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Water Conservation Strategy and its Enhancement Technique in Recharging Rain Water Along with Its Utilization for University B D T College of Engineering, Davanagere

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ABSTRACT: Water is a crucial component for all living things on the planet. The demand for and burden on resources of water is increasing due to populace increase, urbanization, industrialization, and irrigated agriculture.To ensure that there will be no future water shortage, it is crucial to create new water resources like rainwater. The present study area is University B.D.T College of Engineering, Davanagere, Karnataka, India. The aim of the study is to design the recharge pit to recharge the ground water using overall rooftop water and surface runoff water by employing topographical survey. It was observed from the study that UBDTCE campus has the potential of collecting 14.80 Million liters of water annually from roof tops of different buildings and 56.63 Million liters of water by runoff from major catchment areas. And by the investigation, it is concluding that, this mission very useful for enriching the ground water aquifer. Sustainability in water management can be achieved at UBDTCE campus.

KEYWORDS: Rain Water Harvesting, Topographical Survey, Harvesting Potential, Recharge Pit, Ground water recharge.

I. INTRODUCTION

Today, fresh water is a precious resource that is becoming increasingly scarce. Any society's lifeblood is water. Water is necessary for environment, secure access to food, and sustainable progress. [1]. The demand for and burden on resources of water is increasing from day by day [2]. Rainwater harvesting and utilization is one of the many technologies being used to increase freshwater resources [3]. Rainwater harvesting is a technology that uses straightforward methods to collect and store rainwater from roofs, the ground, or rock catchments. A simple method of capturing and storing rainwater as it falls is called rainwater harvesting. Depending on the circumstance, we can either utilize it to refuel groundwater [4]. Through the use of suitable structures like recharge trenches, recharge pits, dug wells and bore wells, harvested rainwater can also be utilized to replenish underground aquifers. There could be a variety of revival assemblies, among which encourage the penetration of water through superficial soil layers (such as revitalize trenches and porous pavements), [5].

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II. OBJECTIVES OF THE STUDY

i. Carryout the detailed Topographical Survey of University B.D.T College of Engineering.
ii. Estimating the harvesting Potential of rain water which can be collected annually from different rooftop area of different buildings and surface runoff water in University B.D.T College of engineering, Davanagere.
iii. Select Recharge Pit Location by Surveying.
iv. Designing the Recharge Pit for Preferred Location in the UBDTCE Campus, for Recharging the Underground Water Table.

III. METHODOLOGY

This chapter deals with methodology carried out for employment of rain water harvesting in University B.D.T College of Engineering, Davanagere. Which includes data collection, detailed topographical survey and estimation of harvesting potential.

3.1 STUDY AREA

University B.D.T college of engineering (UBDTCE), is situated in the center of Davanagere, Karnataka, India. The location of the study area is 14° 27' 6" N latitude and 75° 55' 3" E longitude. Which is of total area 21.15 acres. Satellite view of the University B.D.T College of Engineering as represented in figure 1.

Fig-1: Satellite View of the University B.D.T College of Engineering, Davanagere

3.2 HYDROLOGICAL ANALYSIS

A law determining the flow rate/discharge through soils was established in 1865 by the French scientist Mr. H. Darcy on the basis of experimental data. And he claimed that, this discharge was inversely proportionate to the length of the soil sample(L) and was proportionate to the head loss in the soil (H) and cross sectional area (A).
In other words, Q = K x I x A

Here, Q = Runoff,I represent the hydraulic gradient or head loss (H/L), K is the permeability co-efficient
And, the aforementioned principle was applied to assess the catchment area capability for water collecting. The total amount of water that was gathered from the area's rainfall is referred to as the rainwater legacy of that place. The water harvesting potential refers to the volume which can be harvested effectively.
The following is the formula for calculating harvesting capacity or volume of water received:
Harvesting potential or Volume of water Received (m^3) = Area of Catchment (m^2) x Amount of rainfall (m) x Runoff coefficient. Runoff coefficient for different types of surface areas as represented in table 1.

Table-1: Runoff Coefficient for Different Types of Surface

Sl. No.	Types of Area	Value Of "K"		
		0-5 % slope Flat land	5%-10% Slope Rolling land	10%-30% slope Hilly land
1	Wooden land or Forested area	0.30	0.35	0.50
2	Pastures	0.30	0.36	0.42
3	Cultivated Areas	0.50	0.60	0.72
4	Single family residence	0.30		
5	Urban areas	0.55	0.65	-

According to IS 15797:2008, which provides norms for roof top rainwater harvesting. The average rainfall data for the place and the table represented below must be used to calculate the typical annual runoff from rooftop regions anywhere. Water availability for given roof top area and rainfall as represented in table 2.

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Table-2: Water Availability for given Roof Top Area and Rainfall (For Flat Roofs)

Sl. No	Roof Top Area m^2	Rainfall in mm												
		100	200	300	400	500	600	800	1000	1200	1400	1600	1800	2000
		Water Availability in m^3												
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
i)	20	1.60	3.20	4.80	6.40	8.0	9.60	12.80	16.0	19.20	22.40	25.60	28.80	32.0
ii)	30	2.40	4.80	7.20	9.60	12.0	14.40	19.20	24.0	28.80	33.60	38.40	43.20	48.0
iii)	40	3.20	6.40	9.60	12.80	16.0	19.20	25.60	32.0	38.40	44.80	51.20	57.60	64.0
iv)	50	4.00	8.00	12.0	16.0	20.0	24.0	32.0	40.0	48.0	56.0	64.0	72.0	80.0
v)	60	4.80	9.60	14.40	19.20	24.0	28.80	38.40	48.0	57.60	67.20	76.80	86.40	96.0
vi)	70	5.60	11.20	16.80	22.40	28.0	33.60	44.80	56.0	67.20	78.40	89.60	100.8	112
vii)	80	6.40	12.80	19.20	25.60	32.0	38.40	51.20	64.0	76.80	89.60	102.4	115.2	128
viii)	90	7.20	14.40	21.60	28.80	36.0	43.20	57.60	72.0	86.40	100.80	115.2	129.6	144
ix)	100	8.00	16.0	24.0	32.0	40.0	48.0	64.0	80.0	96.0	112.0	128	144	160
x)	150	12.0	24.0	36.0	48.0	60.0	72.0	96.0	120	144	168	192	216	240
xi)	200	16.0	32.0	48.0	64.0	80.0	96.0	128	160	192	224	256	288	320
xii)	250	20.0	40.0	60.0	80.0	100	120	160	200	240	280	320	360	400
xiii)	300	24.0	48.0	72.0	96.0	120	144	192	240	288	336	384	432	480
xiv)	400	32.0	64.0	96.0	128	160	192	256	320	384	448	512	576	640
xv)	500	40.0	80.0	120	160	200	240	320	400	480	560	640	720	800
xvi)	1000	80.0	160	240	320	400	480	640	800	960	1120	1280	1440	1600
xvii)	2000	160	320	480	640	800	960	1280	1600	1920	2240	2560	2880	3200

3.3 DATA COLLECTION

The rainfall data which is required for the estimation of harvesting potential of overall campus area of University B.D.T College of Engineering is collected. The Annual rainfall data is collected from the power access climate data under India Meteorological Department. Monthly Rainfall data of UBDTCE campus as represented in table 3.

Table-3: Monthly Rainfall of UBDTCE Campus

Sl.No	Month	Rainfall (mm)
1	January	0.69
2	February	2.02
3	March	14.40
4	April	33.82
5	May	90.27
6	June	268.49
7	July	323.75
8	August	268.94
9	September	187.74
10	October	131.07
11	November	39.01
12	December	4.62
Total		1364.82 mm

3.4 PREPARING THE COLLEGE MAP/LAYOUT

To get campus complete pictorial view it is essential to prepare the College layout with the help of AutoCAD software. By taking available copy of UBDTCE campus, the college plan is drawn. From the plan it is get that total rooftop area in the whole UBDTCE campus is 15332.27 m^2 and unpaved area of 71180.73 m^2. The plan of University B.D.T College of Engineering as represented in figure 2.

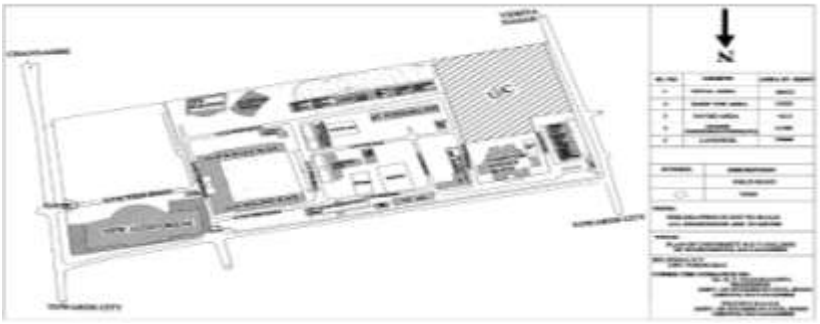

Fig-2:Plan of University B.D.T College of Engineering, Davanagere

International Journal of Advances in Engineering and Management (IJAEM)
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3.5 DETERMINATION OF CATCHMENT AREA

The rooftop surface aids as the rainwater catchment area. By using tape survey, the rooftop area measurement is carried out manually. Before using the tape, the tape's length was carefully checked to ensure accuracy and for any zero errors. The rooftop area of buildings in the campus of University B.D.T College of Engineering as represented in table 4.

Table-4:Rooftop Area of Buildings in the UBDTCE Campus

Sl.No	Building Name	Rooftop Area (m^2)
1	Computer Science Block	1668.50
2	Hydraulic Lab	202.50
3	Mechanical Lab	202.50
4	Basic Workshop	322.65
5	Thermal Power Engineering Lab	322.65
6	Chemistry and Analytical Department	827.00
7	High Voltage Lab	95.40
8	Department of Mechanical Engg	624.50
9	Department of MBA	323.30
10	Wash Room	32.70
11	Dept of Studies in Civil Engg	625.50
12	Library	602.20
13	CAED Lab	210.50
14	Industrial and Production Department	403.50
15	Concrete Lab	613.20
16	Canteen	261.00
17	BMTC Lab	306.60
18	foundry and Forging Lab	230.00
19	Material Testing Lab	306.60
20	Machine Shop	306.60
21	Main Building Block	2468.17
22	Sports Room	176.70
23	Old Alumini Building	390.00
24	New Building	1170.00
25	New Auditorium	2640.00
Total Rooftop Area		15332.27 m^2

3.6 TOPOGRAPHICAL SURVEY OF UNIVERSITY B.D.T COLLEGE OF ENGINEERING, DAVANAGERE

The college campus is surveyed to get topography of the area, to get contour lines passes through campus and to get the recharge pit location. Before starting the survey, the campus area is divided into squares by which the surveying become easy and then survey is carried out in the college campus for getting the contour map. With the use of a dumpy level, each ranging rod point's level is determined, and the benchmark is set at 100.000 meters. The readings are used to compute reduced levels. After contour survey, a contour map is prepared based on set contour intervals that are fixed in both the horizontal and vertical directions. The RL lines passes through the region are 100, 100.5, 101, 101.5, 102, 102.5, 103, 103.5, 104, 104.5, 105, 105.5, 106, 106.5, 107 m. The RL lines which are passes through the UBDTCE pasture as represented in figure 3.

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Fig-3: University B.D.T College of Engineering Campus Contour Map

IV. RESULTS AND DISCUSSION

4.1 VOLUME OF WATER COLLECTED FROM ROOFTOP AREA OF DIFFERENT BUILDINGS OF UBDTCE CAMPUS

The total amount of rainwater that can be collected from any roof surface is estimated by using table 2. And the net volume of rainwater collected from different buildings of University B D T College of Engineering as represented in table 5.

Table-5: Volume of Water Collected from Rooftop Area

Sl. No	Building Name	Rooftop Area(m^2)	Volume of water Available(m^3)	Net volume of rainwater collected(m^3)
1	Computer Science Block	1668.50	1815.32	1633.79
2	Hydraulic Lab	202.50	220.32	198.28
3	Mechanical Lab	202.50	220.32	198.28
4	Basic Workshop	322.65	351.04	315.93
5	Thermal Power Engineering Lab	322.65	351.04	315.93
6	Chemistry and Analytical Dpt.	827.00	899.77	809.79
7	High Voltage Lab	95.40	103.79	93.41
8	Department of Mechanical Engg	624.50	679.45	611.51
9	Department of MBA	323.30	351.75	316.57
10	Wash Room	32.70	35.57	32.01
11	Dept of Studies in Civil Engg	625.50	680.54	612.48
12	Library	602.20	655.19	589.67
13	CAED Lab	210.50	229.02	206.12
14	Industrial and Production Dpt.	403.50	439.00	395.10
15	Concrete Lab	613.20	439.00	395.10
16	Canteen	261.00	283.96	255.57
17	BMTC Lab	306.60	333.58	300.22
18	Foundry and Forging Lab	230.00	250.24	225.21
19	Material Testing Lab	306.60	333.58	300.22
20	Machine Shop	306.60	333.58	300.22
21	Main Building Block	2468.17	2685.36	2416.83
22	Sports Room	176.70	192.24	173.02
23	Old Alumini Building	390.00	424.32	381.88
24	New Building	1170.00	1272.96	1145.66
25	New Auditorium	2640.00	2872.32	2585.08
TOTAL		15332.27 m^2		14808.02 m^3

4.2 INDICATION OF RECHARGE PIT LOCATION IN THE CAMPUS

By the topographical survey results, the map showing recharge pit locations in the campus was prepared. In this map, dark red marking is the lowest elevated patch of land, indicating that these areas are best suitable for recharging underground water. Map showing recharge pit locations in the campus area as represented in figure 4.

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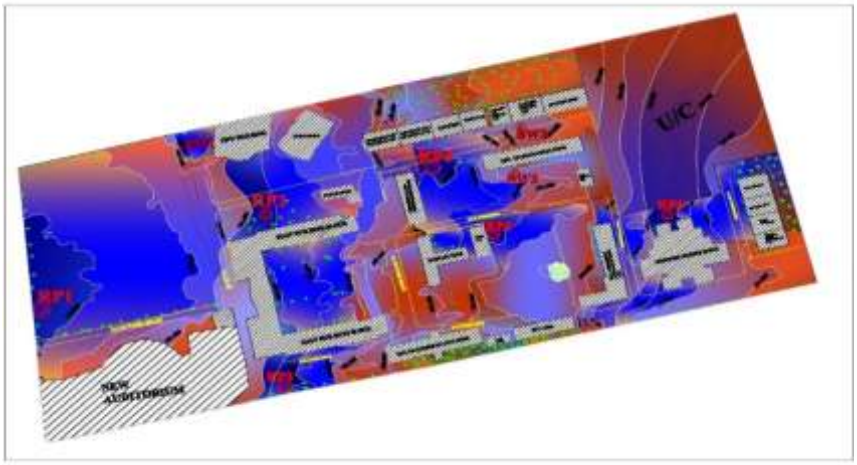

Fig-4: Recharge Pit Locations in the UBDTCE Campus

4.3 DESIGN OF RECHARGE PIT

By knowing the amount of runoff water collected from roof tops and the runoff water from the surface area of campus and by topographical survey results, there are six number of recharge pits are designed at different locations in the UBDTCE campus. The detailed design procedure is as fallows.

Recharge Pit 1: Amount of water collected from rooftop area (New auditorium building) = 2585.088 m^3

Amount of water collected from surface area = 20783.15 x 1.36 x 0.65 x 0.9= 16535.07 m^3

Where, Runoff coefficient for surface area= 0.65, Considering conveyance losses =10%

Total amount of runoff water to pit 1 = 19120.158 m^3

By taking effective rainy days as 120 days, Total runoff water to pit 1 = 19120.158/120 = 6640 liters/ hour

Hence, Optimum dimension of the circular recharge pit 1 = (1.8 m diameter x 2.8 m depth)

Recharge Pit 2: Amount of water collected from rooftop area (New building, Main Building, Old alumini building and Sports room) =4117.39 m^3

From surface area = 6330.98 x 1.36 x 0.65 x 0.9 = 5036.93 m^3

Recharge Pit 3: Amount of water collected from rooftop area (Civil Engg Dept.) = 612.49 m^3

From surface area = 10979.14 x 1.36 x 0.65 x 0.9 = 8735.01 m^3

Recharge Pit 4: Amount of water collected from rooftop area (Mechanical Dept, Industrial and Production Dept, Concrete lab, BMTC lab, Foundry and forging lab, Material testing lab, Machine shop, High voltage lab and Canteen) =2876.58 m^3

From surface area = 8915.54 x 1.36 x 0.65 x 0.9 = 7093.21 m^3

Recharge Pit 5: Amount of water collected from rooftop area (CAED lab, MBA Dept, Wash room, Chemistry and analytical Dept, Library) =1954.18 m^3

From surface area = 8326.67 x 1.36 x 0.65 x 0.9 = 6624.70 m^3

Recharge Pit 6: Amount of water collected from rooftop area (CS Dept, Hydraulic lab, Basic workshop, Thermal power Engg. Lab, Mechanical lab) = 2662.07 m^3

From surface area = 15845.25 x 1.36 x 0.65 x 0.9 = 12606.48 m^3

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 10 Oct. 2022, pp: 759-765 www.ijaem.net ISSN: 2395-5252

Table 6: Design of Recharge Pits

Recharge Pit Number	Amount of Water Collected from Rooftop Area (m^3)	Amount of Water Collected from Surface Area (m^3)	Total Amount of Water to Pit (m^3)	Total Amount of Water to Pit, As effective rainy days= 120 days (m^3/ day)	Total Amount of Water to Pit (liters/ hour)	Optimum Dimension of the Circular Pit in terms of Diameter (m) x Depth (m)
1	2585.088	16535.07	19120.158	159.34	6640	1.8 m x 2.8 m
2	4117.39	5036.93	9154.32	76.286	3180	1.5 m x 2 m
3	612.49	8735.01	9347.5	77.90	3250	1.5 m x 2 m
4	2876.58	7093.21	9969.79	83.08	3460	1.5 m x 2 m
5	1954.18	6624.70	8578.88	71.50	2980	1.5 m x 2 m
6	2662.07	12606.48	15268.55	127.24	5300	1.8 m x 2.8 m

V. CONCLUSION

i. Rain water harvesting is a best approach for collection and storage of rain water to fight against water scarcity in all aspects, in which 14808.02 cubic meter of water can be collected from Rooftop and 56631.40 cubic meter of water can be collected from surface area from University B.D.T College of Engineering Campus annually.

ii. By the rain water harvesting potential of campus area concluded to design the six number of recharge pits at preferred location in the UBDTCE campus for artificial ground water recharge. In which recharge pits 1 and 6 are of same size (1.8 m diameter x 2.8 m depth) and Recharge pits 2,3,4,5 are of same size (1.5 m Diameter x 2 m depth).

iii. Ground water is very important to serve human desires and precious natural resource. Hence, the best way to artificially recharge of ground water through recharge pit with effective and sustainable method. By recharge pit construction, the ground water get recharge and which will also help to increase water level of aquifer in campus area.

REFERENCES

[1]. Pavan Bandakli B R and Lokeshwari M, (2021), "Potential of Rain Water Harvesting and Ground Water Improvement at RVCE", Global Journal of Researches in Engineering: C Chemical Engineering Vol.21(1), pp. 19-24.

[2]. Rehan Ali S, (2015), "Rainwater Harvesting for Recharging Groundwater- A Case Study for Nursing College, T.M.U. Moradabad", International Journal of Advance Research in Science and Engineering, Vol. 4 (1), pp. 238-245.

[3]. Lonkar Swapnil Sunil, Devde Mangesh Ranjendra, Taware Dipesh Parshruram, Band Nayan Arun, Waghmare Prasad Shivaji and Sable Priyanka Ashok, (2019), "Rainwater Harvesting and Ground Water Recharging in Gcoeara Campus", International Journal of Engineering Research & Technology, Vol. 8(9), pp. 45-77.

[4]. Arun Kumar Dwivedi, Virendra B. Patil and Amol B. Karankal, (2013), "Rooftop Rain Water Harvesting for Groundwater Recharge in an Educational Complex", Global Journal of Researches in Engineering, Vol. 13(1), pp. 21-30.

[5]. Nishigandha Waje, Swati Sanap, Yogita Thakur, Shivani Patil and Purva Joshi, (2019), "Implementation of Rainwater Harvesting system in Dilkap College Campus", International Research Journal of Engineering and Technology (IRJET), Vol. 6 (4), pp. 1658-1664.

[6]. IS 15797:2008, Roof Top Rainwater Harvesting- Guidelines

[7]. Text Book: Irrigation Engineering and Hydraulic Structures by Santhosh Kumar Garg.