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Design and Execution of Rainwater Harvesting System at CJITS

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Abstract: *Recognizing the importance of water conservation, our project at Christu Jyothi Institute of Technology and Science focuses on Rainwater Harvesting as a viable and eco-friendly approach. This initiative aims to address the increasing water stress faced by our campus and contribute to the broader goal of sustainable water management. Rainwater harvesting involves the collection, storage, and utilization of rainwater for various purposes. Our system incorporates a network of strategically placed collection points such as rooftops and paved surfaces equipped with gutters and downspouts. The collected rainwater is then directed to storage tanks or recharge pits, depending on the intended use. The main aspect of our project is the integration of modern technology to enhance efficiency and monitoring. The project aligns with the principles of sustainability and environmental responsibility. It promotes a circular water economy by harnessing rainwater, which might otherwise go unused, and utilizes it within the campus ecosystem*

Keywords: Rainwater harvesting, bore well, storage tank, manholes

I. INTRODUCTION

Rainwater harvesting system, technology that collects and stores rainwater for human use. Rainwater harvesting systems range from simple rain barrels to more elaborate structures with pumps, tanks, and purification systems.

The non-potable water can be used to irrigate landscaping, flush toilets, wash cars, or launder clothes, and it can even be purified for human consumption. With water scarcity a pressing problem for many densely populated regions, rainwater harvesting systems can supply households and businesses with water for use in dry seasons and lessen the demand on municipal systems.

The execution of rainwater harvesting at CJITS College involves the installation of pipes to channel rainwater from the roof surface into a storage tank or directly into the ground, thereby replenishing Groundwater levels and preventing water logging. This environmentally friendly strategy seeks to protect the campus from flooding, preserve water resources, and encourage responsible environmental within the college campus

II. NEED FOR RAINWATER HARVESTING SYSTEM

- The rapid rise in human population has made optimum use of fresh water imperative.
- Urban water supply systems in particular are under tremendous pressure to meet the needs of the population as well as industry and large-scale construction.
- The increased need for water results in lower groundwater tables and depleted reservoirs.
- It helps to avoid flood & water stagnation in urban areas
- Reduces water and electricity bills

III. METHODS OF RAINWATER HARVESTING

SURFACE RUNOFF HARVESTING

Surface runoff harvesting is a sustainable method of rainwater harvesting that utilizes the natural flow of rainwater over the ground's surface. This technique involves capturing rainwater that flows over impermeable surfaces such as rooftops, roads, and pavements, and diverting it into storage systems for later use. The collected runoff water is typically stored in tanks, ponds, or reservoirs, where it can be used for various purposes such as irrigation, groundwater

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recharge, or even for domestic consumption after appropriate treatment. Furthermore, surface runoff harvesting systems can be designed to be integrated into existing infrastructure, making them a cost-effective and sustainable solution for water management.

ROOFTOP RAINWATER HARVESTING

Rooftop rainwater harvesting is a sustainable method aimed at collecting and storing rainwater that falls on rooftops for various purposes. The process begins with the installation of gutters and downspouts on the roof to channel rainwater towards collection points. These collection points are connected to pipes that lead to storage tanks or reservoirs located either above or below ground. The collected rainwater undergoes filtration to remove debris and impurities before it enters the storage system.

IV. WATER QUALITY PARAMETERS OF RAINWATER

ACIDITY (Ph) The pH is of important to determine the corrosively of water. Rain is considered acidic when the pH is less 6.5, and levels below this may cause corrosion of metal roofs and fittings. WHO guidelines (1996), give 6.5 to 9.5 as acceptable parameters for pH value in rainwater.

Performing pH test on rainwater

Result: pH of rain water = 5.6

IV. COMPARISON BETWEEN POTABLE WATER AND RAIN WATER

S.NO	Description	Potable Water	Rain Water
1	Source	Normal water comes from various sources like rivers, lakes, or groundwater, and may undergo treatment for purification	Rainwater comes directly from the sky and is collected from rooftops or catchment areas.
2	Composition	Normal water may contain minerals, chemicals, and additives depending on its source and treatment process	Rainwater is relatively pure but may contain pollutants from the atmosphere or contaminants from the surface it lands on.
3	pH	7.5	5.6
4	Turbidity	5 NTU	18.5 NTU
5	Color	Clear and Colourless	Faint yellow to brownish

V. SYSTEMS OF RAINWATER HARVESTING

- **DIRECT PUMPING SYSTEM :** A direct pumping system of rainwater harvesting is a method used to collect, store, and distribute rainwater for immediate use through a pump-driven mechanism. This approach enables the utilization of harvested rainwater even in areas with limited elevation differences.
- **GRAVITY FED SYSTEM :** The gravity-fed system is a fundamental technique to rainwater harvesting that collects, stores, and distributes rainfall without the use of mechanical pumps. This system is based on the notion of water flowing downhill due to gravity force.
- **INDIRECT PUMPING SYSTEM:** Rainwater is gathered and dispersed to the appropriate areas by the indirect pumping system using a combination of distribution pipes, storage tanks, and pumps. Indirect systems

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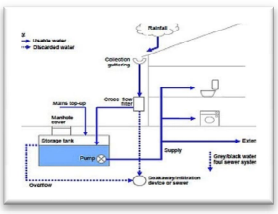
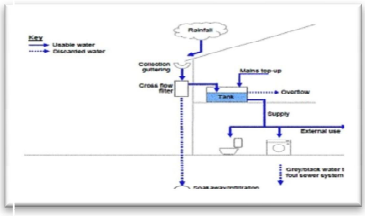
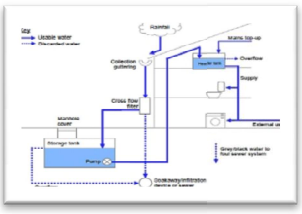
use pumps to move water from collection surfaces to storage tanks, overcoming elevation disparities and increasing distribution efficiency, in contrast to direct systems, which store water directly in tanks close to the collection surface.



Direct Pumping System

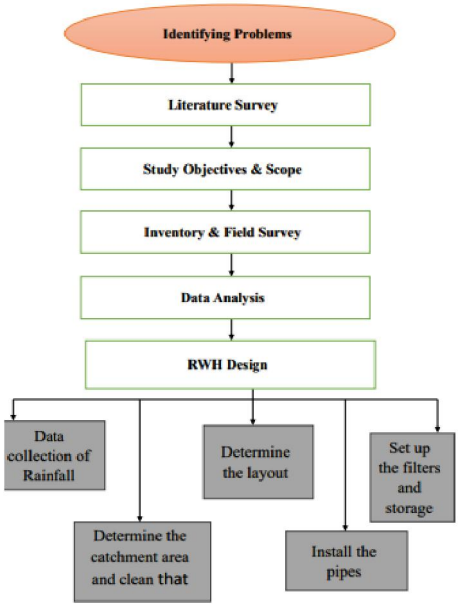


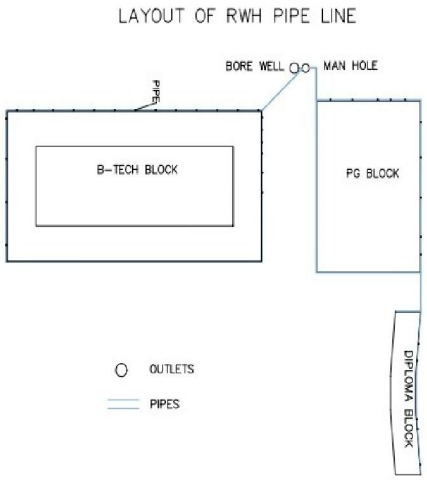
Gravity Fed System



Indirect Pumping System

VI. METHODOLOGY





Layout Plan Of Cjits showing Pipes, Outlets And Storage Of Rainwater Harvesting System

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To design the roof-top rainwater harvesting system we need to design six main steps, they are as follows.
Determine the roof catchment area and Layout
Area Of B-TECH Block = 4000 m^2
Area Of Diploma Block = 660 m^2
Area Of PG Block = 2260 m^2
Total roof catchment area = 6920 m^2
Amount of rainwater captured in CJITS
Average rainfall of Jangaon = 74.15mm
Considering 80mm for future
Average rainfall (R) = 74.15mm
The average rainfall in terms of meters per year (R) =0.07415m/year
Catchment Area (A) = 6920 m^2
Run off coefficient (Cr) = 0.8
Mean annual rain water supply(S) = Average rainfall X Area of catchment X Runoff coefficient
= 74.15 x 6920 x 0.8 = 410494.4 litres/year

Transportation system (install the pipes)

Recharging of ground water level in bore well

VII. REGULATIONS OF RAINWATER HARVESTING OF INDIA

1. The Jal Shakti Abhiyan began in 2019 as JSA-I, expanded in 2021 as JSA CTR, and continued in 2022 and 2023. It aims to promote rainwater harvesting across all districts of India, with a focus on completing various water-related and afforestation projects.

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2. The Government of India's Atal Bhujal Yojana, with a budget of Rs. 6,000 crore, targets 8,220 Gram Panchayats across 229 blocks in 80 districts of 7 states. It aims to address groundwater depletion by fostering community-led sustainable groundwater management. Launched on April 1, 2020, it spans a 5-year period, focusing on identified water-stressed areas in Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh.
3. Watershed Development Component of Pradhan Mantri Krishi Sinchayee Yojana (WDC-PMKSY) has got rainwater harvesting as one of the activities under its Natural Resource Management (NRM) component.
4. The scheme of Surface Minor Irrigation (SMI) and Repair, Renovation & Restoration (RRR) of Water Bodies have multiple objectives like expanding cultivable area under assured irrigation by improvement and restoration of water bodies inter alia increasing ground water recharge and revival of lost irrigation potential.
5. Master Plan for Artificial Recharge to Groundwater- 2020 has been prepared by Central Ground Water Board in consultation with States/UTs which is a macro level plan indicating various structures for the different terrain conditions of the country.
6. Central Ground Water Authority (CGWA) while granting No Objection Certificates (NOCs) for ground water abstraction envisages that the proponents shall install roof top rain water harvesting & recharge systems in the project area
7. Model Building Bye Laws (MBBL) 2016 circulated by Ministry of Housing &Urban Affairs include provisions for Rainwater Harvesting and it has been shared with all the States/ UTs. So far, baring Sikkim, Lakshadweep and Mizoram all the States/UTs have adopted the provisions of rainwater harvesting of MBBL-2016.

VIII. CONCLUSION

The installation of a rainwater harvesting system on campus illustrates a sustainable approach to water management, greatly lowering reliance on outside water sources and encouraging environmental stewardship and a conservation-minded culture among both staff and students.

This project evaluated the feasibility of rainwater harvesting in a locality of CJITS Engineering College Jangaon. When people think about rainwater, they often erroneously think that it contains pollutants but the truth is that rain water is extremely clean and safe, so in such area if rainwater can be collected and stored in a proper and scientific manner, management of water resources would enter a new era. Since the discussed roof harvesting technology does not have any harmful effect on the environment.

Rain water harvesting seems to be a beneficial and sustainable method, therefore advocacy for the adaptation of rain water would certainly lead to a reduction of problems related to water shortage.

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