is the source of all life. The total volume of water on Earth is estimated to be 1.384 billion cubic kilometers. Only 2.5% of this total water is fresh water, while 97.5% is salt water. The majority of fresh water exists as ice, snow, groundwater, and soil moisture, with only 0.3% available as liquid on the surface.

Water scarcity is spreading globally as a result of population growth and urbanization. As a result, demand for water for various purposes is increasing on a daily basis, despite the fact that usable water is extremely limited. Rainwater harvesting is widely used these days to alleviate the scarcity of fresh water, particularly in urban areas.

In this study, a residential high-rise building in Ghaziabad, UP, was considered for Rain Water Harvesting. Currently, ground water is used as a major source of water supply in almost all areas of western UP. The Gangra river provides only a small amount of water. The ground water in the western part of UP is extremely hard. Rainwater harvesting could be one of the best ways to obtain portable water and recharge ground water.

Rainwater harvesting requires the gathering of necessary information, such as catchment zones and hydrological precipitation data. Water gathering capacity, collection system, storage tank, and so on are all estimated, and an appropriate plan is being developed.

1. INTRODUCTION:

All living things, including plants, animals, and humans, require water to survive and perform various activities. Water is used in a variety of daily activities, including drinking, cleaning, washing, bathing, cooking, horticulture, and other domestic and industrial uses. Water is a valuable, necessary, and abiotic component of the ecosystem. Rainwater harvesting is the process or technology that collects, stores, transports, and purifies rainwater that runs off rooftops, parks, roads, and open spaces for later use. Micro hyperpower generation also be used in rain water downward pipe to product electricity.

Rainwater harvesting is a method of collecting and storing rainwater where it falls. Depending on the situation, we can either store it in tanks for later use or use it to recharge ground water. RWH systems provide sources of soft, high-quality water, reducing reliance on other sources and being cost effective in many situations. RWH systems are less expensive to build than other sources such as wells, canals, dams, diversion, and so on.

Rainwater harvesting systems range in complexity from the simplest to the most complex, and can be installed with minimal skill to automated systems that require advanced setup and installation. Because all of the outlets from the building's terrace are connected through a pipe to an underground tank that stores water, the basic rainwater harvesting system is more of a plumbing job than a technical job. Pre-filters, drains/gutters, storage containers, and depending on whether the system is pressurized, pumps, and treatment devices such as chlorination devices and post-filtration equipment, among other things, are common components installed in such systems.

Rainwater capture, storage & uses are being done back thousands of years, to when we first began farming the land and needed to find new ways to irrigate crops.

2. LITERATURE REVIEW:

Rainwater harvesting is a common practice in almost all countries and areas with high annual precipitation and a scarcity of pure drinking and usable water. The economic situation has prompted low-income groups all over the world to harvest rainwater for household and essential uses. Agriculture is the backbone of the Indian economy, and irrigation water is largely dependent on rainwater harvesting. Several countries around the world, in various regions, have demonstrated the popularity of this method.

Studies and experiments have been done to establish the portability of rainwater in world wise. Lots of research have been done world wise and different guidelines have been published by the different authorities. Cities and states around the world are adopting rules related rainwater Harvesting. Various ministries/departments, Govt. of India have issued different guidelines in respect of rain water harvesting under various scheme i.e. Jal Shakti Abhiyan, National water Mission. IS 14961(2001) for Rain water harvesting in hilly areas, IS 15797 (2008) for roof top rain water harvesting, NBC , CPWD etc. are also issued different type of guid line for rain water harvesting.

3. METHODOLOGY:

In general, there are two methods for harvesting rainwater, surface runoff harvesting and rooftop rainwater harvesting. Rainwater harvesting is the practice of collecting and storing rainwater for on-site reuse rather than letting it run off. The stored water is used for a variety of purposes, including gardening, irrigation, and so on.

There are basically two type of raining water system, one is Surface Runoff Harvesting and another roof top rain water harvesting.

In the surface runoff method, Rainwater is collected as surface runoff and stored for later. Contour Bunds, Semi-Circular Hoop, Trapezoidal Bunds, Graded Bunds, Rock Catchment, Ground Catchment, Dugout Ponds, Embankment Type Reservoir, Irrigation Dam, Silt Detention Dam, High Level Pond, Farm Pond, Water Harvesting Pond, Percolation Dam are some examples of methods. Surface water can be stored by diverting the flow of small creeks and streams into surface or underground reservoirs. It can provide water for farming, cattle, and general household use.

In the roof water harvesting, the roof becomes the catchment and rainwater is collected from the roof of the house/building. It can be stored in a tank or diverted to a man-made recharge system. This method is less expensive and very useful, and if properly implemented, it contributes to increasing the area's groundwater level. Even electricity can also be generated through Micro hyperpower system from rain water downward pipe. Rooftop Rainwater Harvesting Components are Catchment, Transportation, First Flush, Filter, Storage Facility, Recharge Structures, and so on.

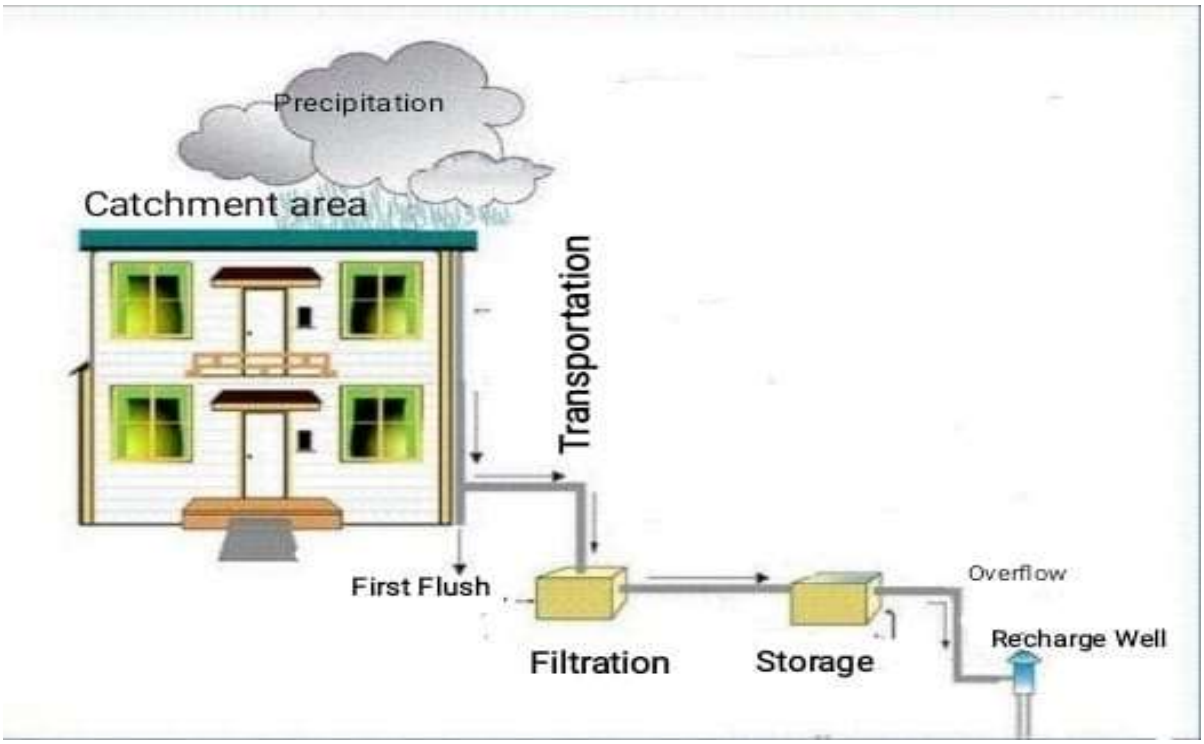

Fig. Components of Rainwater Harvesting

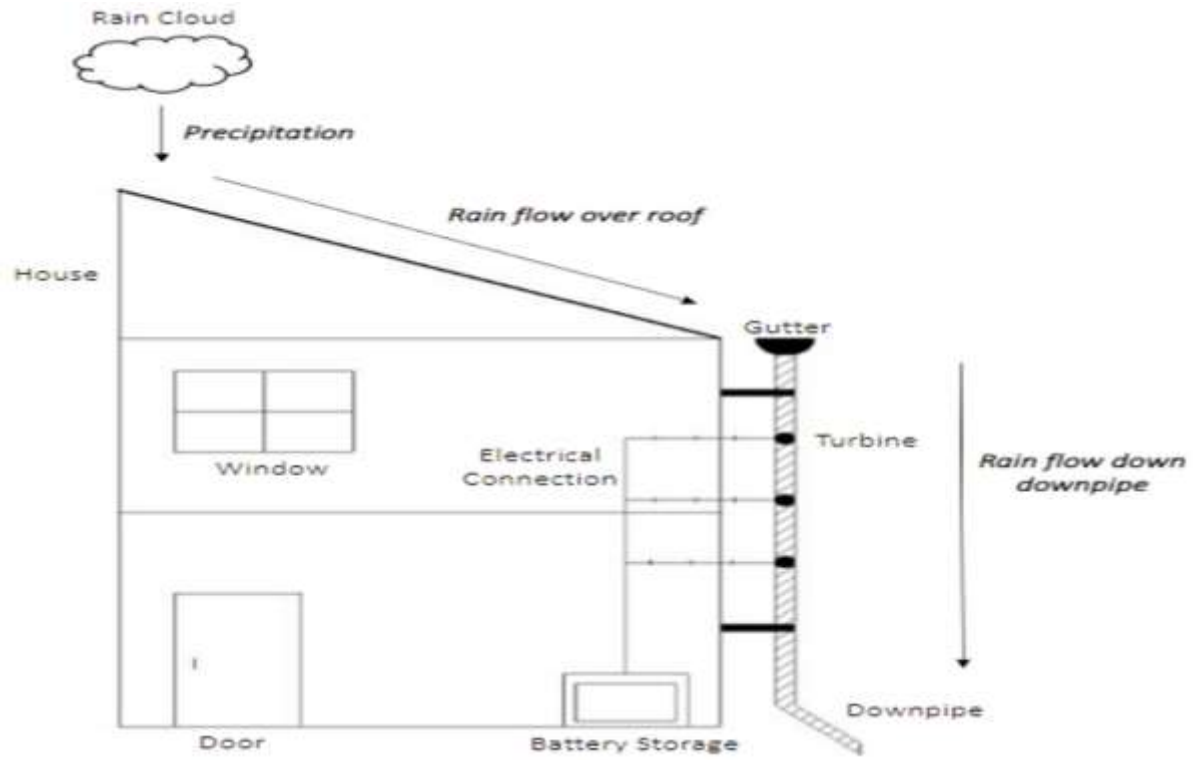

Figure 2. Home schematic of turbine series

Rooftop Rainwater harvesting process: Design of Storage, Settlement Tanks: The amount of water stored in a water harvesting system is determined by the size of the catchment area and the storage tanks. Water requirements, rain fall, and catchment availability must all be considered when designing storage tanks.

Basic Data Required: (i) Average annual rain falls, (ii) Size of catchment, (iii) Water requirements

Runoff coefficient with respect to types of surfaces are as:-(As per India Road Congress Report, 2013)

Table-1

Sl. No.	Describe of Surface	Coefficient of Run-off
1	Total Watertight areas (i.e. Rooftop, Concrete, Bitumen etc.)	0.9
2	Green Area (Loamy)	0.3
3	Green Area (Sandy)	0.2
4	Unpaved area Along roads	0.3
5	Lawns & Pars	0.15
6	Flat built-up area with about 60 percent area impervious	0.55
7	Moderately steep built-up area with about 70 percent area impervious	0.8

Design Parameters for Settlement Tank: Settlement tanks are used to clean rainwater of silt and other floating impurities. A settlement tank is similar to a regular container in that it has provisions for inflow, outflow, and overflow. The bottom of the settlement tank can be left unpaved to allow standing water to percolate into the soil. Apart from removing silt from water, the desisting chamber acts as a system buffer.

Aspects For Designing: Following aspects have to be considered:

(i) Size of catchment, (ii) Intensity of rainfall, (iii) Rate of recharge

Because the desisting tank also serves as a buffer tank, it is designed to hold a certain amount of rainfall, as the rate of recharge may not be comparable to the rate of runoff. The tank's capacity should be sufficient to retain runoff generated during peak rainfall conditions. The peak hourly rainfall in Delhi

is 90 mm. The rate of recharge in comparison to run off is an important consideration. However, because accurate recharge rates are not available, the rates must be assumed.

The capacity of recharge tank is designed to retain runoff for at least15 minutes of rain fall of the peak intensity (for Delhi/NCR 22.5 mm / per 15 minutes say 25 mm per 15 minutes).

The basic rainfall data for station can be obtained from the Indian Metrological Office.

Options For Settlement Tank: Any container with sufficient storage capacity can be used as a settlement tank. Underground tanks made of masonry or concrete are generally preferred. Because they take up no surface area. Pre-fabricated PVC or ferro cement tanks can be used for overground tanks, and pre-fabricated tanks are easier to install.

4. DISCUSSION OF RECHARGES:

For recharges, a Residential Building in Ghaziabad, Uttar Pradesh, India has been taken.

About the building: The residential campus covers approximately 3 acres of land. The campus is having around 1500 population. Current source of water is ground water. With an annual rainfall of around 700 mm and an intensity of 20 mm per hour, the Ghaziabad area provides excellent opportunities for rainwater harvesting.

The main campus has consist of infrastructures i.e. 3 nos. high-rise building blocks, open paved area, play grounds etc.

Catchment Area & Volume of Rainfall:

Table-2

Sl. No.	Location	Roof areas (in sqm)
(A)	Watertight areas:	
	1. Buildings roof area	3500
	2. Other Watertight area i.e. Roads, paths, Pavement etc.	2000
	Total Watertight areas	5500
(B)	Green Aera (Sandy)	6500
	Total	12000

The average rain fall in Delhi is around 700 mm in a year.

Annual Rainwater Harvesting Potential Is Given:-

V = C × I× A Where, V=Volume of water that can be harvested annually in cum, C = Runoff coefficient, I = Annual rainfall in mm, A= Catchment area in sqm.

Table-3

Sl. No.	Location	Catchment Area in sqm., (A)	Annual Rain fall in mm, (I)	Runoff Coefficient, (C)	Annual rain water potential	
					Volume in CUM, (V=CxIxA)	Quantity in Kilo liters (Vol.X1000)/ 1000
(A)	Watertight area	3500	700	0.9	22,05,000	22,05,000
(B)	Green Aera (Sandy)	2000	700	0.2	2,80,000	2,80,000
	Total					24,85,000

Appropriate plan for Water Collection System, Storage Tank, Recharged, and Estimation: Rainwater can be collected on campus in two ways: (a) surface runoff harvesting and (b) rooftop rainwater harvesting, depending on the amount of water needed and the cost of doing so. Rooftop rainwater can be stored in various storage tanks located near various buildings. After filtration, it can be used for a variety of domestic purposes, including bathrooms, gardening, and even cooking and drinking. Surface runoff water can be discharged into groundwater aquifers. The estimated cost of rainwater harvesting will vary depending on storage capacity, the number of re-charge structures provided, and other factors.

5. CONCLUSION AND FUTURE DEVELOPMENT:

Ground water table recharge is a gradual process; we cannot suddenly increase the ground water table after constructing any type of recharge structure, but we can contribute to aquifer recharge. This will aid in the replenishment of depleted ground water resources. Help to save the small amount of rainwater that has been drained for many years. As a result, it is concluded that implementing a RWH system in the residential campus would result in the best approach to dealing with the current scenario of water scarcity and storing a massive amount of 24,85,000 liters in a year in the campus. However, more effort is required for rainwater harvesting, particularly in India.

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