# FEASIBILITY STUDY ON THE IMPLEMENTATION OF ROOFTOP RAINWATER HARVESTING FOR SUSTAINABLE WATER MANAGEMENT AT CIVIL AND ELECTRICAL BLOCKS, PESCE MANDYA

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**Keywords:**

Decentralized Water System, Aquifer Replenishment, Runoff Estimation, Storage Efficiency, Environmental Sustainability, Water Demand Analysis


**Introduction:**

Water is a vital natural resource that supports human life, ecological balance, and economic development. However, rapid urbanization, population growth, and climate change have significantly increased water demand and led to the depletion of groundwater resources. Rainwater harvesting (RWH) is a sustainable and decentralized approach to water management that involves the collection, storage, and utilization of rainwater from rooftops and other catchment areas. It reduces dependency on conventional water sources, promotes groundwater recharge, and minimizes urban flooding and soil erosion. RWH systems are cost-effective, environmentally friendly, and suitable for domestic, agricultural, and industrial applications. In institutional campuses, implementing RWH can optimize water usage and reduce overall demand. Therefore, integrating rainwater harvesting into infrastructure planning is essential for ensuring long-term water security, improving resource efficiency, and achieving sustainable development goals.

**Objectives:**

1. To estimate the quantity of rainwater that can be harvested and stored based on rainfall intensity, catchment area, and roof characteristics.
2. To design an efficient storage-based rainwater harvesting system with proper conveyance, filtration, and storage components.
3. To evaluate the suitability of harvested rainwater for non-potable applications such as gardening, flushing, and cleaning.
4. To analyse the technical feasibility by comparing storage capacity with institutional water demand.

5. To assess the economic feasibility in terms of installation cost, maintenance, and potential savings in water bills.
6. To recommend strategies for sustainable utilization and large-scale adoption of rooftop rainwater harvesting systems within institutional premises.

**Methodology:**

1. The project methodology adopted for the study and implementation of the rooftop rainwater harvesting system integrates both analytical assessment and practical execution. Initially, the Civil Engineering Department building was selected for detailed analysis, and the rooftop catchment area was evaluated. Rainfall data obtained from standard sources was used to estimate the annual rainwater harvesting potential.
2. Based on the calculations using appropriate runoff coefficients, the Civil Engineering Department alone was found to generate approximately 5,00,000 litres of rainwater annually, whereas the total potential from all departments within the campus was estimated to be around 15–17 lakh litres per year.
3. Subsequently, a suitable system was designed comprising rooftop collection, conveyance through downpipes, a collection chamber for initial sedimentation, and a recharge pit for groundwater replenishment. The recharge pit was designed considering soil conditions and infiltration capacity, with in-situ filtration layers consisting of large stones, gravel, coarse sand, and charcoal, eliminating the need for a separate filtration unit. A first flush arrangement was also provided to improve water quality.
4. Finally, partial implementation of the system was carried out for the Civil Engineering Department to validate the feasibility of the proposed design. Post-implementation observations were conducted to assess the functional performance of the system, including flow efficiency, infiltration behavior, and structural stability. The collected data was analyzed to verify the effectiveness of groundwater recharge and overall system reliability. Based on the observations, necessary design considerations and improvements were identified to enhance efficiency and support large-scale implementation across the campus.
5. Furthermore, the methodology establishes a scalable and replicable framework that can be adapted to varying building configurations and site conditions. It also promotes integration with institutional water management policies, encouraging long-term sustainability, resource conservation, and reduced dependency on external water sources. The approach thus ensures both technical feasibility and environmental viability for widespread adoption.
6. Furthermore, it contributes to improved groundwater levels, reduction in urban water stress, and supports the development of a self-sustaining and water-efficient campus ecosystem.

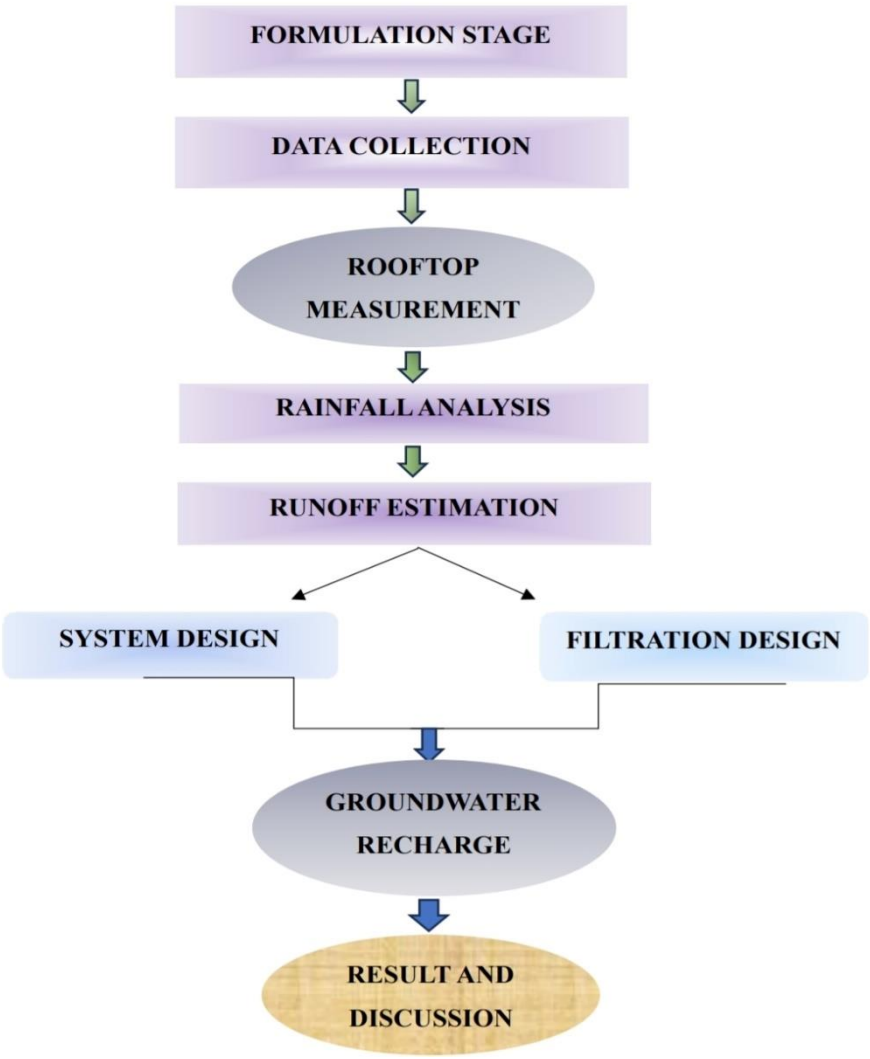


Figure 1: Methodology

**Result and Conclusion:**

1. In conclusion, the study and partial implementation of the rooftop rainwater harvesting system for the Civil Engineering Department clearly demonstrate the effective utilization of approximately 5,00,000 litres of rainwater annually for groundwater recharge. The system integrates rooftop collection, a collection chamber (2.5 ft × 2.5 ft × 2.5 ft) for initial sedimentation, a first flush arrangement, and a recharge pit of about 6–6.5 ft depth with graded filtration layers consisting of charcoal, coarse sand, gravel, and large stones.
2. The results indicate that the designed recharge structure is hydraulically adequate to accommodate the generated runoff and facilitate efficient infiltration into the subsurface strata. The in-situ filtration arrangement within the recharge pit effectively removes suspended impurities, eliminating the necessity for a separate filtration unit and thereby improving cost efficiency and operational simplicity.
3. Furthermore, the system significantly contributes to groundwater replenishment, minimizes surface runoff losses, and supports sustainable water management practices within the campus. The observed performance highlights the practicality and scalability of such systems even at a departmental level.

4. In conclusion, the project validates that rooftop rainwater harvesting coupled with a scientifically designed recharge pit is a technically sound, economically feasible, and environmentally sustainable solution. The methodology can be effectively replicated across other institutional buildings to enhance overall water conservation and groundwater sustainability.

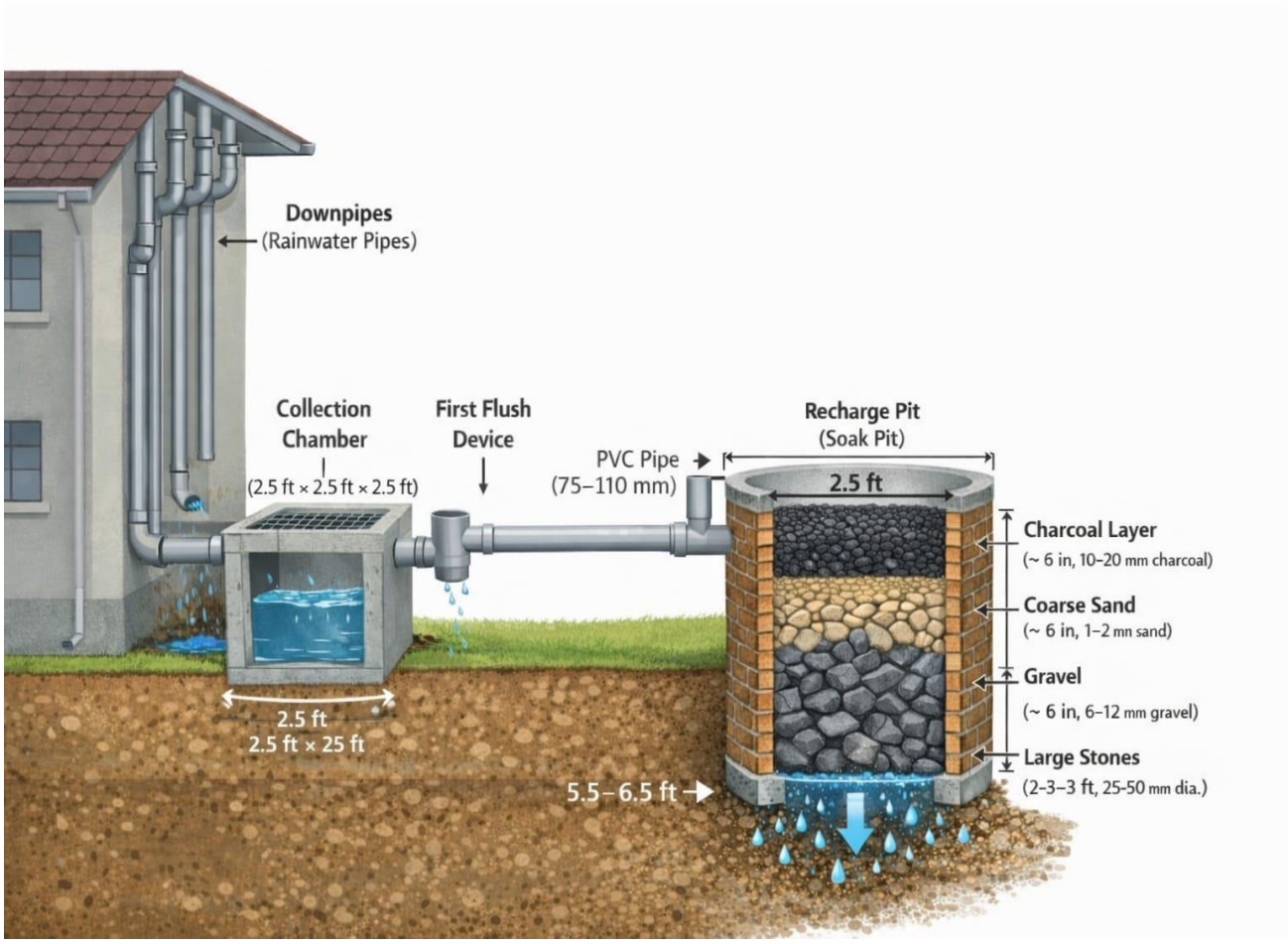


Figure 2: Rooftop Rainwater Harvesting System with Integrated Groundwater Recharge Structure

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**Future Scope:**

The future scope of this project includes:

1. The implemented rooftop rainwater harvesting system can be expanded to other departments and buildings within the campus to increase overall groundwater recharge capacity.
2. Incorporation of monitoring systems can help in evaluating recharge efficiency, water quality, and seasonal performance of the system.
3. The design can be further optimized based on long-term rainfall data and soil characteristics to enhance infiltration efficiency.
4. Adoption of improved filtration materials and regular maintenance practices can ensure better performance and durability of the system.
5. The proposed system can be replicated in other educational institutions and urban areas as a sustainable water management solution.
6. Future implementation at a larger scale can contribute significantly to groundwater conservation and reduction of surface runoff losses.