A study on Rain Water Harvesting at Gandhi Institute of Engineering and Technology Main Campus, Gunupur, Odisha

Diptikanta Acharya[1], Shilpika Panda[2], Niharika Patel[3], Shubhasmita Prusty[4], Manoja Das[5]

[1,5]Department of Biotechnology Engineering, Gandhi Institute of Engineering and Technology, Gunupur-765022, Odisha
Email: manoja2003@rediffmail.com
[2,3,4]Department of Civil Engineering, Gandhi Institute of Engineering and Technology, Gunupur-765022, Odisha

Abstract— *India is agriculture based country. Most of the people of India depend on agriculture for their live hood. Water is highly essential for agriculture apart from day to day use. Now fresh water is going to be scarcity because of water of lakes, rivers, ponds and lakes are polluted and even today some of the water bodies are not suitable for human use. Therefore, present day demands the conservation of fresh water and adaptation of rain water harvesting. Gandhi Institute of Engineering and Technology, Gunupur is a premier institute of south Odisha and the buildings are designed not only for good ambiences but also to catch the rain water. In this present work we have studied the catchment area of buildings, hydrological potential and runoff coefficient of Gandhi Institute of Engineering and Technology, Gunupur for the year 2015. The rain water harvesting potential (RWHP) of the buildings was found to 21039.63 m^2.The study revealed that buildings of GIET campus are a potential source of rain water harvesting in this locality.*

Keywords— Rain water, rainwater harvesting potential, Gunupur.

I. INTRODUCTION

Water covers more than 70% of earth surface out of which only 2% are fresh water [1]. Fresh water is necessary for day to day activity of human, industries and agriculture. As human population increases tremendously the demand on fresh water is also increasing rapidly. A survey report indicate that in India the per capita average annual fresh water available has been reduced from 5177 m^3 to 1820 m^3 in between 1951 to 2001 [2]. It is also estimated that the fresh water will be reduced to 1341 m^3 in 2025 [3]. Now though people prefer for use of ground water but indoctrinate pumping of ground water lower the water table abnormally [4]. The scarcity of water becomes a serious problem in future due to change of global climate. Thus, the situation demands attention of human to find out the solution of this problem otherwise it may arise as a serious issue for our future generation. Rain is a natural source of fresh water and it is considered as almost pure [5, 6]. Gandhi Institute of Engineering and Technology is established at Gunupur, Odisha. Gunupur is situated in southern part of Odisha in the foot hill of Eastern Ghat and bank of Bansadhara River. The river is source of water for inhabitant of Gunupur but unfortunately the river dried up during summer. The local people are mostly farmers and they depend on cultivation of various crops. It is therefore an urgent need to find out a way for water resource management in this area for sustain utilization of natural water. Rain water harvesting is an important area of water management and is refers to direct collection of rain water from roof top or earth surface without allows them to pass as the surface runoff on the land. In this study we have studied the rain water harvesting capacity of roof top of buildings of GIET campus and their potential for use as a source of rain water harvesting. Further it is also proposed that the process can be implemented to the other buildings of Gunupur area for effective water resource management.

II. METHOD

2.1 Study Area

The study area of the project work is Gandhi Institute of Engineering and Technology (GIET) campus, Gunupur. The campus is stretched about 72 acres of land by the side of a hill with beautiful infrastructure. The roofs of all the building of GIET campus are conceded as a catchment area for rain water. The important buildings identified for water harvesting purposes are Computer science, Basic Science, Administrative Office, Chemical Engineering, Mechanical Engineering and Library and Biotechnology block. The satellite picture of GIET campus building which is used for the harvesting system is represented in fig 1.

FIGURE 1: SATELLITE VIEW OF GIET CAMPUS, GUNUPUR

2.2 Determination of Catchment Area

Gandhi Institute of Engineering and Technology, Gunupur is located in south part of Odisha at district Rayagada, Odisha. The town is situated in the bank of river Bansadhara. The altitude is 120.80 feet above mean sea level [7]. It has a mixed climate of mountain and postur plane. The average rainfall of GIET Gunupur is recorded and represented in figure 2.

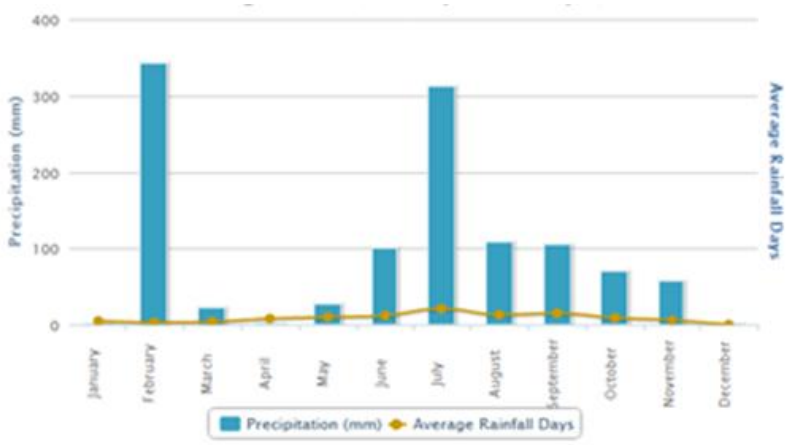

FIGURE 2: AVERAGE RAINFALL (MM GRAPH FOR GUNUPUR)

The roof top surface area of the building of GIET Campus are measured with fibre tap and represented in Table 1. Before taking the measurement checked for zero error and length for better accuracy.

TABLE 1
ROOF TOP AREA OF DIFFERENT BUILDINGS OF GIET CAMPUS, GUNUPUR

Sl No.	Building name	Roof top area (m^2)
1	Administrative Block	2073.00
2	B.S.H Block	834.69
3	Biotechnology Block	427.44
4	Civil Block	942.6
5	CSE Block	880.6
6	Library Block	1252.95
7	Mechanical Block	1076.856

2.3 Hydrological Analysis

The flow of runoff water was calculated by following the method of H. Darcy, 1856 [8, 9]. He demonstrated experimentally that the discharge velocity of runoff water is directly proposnate to the hydraulic gradient (i)

$$v=Ki$$

The discharge per meter run,

$$q= vA$$

Thus $q= KiA$

Here, i=hydraulic gradient

and A= Area of catchment.

K=coefficient of permeability

Based upon the above concept the rain water harvesting (RWH) is calculated. The total amount of received water from rain fall is taken as "rain water legacy" of the area and effected harvested is considered as the "water harvesting potential" of the area.

The volume of water received=area of catchment *runoff coefficient * amount of rain fall.

The runoff coefficient is the ratio between volumes of water that run off over a surface to the volume of rainfall, that fall on that surface,

TABLE 2
VALUES OF RUNOFF COEFFICIENT (K) OF DIFFERENT AREAS

Sr. no.	Types of area	Value of K		
		Flat Land 0 -5 % slope	Rolling Land 5% -10% slope	Hilly Land 10% -30% slope
1.	Urban areas	0.55	0.65	-
2.	Single family residence	0.3	-	-
3.	Cultivated Areas	0.5	0.6	0.72
4.	Pastures	0.30	0.36	0.42
5.	Wooden land or Forest areas	0.3	0.35	0.50

Source: Hydrology and runoff computation, Irrigation, Engineering & Hyraulic Structure, by Garg, S.K.[10]

2.4 Computation of Volume of Runoff per Year

The volume of water received (in cubic meter) is calculated [11, 12] as per the following:

Volume of water received =area of catchment * amount of rainfall

Here, the annual average rain fall was assumed to be 1400 mm.

TABLE 3
MONTH WISE RECORDED RAINFALL AND DISCHARGE OF ROOF TOP AREA OF GIET CAMPUS, GUNUPUR (YEAR 2015)

Sl no	Month	Rainfall in (mm)	Discharge (in m^3)						
			Library block	BSH block	Biotech block	CSE block	Administrative Block	Mechanical block	Civil and chemical block
1	January	16.07	40.025	28.25	22.28	30.02	60.259	35.28	33.22
2	February	25.99	66.09	42.11	37.76	44.16	80.289	52.09	49.36
3	March	16.07	41.89	29.16	25.36	31.25	60.25	37.11	34.25
4	April	16.07	41.89	28.39	22.25	30.19	60.25	36.99	32.18
5	May	40.6	106.6	85.27	77.76	87.26	158.28	98.5	95.27
6	June	237.7	619.44	392.76	297.39	425.36	818.29	529.00	511.76
7	July	386.5	1009.10	512.25	428.36	612..51	1225.28	828.22	798.25
8	August	400.0	1050.03	725.18	658.25	821.26	1325.36	1011.00	998.00
9	September	215.56	523.98	225.17	201.36	301.15	735.28	469.28	399.25
10	October	56.6	159.8	65.28	59.25	79.25	286.19	101.25	98.25
11	November	9.2	23.9	10.28	8.36	13.25	35.27	19.00	15.06
12	December	8.75	12.9	8.25	5.01	7.26	18.36	10.25	9.25
TOTAL			**3695.64**	**2152.35**	**1843.39**	**2182.92**	**4863.34**	**3227.89**	**3074.1**

2.5 Rain Water Harvesting Potential of Different Buildings at GIET Campus, Gunupur

The rain water harvesting capacity of different buildings is given in Table 4. The roof top area of all educational or non educational buildings is taken into consideration. These buildings are completely differs from each other with respect to architecture and infrastructure area.

TABLE 4
THE ROOF TOP AREA AND RUNOFF OF GIET CAMPUS, GUNUPUR

Serial no	Building name	Roof top area(m^2)	Runoff water(m^3)
1	Administrative Block	2073.00	2902.2
2	B.S.H Block	834.69	1168.57
3	Biotechnology Block	427.44	594.216
4	Civil Block	942.6	1319.64
5	CSE Block	880.6	1232.84
6	Library Block	1252.95	1754.13
7	Mechanical Block	1076.856	1507.59
TOTAL	**7488.136**	**10479.186**	

III. SUMMARY AND CONCLUSION

The campus area of Gandhi Institute of Engineering and Technology, Gunupur is 72 acre. The average annual rainfall of the campus is 19.0925 mm. Total catchment areas are 7488.136 m^2. Total amount of rainfall was 1429.11 mm for the year 2015. Total potential of roof rain water harvesting in campus area of Gandhi Institute of Engineering and Technology is 21039.6 litre. In this paper we conclude that Rain water harvesting in GIET campus is a good potential for rain water conservation and by implementing rain water harvesting project in the GIET campus runoff water conservation can be made and that can be meet the present water scarcity situation of this location. We propose the roof top harvesting technique at Gunupur to meet the water deficit of this locality.

REFERENCES

[1] K. Behzadian, and Z. Kapelan, "Advantages of integrated and sustainability based assessment for metabolism based strategic planning of urban water systems". Science of the total Environment. Vol 528,pp 220–231,2015

[2] R.N. Athavale, "Water harvesting and sustainable supply in India", Rawat Publication. New Delhi.2003

[3] Ministry Of Water Resources, Government of India, "Water resources of India and world. Newsletter on Fresh Water,2003

[4] *J. Devkota, "Life cycle based evaluation of harvested rainwater use in toilets and for irrigation." Journal of Cleaner Production, 2015*

[5] A.S. Jasrotia, "Water balance approach for rain water harvesting using remote sensing and GIS techniques.", Water Resource Manage, India ,2009 pp. 3035-3035

[6] J. Gould, and E. Nissen-Petersen, E. "Rain water catchment system for domestic supply". International Technology Publications, United Kingdom.1999

[7] M. Das, "Physicochemical and biological properties of water bodies in and around Gunupur, Orissa". J. Indian Botanical Society, vol. 87, pp. 294 -296,2008

[8] *S. Whitaker, "Flow in porous media I: A theoretical derivation of Darcy's law". Transport in Porous Media, vol 1, pp. 3–25,1986*

[9] C. Liaw, and T. Yao-lung, "Optimum storage volume of roof top rain water harvesting system for domestic use". Journal of the American Human Resources Association,vol.40(4), pp. 901-912,2004

[10] S. K. Garg, "Hydrology and runoff computation", irrigation Engineering & Hydraulic structure, pp. 1-674,1987

[11] A. Nahila, "Water Poverty Index Mapping and GIS Based Approach for Identifying Potential Water Harvesting Sites", Journal of Earth Systematic Science, vol. 1(3), pp. 1-11,2012

[12] S. Panhalkar, "Domestic Rain water harvesting System: A model for rural development", International journal of Science and Natural, vol. 2(3), pp. 861-867, 2011