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ANALYSIS OF ROOFTOP RAIN WATER HARVESTING SYSTEM IN NAGPUR CITY - A CASE STUDY

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Abstract: - Water is one of the most precious resources on earth. Even though water covers a three quarters of the planet, 97% of the Earth's water and thus useless for drinking and other purposes less than 3% of water is fresh water. In the past few years, the national conference was organised and the point which comes towards is the fresh water decreases day by day. Further increasing the population of all over the world or India than the more crises of water demand will also rise in future. Nagpur is one of the fastest growing cities in India and hence comparatively of population will also rise with water demand. In this paper, we are studied that the rooftop rain water harvesting system & also the sample calculation of house 100sq.m area for Nagpur city. The prime objective of this paper is to minimize NMC (Nagpur Municipal Corporation) water, reuse of rain water for household uses and ground water recharging. There is huge gap between demand and supply of water in Nagpur city. So, we need adopt the technology like RWH to avoid the water scarcity in the Nagpur city.

Keywords: - Rain water harvesting, RWH, Run off coefficient, Rainfall.

I. INTRODUCTION

Water is scare natural resource, even though 71% of land is covered by water. Out of total water on the earth near about less than 3% is fresh which is utilized for various purposes viz. domestic, irrigation and industrial are common. Water scarcity is one of the most serious global threat due to hazardous population growth, frequent droughts and changing climate pattern. Now a day, the need of domestic water is magnifying tremendously in a developing country like India. So, we haven't work on those such think than rooftop rain water harvesting is best suitable method. Rooftop rain water harvesting is defined as the process of collecting and storing rain for later productive use. It is a mini-scale water resources project that collects rain water by structural measures and regulates and makes use of it for domestic and productive use. Rooftop rainwater harvesting is mainly done due to following reasons:

- Environment friendly and easy approach for water requirements.
- RWH is an ideal solution for water requirements in areas having inadequate water resources.
- Increases ground water level and improves ground water quality.
- Mitigates the effects of drought.
- Reduces the runoff, which otherwise cause flood storm water drains.
- Reduces flooding of roads and low-lying areas.
- Reduces soil erosion.
- Cost effective and easy to maintain.

II. OBJECTIVES & PURPOSES

- To minimize the surface runoff during monsoon.
- To conserve the water by using rain water.
- To recharge ground water.
- It is very easy to understand.
- Less land consuming.
- Economical and easy to maintain.

III. LITERATURE REVIEW

Rahitashw Kumar, Thaman S., Agrawal G. & Sharma Poonam is describe about the rain water harvesting and ground water recharging is less economical and highly improve the quality of ground water.[1] The method is applied into the paper like ponds to collect rain water and recharging ground water. The conclusion of these paper is that the risingly growth of agriculture and also distribute the agricultural water which comes from irrigation department and use into the city.

Utsav R. Patel, Vikarant A. Patel, Manjurali I. Balya, Harshad M. Rajgor is describes about the rooftop rain water harvesting system.[2] The method is adopted into the paper is that to collect rain water and captured area data for harvesting process and also study the geographical analyse. They conclude that the volume of rainfall for adopting the S.P.S.V Campus to avoiding the water crises problem.

S. Vishwanath is describes about the domestic rooftop rain water harvesting and use into the rural context for collect water in agricultural purpose.[3] The method is applied into the paper for collecting data and study area. To conclude that those such thing is calculate runoff volume for rain water harvesting.

Saif Ullah Khan is says about the water essential for human being and also the climate factor.[4] In all of that the intensity of rainfall data average and also falling into the earth surface. The shallow open well is also consider for concluding the ground water recharging process using rain water.

Preeti P. Shiras, Nikhil A. Maske is describes about the design and analysis of rooftop rain water harvesting system in Y.C.C.E. Campus.[5] They applied the method for study area, ground water data, rainfall data, and volume of water for capturing the rain. They conclude that volume of rainfall for using in various purpose in campus.

IV. METHODOLOGY

4.1. Geographic information about Nagpur city

Nagpur is one of the district which comes into the Vidarbha region of Maharashtra state. It is located at $21^0 15^{'}$N longitude and $79^0 09^{'}$E latitude & elevation is 310m. The geographical area of Nagpur district is 9930sq km.

Data Collection Of Rainfall (Source: Revenue Department, Zilla Parishad,, Nagpur)

Table 1. Monthly rainfall Data of Nagpur District

Month	Rainfall (mm)	% of Total Rainfall
January	1.292	0.12%
February	36.97	3.41%
March	5.32	0.49%
April	3.66	0.34%
May	0	0%
June	174.056	16.04%
July	360.811	33.26%
August	280.414	25.85%
September	170.984	15.76%
October	43.369	3.99%
November	7.315	0.67%
December	0	0%

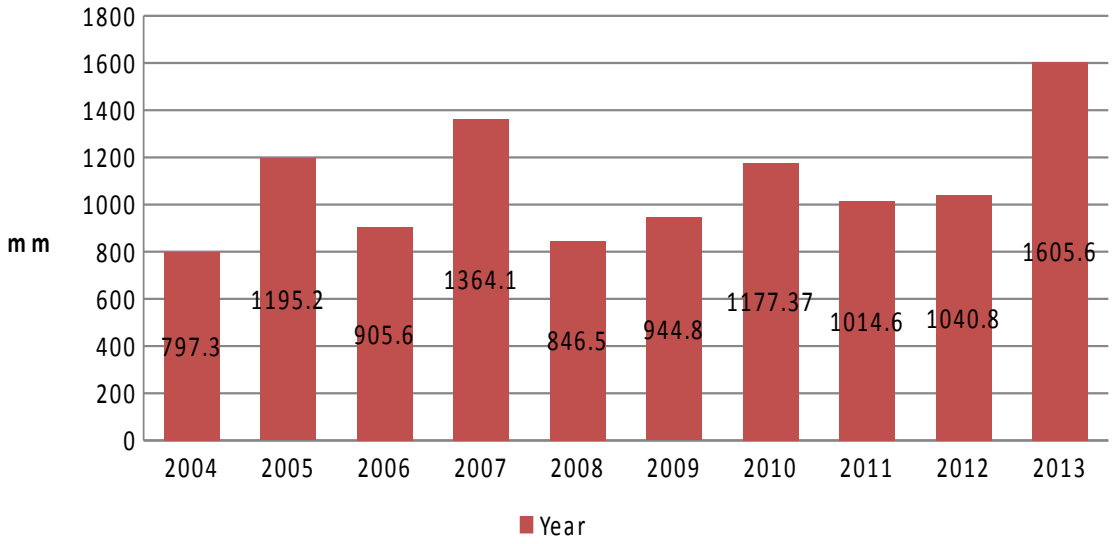

Figure 1. Amount of rainfall collected in though the last 10 years of Nagpur District

4.2. Runoff Coefficient

Runoff coefficient for any catchment is the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface. Runoff coefficient accounts for losses due to spillage, leakage, infiltration, catchment surface wetting and evaporation, which will all contribute to reducing the amount of runoff.

Table 2. Value of Runoff Coefficient (k)

Sr. No.	Types of Area	Flat Land (0-5%)	Rolling Land (5-10%)	Hilly Land (10-30%)
1	Urban Area	0.55	0.65	-
2	Single Family Residence	0.3	0.3	0.3
3	Cultivated Area	0.5	0.6	0.72
4	Pastures	0.3	0.36	0.42
5	Wooden Land of Forest	0.3	0.35	0.5

(Source: Table 7.31, Irrigation Engineering & Hydraulic Structure, by Garg, S.K.)

4.3. Case study of 100sq.m area for Rooftop

Sample calculation

- Consider a building having a flat terrace area is 100 sq.m
- The average annual rainfall is about 1090mm
- The land should be flat enough and consider impermeable
- Coefficient of runoff for flat land = 0.55
- Total amount of rainfall which can be harvested = 100 x 1.09 x 0.55
  = 59.95m^3/year
  =59950 lit/year

As Per Who 135lpcd Water Uses Per Person Than Drinking & Cooking 5% (6.75lpcd), Washing 33% (44.55lpcd), Gardening 17% (22.95lpcd), Bathing 15% (20.25lpcd), Flushing 30% (40.5lpcd).

As Per Assume Analysis Of Roof Top Rain Water Harvesting is 59950lpcd Than Washing 33% (19783.5lpcd), Gardening 17% (10191.5lpcd), Bathing 15% (8992.5lpcd), Flushing 30% (17985lpcd).

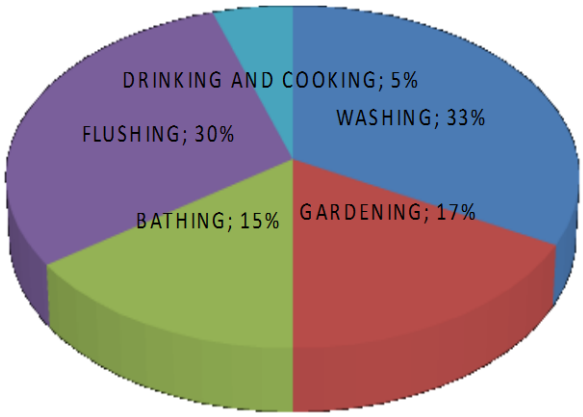

Figure 2. Domestic Water consumption for per person as per WHO in India

We are using those water only for daily needs not for drinking and cooking purpose. As per the calculation, we are using the water for 468 days per person but the large tank will be constructed than we are use those water for only 100 days. As per 100 Days (13500lpcd) water is used for person and remaining days of water is to treatGround water recharge.

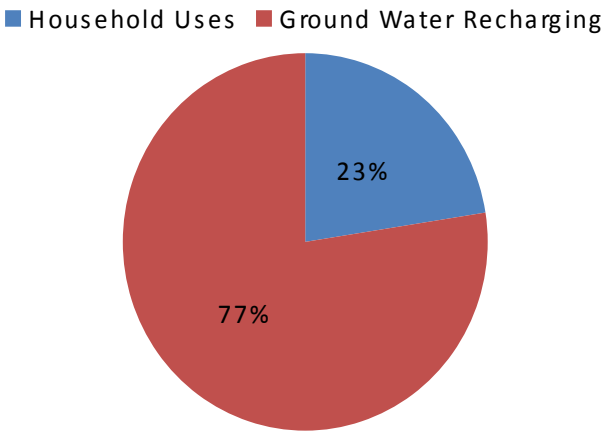

Figure 3. Volume of water saves (100days) and Ground water Recharge

To take the save water for only 100 days then:

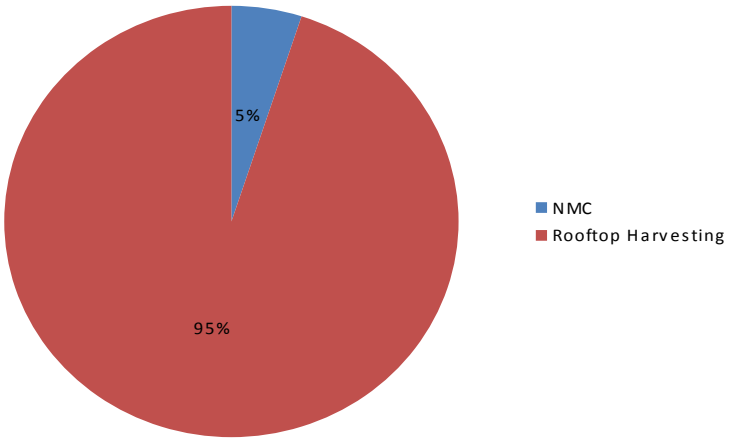

Figure 4. Percentage NMC water saving ratio for 100day

V. RESULT & CONCLUSION

Table 3. Satisfactory result have been found from the case study analysation for 100days-

Sr. No	Type of Area	Area (sq.m)	NMC water uses in %age	Other Uses (RWH)	Ground water recharge in %age
1	Urban Area (Flat land)	100	5%	95%	77%

Hence it was finally conclude that implementation of RWH system in Nagpur city is the best approach to fight with present scenario of the water scarcity. After adopting the RWH system we can save 95% of water for NMC in 100days and also recharge the GWT by 77%. Future problems like water crises and drought like situation can be minimizing. It gives the benefit like cost of water consumption will be less and also rising ground water table in upcoming year. The pressures on water supplies, greater environmental impacts due to new projects, no development surface of water sources as well as deteriorating water quality in surface, constrain the ability of communities to meet the demand for fresh water from traditional sources, and present an opportunity for augmentation of water supplies using these technologies.

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