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Rain Water Harvesting Potential of R. B. N. B. College Campus, Shrirampur

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Abstract: ***Last few years not only Ahmednagar district but also many parts of Maharashtra are facing drought due to scanty rainfall. Most of the water resources are being rapidly exploited without recharging, which leads to increased water scarcity. Therefore, conservation and preservation of water resources is need of the hour. To tackle this problem a study was undertaken to evaluate the potential for water saving by using rainwater harvesting in R.B.N.B. college campus, Shrirampur. The total catchment area of college was calculated as 61840.64 sq. m. Using average annual rainfall data and catchment area rainwater harvesting potential has been calculated as 16718630 litres per annum. The demand of water per year has been estimated to be 22859395 litres out of that 21311500 litres water is extracted from two bore wells. The study clearly shows that the amount of rainwater harvesting potential is 78.44% of the total ground water demand of college.***

Keywords: Drought, Rain Water Harvesting, Catchment area, Water conservation, Water recharge

1. Introduction

Last few years the climate change is emerging as foremost challenge and this refers to any change in climatic variables. Rainfall is the key climatic variable, which is highly erratic in nature and can have long-term inferences in respect of its quality and quantity of water. During last three decades rainfall trend is decreasing (Negative) in Shrirampur, Parner, Shrigonda, Karjat, Jamkhed and Nagar tehsils (Sasane, 2016) whereas last four years Ahmednagar district is facing drought due to scanty rainfall. This is putting enormous pressure on water resources in the region. Most of the water resources are rapidly exploited without recharging as a result the scarcity is also rapidly increasing. So to tackle the water scarcity hazards, there is an urgent need to boost the ground water through suitable groundwater resources management. The management of ground water through artificial recharge of rain water by following roof top harvesting has now been accepted world-wide as a cost-effective method to boost ground water in areas having low rainfall and overexploitation without recharging ground water. Rain water harvesting is one of the oldest, affordable and easy methods to collect and recharge the rain water.

Many scholars applied this method for recharge of ground water. Venkateswara Rao (1996) explained that the roof tops of the buildings recharged through specially designed recharge pits meets almost 80% of domestic water requirements of for Hyderabad city. Bisrat (2000) studied Basavapura micro-watershed in Kolar district of Karnataka, the average yield of bore well increased due to construction of water harvesting structures. Kadirvelu (2002) describe the RWH system in madras University-Marina campus and concluded that the quantity and quality are improved. Herrmann and Schmida (2008) showed that the potential of potable water saving in a house might vary from 30% to 60%, depending on the demand and roof area. Ghisi et al. (2009) proved the potential water saving by using water harvesting in 62 cities ranges from 34% to 92%, with an average potential for potable saving of 69%. Coombes et al. (2011) analyzed 27 houses in Newcastle and concluded that rainwater usage would promote potable water saving of 60%.

The selected area is situated in rain-shadow zone of Western Ghat which receives only 554 mm of average annual rainfall. Therefore an attempt has been made to calculate harvested rain water to recharge ground water in R. B. N. B. college campus, Shrirampur of Ahmednagar district.

2. Study Area

Rayat shikshan sanstha's R. B. N. B. College is one of the leading colleges offering quality education to the students in rural area with 7000 student strength. College campus is located in NE of Shrirampur city and is extended between 19° 37'07" to 19° 37'20" N latitudes and 74° 40'15" to 74° 40'29" E longitudes. It receives only 554 mm of average annual rainfall due to it being located in rain shadow zone. The total area of Campus is 43 acres out of that college covers almost 15. 28 acres (61840.64 sq. m.) including a large surface area of 48358.55 sq. m. and rooftop area 13482.09 sq. m. The study makes an attempt to estimate the quantity of rainwater harvested to enable the same to be utilized for recharging the ground water level.

Figure 1: Google Earth Image of R. B. N. B. College, Campus Shrirampur

3. Methodology

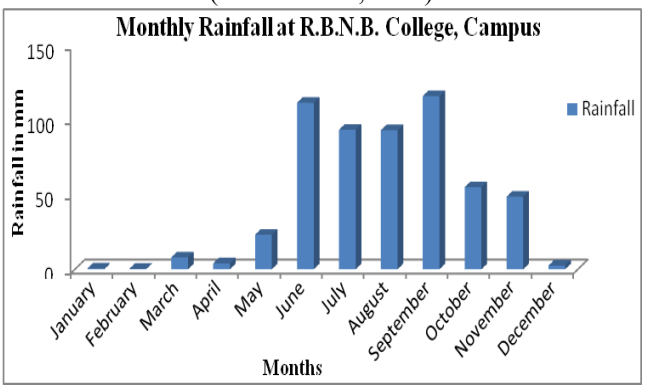
3.1 Data collection

The RWH potential study is based on primary data as well as secondary data, primary data regarding area of buildings was collected from campus field survey and secondary data specially rainfall data was obtained from Indian Meteorological Department, Pune and various published and unpublished books, articles, etc.

Table 1: Monthly Average Rainfall at Shrirampur during 1981 to 2011

Months	Rainfall (mm)	Months	Rainfall (mm)
January	0.6	July	93.6
February	0.3	August	93.3
March	8.0	September	116.2
April	4.0	October	55.1
May	23.2	November	48.7
June	111.7	December	2.5
Total - 554.9			

(Source: IMD, Pune)



3.2 Calculation of Coefficient of Runoff

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.

$$\text{Coefficient Runoff} = \frac{\text{Volume of runoff water}}{\text{Volume of rainfall that falls on the surface}}$$

Therefore, in present research, runoff coefficient is equal to 0.8 for building rooftop area due impervious surface and 0.4 for surface land area.

3.3 Hydrological Analysis

The potentiality of rainwater harvesting is calculated by using Gould & Nissen, 1999 formula as below:

$$P = R \times A \times Cr$$

Where,
P = Potentiality of rainwater harvesting (m^3)
R = Mean Annual Rainfall (mm)
A = Catchment Area (m^2)
Cr = Coefficient of Runoff

4. Results and Discussions

4.1 Calculation of Rainwater Harvesting Potentiality

The monthly average rainfall was obtained from IMD, Pune; the rooftop of each building was measured with a metric tape. The total rooftop area has been calculated as 13482.09 sq. m., this is subtracted from total campus area of 61840.64 sq. m. to find out the total unconstructed surface area as 48358.55 sq. m.

Table 2: Rainwater Harvesting Potentiality of College, Campus

Sr. No.	Building Name	Catchment Area (m^2)	Potentiality of RWH (m^3)	Potentiality of RWH (Litres)
1	Main Building	2670.32	1185.41	1185410
2	MCVC Department	635.91	282.29	282290
3	Aniket Hall	413.10	183.38	183380
4	Department of English	390.71	173.44	173440
5	Chemistry Department	452.88	201.04	201040
6	Chemistry Storeroom	165.70	73.56	73560
7	Jr. College Building	126.64	302.20	302200
8	Gents Toilets	680.75	56.22	56220
9	Department of Humanities	781.22	346.80	346800
10	Women Hostel No.1	263.50	116.97	116970
11	Women Hostel No.2	425.33	188.81	188810
12	Women Hostel No.3	495.46	219.94	219940
13	Rector Rec. Women Hostel	51.89	23.04	23040
14	Mess- Women Hostel	129.75	57.60	57600
15	Servant Quarters	232.25	103.10	103100
16	Servant Room	36.78	16.33	16330
17	Staff Quarters	288.32	185.93	185930
18	Non-Teaching Quarters	418.84	127.99	127990
19	Principal Quarter	104.31	46.31	46310
20	Indoor Sports Training Centre	1142.64	507.24	507240
21	Administrative Building	584.29	259.38	259380
22	Boy's Hostel	1371.50	608.84	608840
	Cycle Stands			
23	Staff	168	74.58	74580
24	Ladies No. 1	168	74.58	74580
25	Ladies No. 2	168	74.58	74580
26	Ladies No. 3	168	74.58	74580
27	Ladies No. 4	84	37.29	37290
28	Boy's No.1	300	133.18	133180
29	Boy's No.1	150	66.59	66590
30	Staff Quarter No.1	126	55.93	55930
31	Staff Quarter No.2	126	55.93	55930
32	Ladies Hostel	126	55.93	55930
33	Boy's Hostel	36	15.98	15980
	Total Rooftop Area	**13482.09**	**5984.97**	**5984970**
	Total Surface Area	**48358.55**	**10733.66**	**10733660**
	Total Campus Area	**61840.64**	**16718.63**	**16718630**

(Source: Computed by Researcher)

Rain water harvesting potential was calculate with applying Gould & Nissen (1999) formula, potentiality is outcome of total catchment area multiplied by average rainfall and runoff coefficient. The amount harvested water from rooftop was calculated as 5984.97 cu. m. while from surface land area calculated as 10733.66 cu. m. The total college

campus's harvesting potential was as 16718.63 cu. m. or 16718630 litres (Table 2). This huge water can be used for recharged ground water level of bore wells within campus. The water can also be stored in a sump of designed dimension to ensure watering for plants and for vehicle washing.

4.2 Estimation of Annual Water Demand

The total demand of water is about 22859395 litres per annum out of that 1547895 litres for drinking with 3 litres person per day (C. P. C. B. standards for rural areas) 19344000 litres for other uses with 100 litres person per day, 142500 litres for cleaning and 1825000 litres for gardening purpose. (Table3).

Table 3: Estimation of Water Demand

Block	*No. of Users*	*Water Demand ((Litres)*		*Total Water Demand (Lit.)*
		Drinking	Other Use	
Staff Quarters	85	85 X 3 X 300 = 76500	85 X 100 X 300 = 2550000	2626500
Non-Teaching Quarters	24	24 X 3 X 300 = 21600	24 X 100 X 300 = 720000	741600
Ladies Hostel	329	329 X 3 X 285 = 281295	329 X 100 X 285 = 9376500	9657795
Boy's Hostel	200	200 X 3 X 285 = 171000	200 X 100 X 285 = 5700000	5871000
Students	7000	7000 X 0.5 X 285 = 997500	7000 X 0.50 X 285 = 997500	1995000
Cleaning	-	500 X 285		142500
Gardening	-	5000 X 365		1825000
			Total	**22859395**

(Source: Computed by Researcher)

4.3 Water Balance

It observed that the total demand of water is estimated about 22859395 litres per annum, to fulfil this demand 1547895 litres (6.77 %) of water is supplied by Shrirampur Nagar Parishad for drinking purpose and 21311500 litres (93.23 %) ground water is extracted from two bore wells for other use (Table 4). At present 21311500 litres of ground water is being extracted. In case the RWH project is implemented then 16718,630 litres (78.44 % of current total ground water requirement) will be accumulated, which can be used to recharge ground water aquifer (Table 5).

Table 4: Annual Water Balance

Demand of Water (Litres)	Supply from Nagar Parishad for Drinking (Litres)	Extracted from bore wells for other use (Litres)
2,28,59,395	1547895	21311500
100 %	**6.77 %**	**93.23 %**

(Source: Computed by Researcher)

Table 5: Ground Water Balance

Demand of Ground Water (Litres)	Potentiality of RWH (Litres)	Deficit (Litres)
21311500	16718630	4592870
100 %	**78.44 %**	**21.56 %**

(Source: Computed by Researcher)

5. Conclusion

The present study has focused on the issue regarding water scarcity problem and reduction of scarcity using RWH. The rain water harvesting is one of the cost effective measure to overcome the problems faced due to water scarcity. This approach computes the harvesting potential of rainwater based upon the catchment area characteristics. The quantity of water available from the catchment therefore depends upon the annual average rainfall, catchment area characteristics and extent of catchment area. The water demand can be assessed by working out the catchment area water supply and the actual demand of water. This can be further used to evaluate the supply, demand and subsequent scarcity issues. The study has quantified that the rain water harvesting potential is 78.44% of the total ground water demand of campus. Hence, if this project is implemented then huge quantity of harvested rain water will be collect for recharging ground water and other uses eventually reducing the problem of water scarcity.

References

[1] **Cholke S. P., (2012):** Village Information System (V.I.S.) for watershed management in the North Ahmednagar district, Maharashtra, unpublished Ph.D. Thesis, Pune University, Pune.

[2] **Gould John (1999)**: "Is rainwater safe to drink? A review of recent findings" *9th International Rainwater Catchment Systems Conference*. 1999.

[3] **Reddy P.Sai Rukesh and Rastogi A.K., (2008):** Rainwater Harvesting in hostel 12 and hostel 13 of IIT Bombay, *The Indians society for Hydraulics and Journal of Hydraulic Engineering.*

[4] **S. K. Garg,** Table 7.31, Chapter Hydrology and runoff computation, Irrigation Engineering & Hydraulic Structure.

[5] **Sasane S. B., (2016 a):** Detection of Changes in Rainfall for Identifying Climate Change using Mann-Kendall Test. *International Journal of Researchers in Biosciences, Agriculture and Technology*. 2 (2) pp-150-152.

[6] **Sasane S. B., (2016 b):** Assessment of Drought Severity for Understanding Climate Change in Ahmednagar District, Maharashtra. *International Conference on Global Environment: Issues, Challenges and Solutions, 2016.* Part II, pp- 240-244.

[7] http://www.rainwaterharvesting.org