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Rooftop Rainwater Harvesting System for TSSMs BSCOER and JSPMs NTC Narhe Pune

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ABSTRACT: At the speed in which India population is increasing, it is said that India will definitely take number one position China of most heavily populated nation in the world after 20-30. These will increase utilization of most profitable regular asset; Water's subsequent enlargement of weights on the allowed freshwater assets. Old technique for damming water and transporting water to urban zone has its own endless problems of social and political issues. Keeping in mind the end goal to save and take care of our day by day demand of water prerequisite, we have to think for elective savvy and generally less demanding mechanical techniques for monitoring water. Rain water reaping is outstanding amongst other techniques satisfying those necessities. The specialized parts of this paper which know as rain pod is thought to be catchment territories from house top for rainwater harvesting. As a matter of first importance, required information are gathered i.e. catchment zones and hydrological precipitation information. Water gathering potential for the college rooftop was ascertained, and the tank limit with appropriate plan is being considered. Volume of tank has been ascertained with most suitable strategy for estimation. Ideal volume of tank based on hydrological investigation.

KEYWORDS: Freshwater, Rain pod, Estimation, Precipitation, Rainwater harvesting.

I. INTRODUCTION

Water is very important parameter on earth. Water demand is continuously increasing in developing India as population increases. To overcome this huge amount of water demand rainwater harvesting (RWH) is effective and economical tool for growing India. Rainwater harvesting is sustainable and economic development. Harvesting of rainwater is the process of collecting rainwater from various surfaces such as rooftop, sloped roof, roof tiles or ground and store it for future purpose. RWH can be used to increase ground water table by artificially recharging groundwater resources like tube wells, bore wells and open well. Types of RWH system are 1. Surface runoff harvesting. 2. Rooftop runoff harvesting. Rooftop rainwater harvesting is carried out by collecting rainwater from roof of building, sheds and tops of structures. Surface runoff harvesting is carried out by collecting water from surface such as lawns, roads and inclined surface. Water collected from surfaces and roof is stored for future purpose. This paper help use for developing rainwater harvesting system for urban areas, school and colleges where roof area available as a catchment for rainwater harvesting.

II. RELATED WORK

We have considered two Institutional campuses as our study area namely TSSM's Bhivarabai Sawant College of Engineering & research and JSPM's Narhe Technical Campus Narhegaon district Pune, Maharashtra. Both campuses include total eight numbers of buildings and having a total rooftop area of 8200 sq. m. The annual rainfall of nearby regions is about 700 mm which is considered for the purpose of analysis of amount of water which can be harvested for the study area. Total numbers of people in campus are 3000 out of these 500 students are living in the hostel. Daily average water demand in summer season 62500 liters for drinking and flushing purpose. Such a huge water

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demands creates water scarcity in summer season. In other seasons water demand is fulfilled by bore well and open well available in campus area. To overcome this water scarcity, it is supplied using tankers from outside sources. So, we have selected this case to tackle the issue in college campus by developing an optimized RWH system.

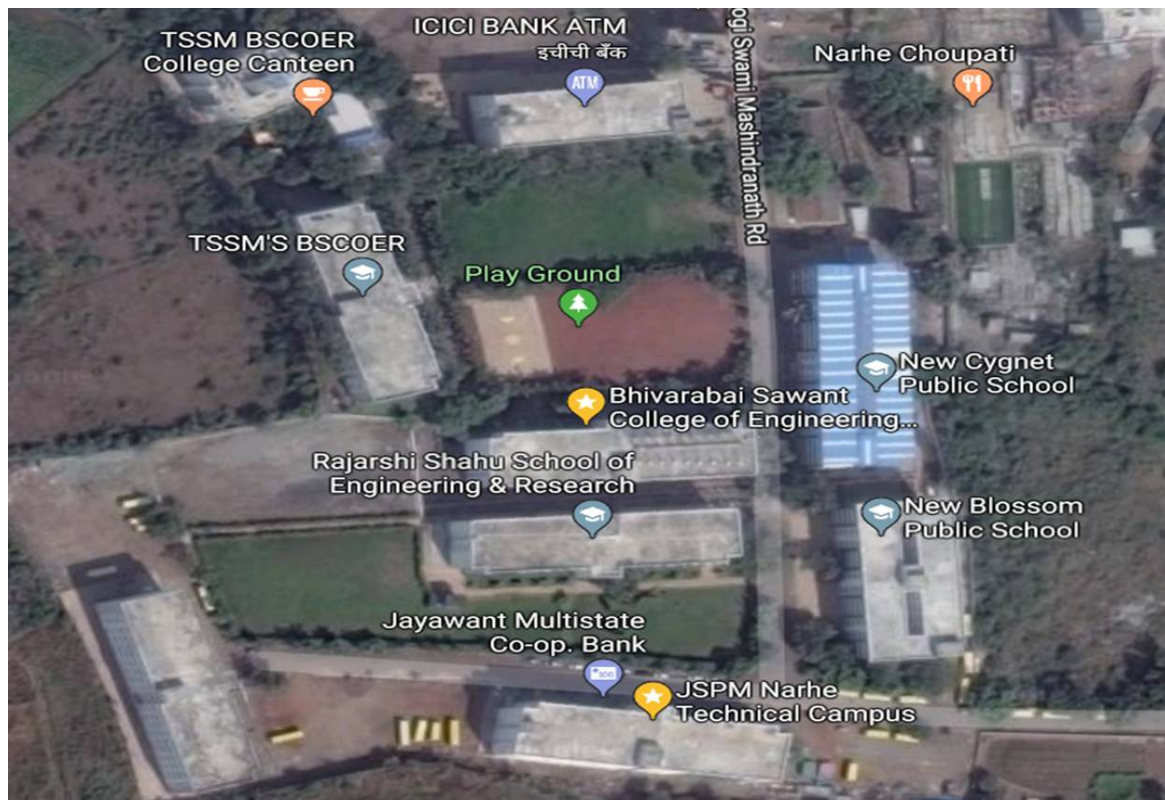


Fig. 1. Study Area

III.METHODOLOGY

Average annual rainfall for Pune Region is 694.386 mm for past 10 years. The highest rainfall in last 10 years was 1214.9mm in 2016 and lowest rainfall was 197.88mm in 2011. Rainfall data is collected from Indian MetrologicalDepartment. For study purpose we have taken annual rainfall 700mm. catchment area for college is rooftop area of college and hostel buildings available in campus area. Rooftop area is calculated by using building map and manually for accuracy purpose. Eight buildings are available for RWH in college campus. Total rooftop area available as catchment is 8200 sq. m. The numbers of people in campus are 3000. Average daily water demand 105000 liter, this demand is fulfilled by using bore well water available in campus. In summer season water demand is 62500 liter daily.

Rain pod is introduced as catchment area on rooftop of building. Rain pod provide surface for water collection and store water at roof top. Rain pod are design as per the requirement of building. As water is directly collected from top we get fresh water. This water we can directly use for domestic purpose.

Example- catchment area of rain pod = 10.64 sq. m., Average annual rainfall = 0.7 m, Runoff coefficient= 0.95. Water collected in rain pod = $10.64 \times 0.7 \times 0.95 = 6.703$ sq. m. = 6703 liter.

Total water available in natural water resources satisfies the demand for eight month from June to January. Water table level is good in these months. As summer starts ground water level decreases and bore well and open well water is not

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enough to tackle the water demand. Therefore daily water demand is satisfied by tankers. Total expenditures on tanker water are 1560000 Rs per year. Annual rainwater collected from rooftop ($8200 \times 0.7 \times 0.95 = 5453 \text{ sq. m}$) 5453000 liter. Out of this 40 % water is used for ground water recharge by using bore wells. Water available for storage is 3271800 liter. This water satisfies the water demand for 52 days in summer.

IV.DESIGN AND ANALYSIS

Area selected is located in Pune region. Annual rainfall data collected from IMD Pune, and annual average rainfall is calculated. Average annual Rainfall is 700 mm. Rooftop areas of college buildings 8200 sq. m. Rainfall Coefficient is take as 0.95. Total precipitation on rooftop is calculated $W = T \times A \times R = 5453000 \text{ liters}$.

Table 1: Water requirement in summer season

Month	water requirement		No of students	Total water required	
	drinking	flushing		per day	per month
February	5	20	3000	75000	1875000
March	5	20	3000	75000	1875000
April	5	20	2000	50000	1250000
May	5	20	2000	50000	1250000
				Avg = 62500	Total= 6250000

• Collection of Water & Filtration

Water collected from building top is transfer to the filter by using 6 inches pipes. Selection of filter is carried out on the basis of open space available in college campus. Rainy filter required less space as than traditional sand filter. Capacity of one unit of filter is 480 LPM. Work on gravitational force. First flush is provided in filter itself to clean the filter. From filter water is move towards storage tank by using pipelines. Diameter of pipes selected is 6 inches. For storage we have selected underground water tank and open pond in college area. Two underground storage tanks of capacity 1004480 liters [$14.6 \times 8.6 \times 4 \text{ m}^3$] are selected. For ground water recharge one bore well of 200 feet with 5 inches per building is provided near the filter outlet.

• Calculations

Total installation cost of one building plumbing, filter unit and bore well is 1, 76, 000 Rs. We have eight building Total cost of eight building will be $1, 76, 000 \times 8 = 14, 08,000 \text{ Rs}$.



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2. Rainy filter seat up

Estimated cost of water storage by PWD DSR method is 47, 96,336 Rs with pipeline setup.

Total cost of Rooftop RWH project = 62, 04,336 Rs.

Annual expenditures on water supply from outside sources is 15, 60, 000 Rs.

Payback period for total cost recovery of project = $\frac{\text{Total amount spend on RWH}}{\text{Amount spend for consumption of water per year}}$

$$= \frac{6204336}{1560000} = 3.97 \text{ years} = 4 \text{ years.}$$

$$\text{Stored water satisfies demand of} = \frac{3271800}{62500} = 52.34 \text{ days.}$$

V. RESULT

RWH system annual water collected from rooftop of TSSMs BSCOER and JSPMs NTC Narhe 5453000 liters. Out of which 40 % of water is use to increase ground water level by using tube wells, excess water stored in Underground storage tank of size 14.6 x 8.6 x 4 meter. Two storage tanks are provided and overflow water is collected in open pond for future. This water storage satisfies 52 days water demand in summer season. Total annual expenditure on RWH system is about 6204336 Rs. Payback period for total rainwater harvesting project is 4 years.

VI. CONCLUSION

India receives highest rainfall in rainy season which satisfies the water demand in rainy and winter season, but in some regions water scarcity occurs in summer season as ground water level decreases in summer. To solve this problem RWH is better solution to save future. RWH satisfies the water demand in future also increases the ground water level by filling the natural water sources such as bore well, open well and ponds. Selected site for RWH also have problem of water scarcity in summer, to fulfil the summer water demand. Rooftop RWH system design for the college campus. In the design rainy filter is used for filtration of rainwater. Storage tanks are design to store water for future water demand. This paper gives the optimized solution for RWH. For water collection new technique of rain pod is introduced. Rain pod is useful for water collection and storage for small houses. RWH of campus satisfies 52 days water demand for college. This system is cost effective and payback period is also less.

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