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WATER CONSERVATION: RAIN WATER HARVESTING PROJECT FOR DHARUR VILLAGE

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ABSTRACT:
The Paper deals with the study of water requirement, water availability and collection of rainwater for the selected colony. The method adopted was rain water harvesting and groundwater recharge. The research work started with collection of the data of rainfall and calculations of roof area for the analysis, followed by analyzing quantity of water collected from the roof top. Considering this quantity storage capacity of underground water tank is substituted and size for the same is calculated. Simultaneously design of collection system, distribution system is calculated. The study was conducted in "Dharur" village is situated in this drought prone area of Maharashtra. This is at high altitude and having average annual rainfall of 761 mm. For the water supply of water for "Dharur Village Lake" is main sources used. Data collection also includes collection of basic data of the village such as population of the village, no of bore well, roof area, average rainfall and coefficient of runoff. The main objective was to minimize the duplication of ground water table as extraction from those will reduces and to reduce load on water treatment plant as demand decreases.

Keywords: Rainwater harvesting, Quantity of rainwater collection, Groundwater recharge.

INTRODUCTION:

PROFILE OF DHARUR VILLAGE:

Dharur is the village in the Osmanabad district which is 9 km from the Tuljapur city. It is 22 km away from District Head Quarters Osmanabad. This is historical and famous pilgrim center because of Shri Bhairavnath Temple. The total geographical area of village is 1524 hectares. Dharur has a total population of 2,660 peoples, out of which male population is 1,398 while female population is 1,262. . There are about 553 houses in Dharur village**.** Geographically the town lies between Latitude 18°6' S

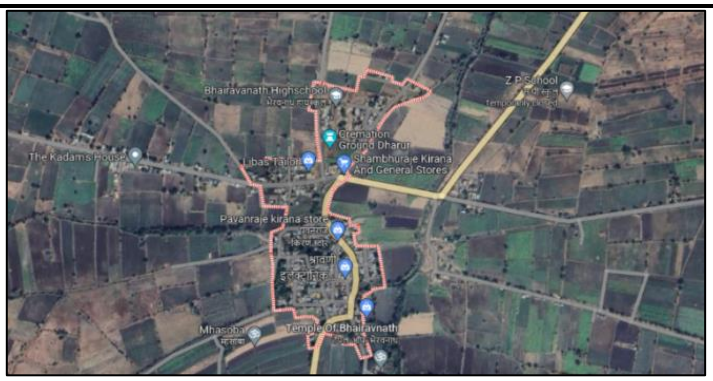

Fig. 1 Location of the Dharur village

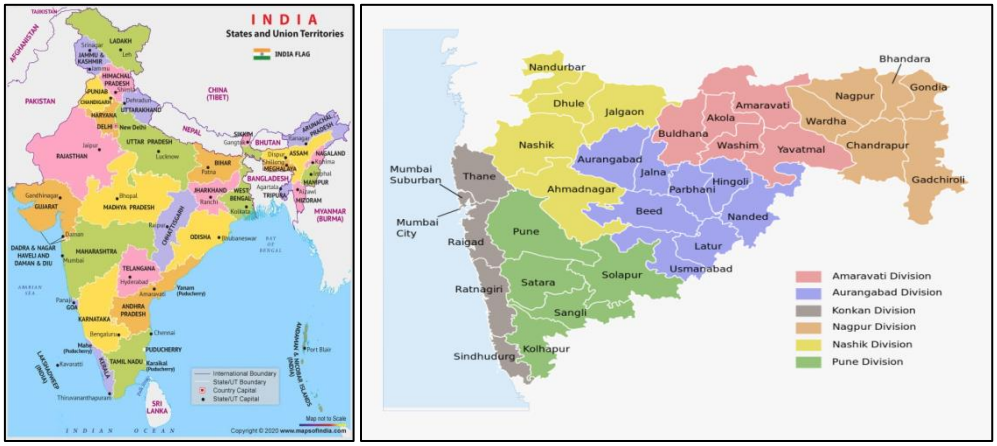

Fig. 2 Location map of Osmanabad

GEOLOGY

To get the information of Geology of the area, 80 dug well sections have been examined through well inventory study. Geologically the district area is mainly covered by Deccan trap basalt. The rock formations are made up of less fractured massive cap rock followed by vesicular zeolites basalt. The upper less fractured massive basalt varies in depth from 12 meters to 4 meter and is moderately weathered up to 2 to 4 meters. The Black Cotton Soil (BC) is about 0 to 3 m thickness; underlying 3 to 6 m highly weathered and fractured basalt. This is followed by 6 to 12 m fractured and brecciaed flow which is followed by jointed and massive basalt.

HYDROGEOLOGY

The areas of watersheds are occupied mainly by succession of basaltic lava flows belonging to Deccan trap with small alluvial patches of recent age. Flows are thick and extensive. Each lava flow is separated by the occurrence of red bole which shows time gap between two flows. The rock formations are made up of less

fractured massive cap rock followed by vesicular zeolite basalt. The upper less fractured massive basalt varies in depth from 4meters to 12 meter and is moderately weathered up to 2 to 4 meters. The Black Cotton Soil (BC) is about 0 to 3 m thickness; underlying 3 to 6 m highly weathered and fractured basalt. This is followed by 6 to 12 m fractured and brecciates flow which is followed by jointed and massive basalt. The Blight plateau with slope towards southwest and south has varied topography consisting of hills, plains and undulating topography near river banks. The main water bearing formations (Aquifer) of the area are predominantly weathered, fractured and jointed massive basalt and Vesicular zeolite portion.(Shaikh, 2015)

SOURCES OF WATER USED FOR DHARUR VILLAGE:

The Dharur village is consisting of only one lake which supplies drinking the water to whole village. The lake is located at outside the village on Keshegaon road. These sources can fulfill the requirement in rainy season and winter season but in summer season it is very difficult to fulfill the demand due to insufficient intake. To fulfill the demand in summer day the Grampanchyat provides tankers to the Villagers their detail are collected from collector office and shown in plate no.1.1.

Plate no.1.1 Details of tanker provided in summer season (Source: Data collected from collector office)

पाणी टंचाई माहिती

जिल्हा- उस्मानाबाद

एकूण खर्च-लाखात

जिल्हा-उस्मानाबाद

अ क्र.	न.प.नांव	वर्ष सन-2010-11 वर्षातील टंचाई कालावधीतील प्रतिदिन लावलेल्या टैकरपैकी महत्तम टैकरची संख्या			वर्ष सन-2011-12 वर्षातील टंचाई कालावधीतील प्रतिदिन लावलेल्या टैकरपैकी महत्तम टैकरची संख्या			वर्ष सन-2012-13 वर्षातील टंचाई कालावधीतील प्रतिदिन लावलेल्या टैकरपैकी महत्तम टैकरची संख्या			वर्ष सन-2013-14 वर्षातील टंचाई कालावधीतील प्रतिदिन लावलेल्या टैकरपैकी महत्तम टैकरची संख्या			वर्ष सन-2014-15 वर्षातील टंचाई कालावधीतील प्रतिदिन लावलेल्या टैकरपैकी महत्तम टैकरची संख्या		
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जिल्हा प्रशासन अधिकारी
नगर विकास शाखा श्रेणी-१
उस्मानाबाद.

Fig.3 Images Sources of Water Used In Dharur Village Lake

LITERATURE SURVEY:

S.S. Shinde and P.A. Hangargekar, in their scenario, “RAINWATER HARVESTING FOR COLLEGE CAMPUS” in 2020, adopted a method to save water by rainwater harvesting. In this case the rainwater

collected throughout the campus area and stored into the storage tank and this water is useful to fulfill the various needs of the surrounding people.

S.S. Nalwade and P.A. Hangargekar, in their scenario, "WATER BALANCE STUDY IN A GOLEGAON: CASE STUDY" in 2017, observed that whatsoever water precipitated within village boundary fulfils the demand. But due to lack of system, 550 TCM water get flush away and creating scarcity. Total remedy measures were suggested to built structures and cropping pattern to given region.

A. Keshar, S. Taji, et al, demonstrates the design of water distribution system for a area located in the college GEC campus. The economical diameter of water supply distribution system is designed by considering the constraint such as residual nodal pressure, velocity of flow in pipe, pipe material, reservoir level, peak factor and available commercial pipe diameters etc. The water supply distribution system is designed for the Nava-Sihora region of the state of Gujarat, India.

Mr. Satyajit R. Mahajan et al, studied that the proper plan and assessment of a water collecting framework is important to enhance framework execution and the soundness of the water supply.

Aditya Morey, et al, worked on tank for storing rain water from the roof of the building, that requirement for VNIET fair fashion need for water in this paper.

Mustaq Ahmad Jabir Shaikh et al, stated that trend of water level of pre monsoon season (2000-2013) from 114 observation wells (GSDA report) in relation to precipitation for the last 10 years (2004-2013). The GIS technique was used to map the depletion of water level information.

Zain M. Al-Houri et al, made two case studies at Al-Jubiha and Shafa-Badran districts in Amman city. All existing rooftops in both districts were identified by digitizing 2012 satellite images of the two districts using Google earth and Arctic tools. Rational method was used to estimate the potential volume of rainwater that can be harvested from the digitized rooftops. Results indicated that 1.17 and 0.526 MCM/yrcan be harvested in Al-Jubiha and Shafa-Badran districts, respectively.

Dr. Arun Kumar Dwivedi, et al evaluate the rainwater harvesting locally collects and stores rainfall through different technologies, for future use to meet the demands of human consumption or human activities. The cost estimation of different components of roof top rain water harvesting project for each zone is done. The annual equivalent capital cost is estimated with and without the cost of ground water recharge structure. The unit cost of water is high as compared to the market price of water. However, the environmental benefits of the ground water recharging with good quality water justifies such projects.

Piplewar S.K, et al, worked on Pindkepar village's Water Distribution Network (WDN) design which is located at district Gondia, State Maharashtra, India. For the design of Pindkepar village water distribution network, study of present population, population forecast for the three decades, daily water demand, and flow characteristics and also survey of the village is done.

J.R. Julius, et al, stated that as the world population increases, the demand increases for quality drinking water. Surface and groundwater resources are being utilized faster than they can be recharged. Rainwater harvesting is an old practice that is being adopted by many nations as a viable decentralized water source.

Sadia Rahman et al studied the sustainability of system through assessing several water-quality parameters of collected rainwater with respect to allowable limits. A number of parameters were included in the analysis: pH, fecal coliform, total coliform, total dissolved solids, turbidity, NH3–N, lead, BOD5, and so forth. The study reveals that the overall quality of water is quite satisfactory as per Bangladesh standards. RWH system offers sufficient amount of water and energy savings through lower consumption.

OBJECTIVE:

The main objective of this paper is to calculate the water demand in Dharur village & quantity water collected from roof top, to design the rainwater harvesting system and find out cost required for it.

METHODOLOGY AND PEFORMANCE:

DESCRIPTION OF PROJECT AREA

Dharur is situated in the southern part of the State abutting Andhra Pradesh in south and lies between north latitudes 17°37' and 18°42' and east longitude 75°16' and 76°47' and falls in parts of Survey of India degree sheets 47 N, 47 O, 58 B and 56 C. The district has a geographical area of 1524sq. km. The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The mean minimum temperature is 14°C and means maximum temperature is 42.5°C.

DETAILS OF VIILAGE AREA:

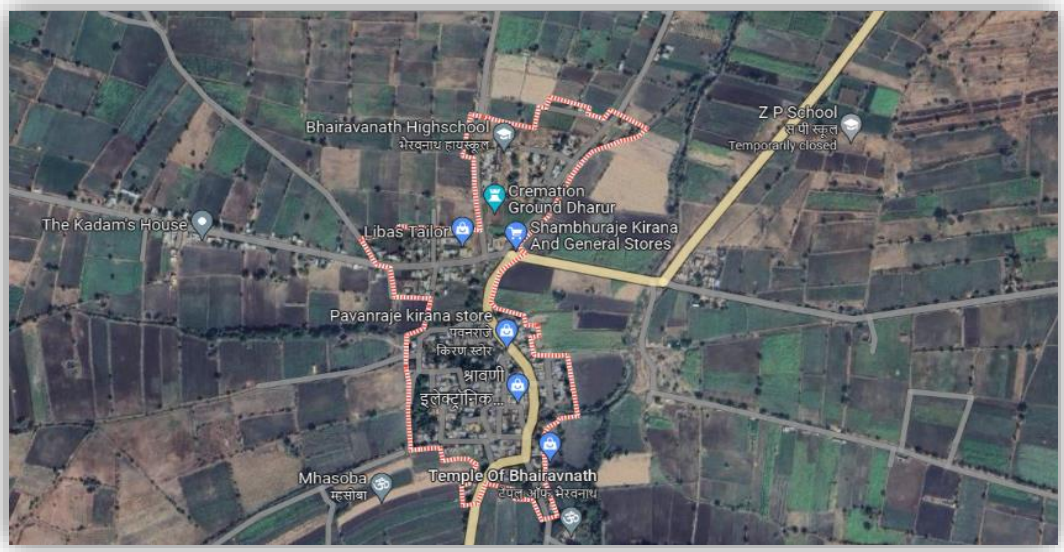

Fig 4: Image of Layout plan of Dharur Village.

The fig 4. represents the layout plan of proposed work site of college campus with survey number. This will helpful to locate the collection system, distribution system and underground water tank.

Table no. 1: Details of Owner Houses, Bore well, Roof area.

Sr. No.	Name of Owner	Name of House	Borwell Y/N	Roof Area (Sq.m)
1	Kadam Sambhaji	Vitthai Niwas	Y	120
2	Gaikwad Shri	Jijau Niwas	N	69.96
3	Garad Omkar	Vandana Sadan	N	198.9
4	Shinde Gorakhnath	Mukktai	N	120.96
5	Kadam Achut	Gokulnandan	N	105.3
6	Shete Dnyaneshwar	Jadhav Sadan	N	142.2
7	Shri Bhairvanth Highschool		Y	1646.39
8	Gore Gopal	Tuljai Niwas	N	118.08
9	Kamte Shrinath	Shiv Sadan	N	105.75

10	Patil Chandrkant	Parwati Niwas	Y	67.2

Source: Visited to Dharur Village and collected information.

RAINFALL DETAILS:

Rainfall in each region is different. It depends upon the locality the rainfall of that region changes. Mainly Maharashtra state is divided into four Zone as shown fig 5.2. Zone I is of high rainfall zone, Zone II is of transition zone, Zone III is of average rainfall zone and Zone IV is of assured rainfall zone.

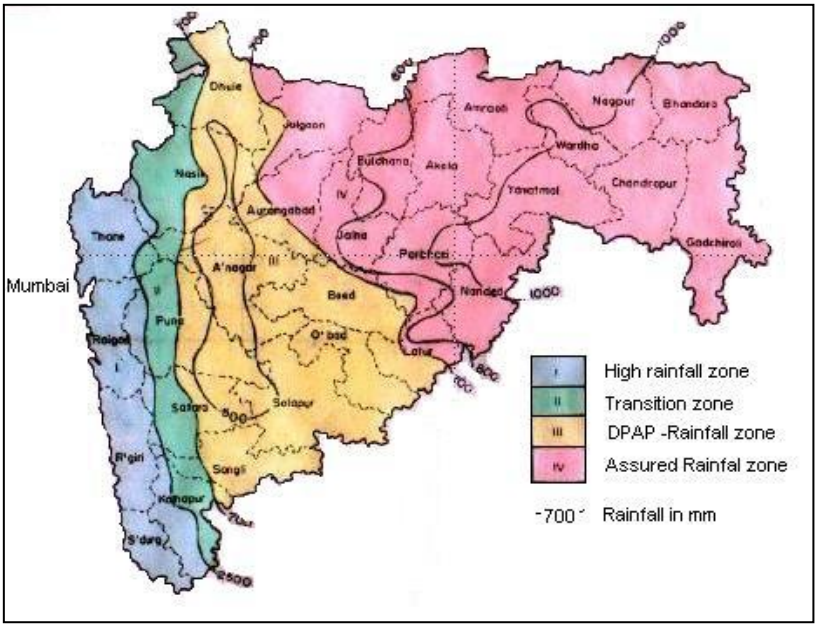

Fig 5: Rainfall zones in Maharashtra state

The normal annual rainfall over the district varies from 600 mm to about 850 mm. It is minimum in the western parts of the district around Paranda (576 mm) and increases towards east and reaches a maximum around Kalamb (775 mm).

Table 2: Annual Rainfall, Osmanabad District in mm (2002-2011)

Year	**Rainfall (millimeters)**	**Year**	**Rainfall (millimeters)**	**Year**	**Rainfall (millimeters)**	**Year**	**Rainfall (mm)**
2002	679.2	2007	979.4	2012	440.8	2017	880.5
2003	431.4	2008	1096	2013	736.2	2018	505.1
2004	741	2009	658	2014	622.5	2019	805
2005	857	2010	1000.7	2015	476.5	2020	499.5
2006	673.6	2011	538	2016	898.3	2021	531.5
						Average	**702.5mm**

Source: Data collected from metrological department of collector office.

The average annual rainfall of the district for the period 2002-2011 is 761 mm as shown in table 2.

ESTIMATION OF RAINWATER COLLECTION:

The rain water falling over the surface exact that much quantity of water will not be collected some quantity of water may be lost in evaporation or absorption or by friction. To calculate the quantity of rain water collection we have to consider the type of catchment from where water may be collected. As type of catchment is known then coefficient corresponding to it is taken to calculate the quantity of rainfall collection. The table 4.3 is gives the coefficient of runoff for respective catchment.

Table - 3 Runoff coefficients for various catchment surfaces

Type of catchment	**Coefficients**
Roof catchments	0.8-0.9
Corrugated metal sheets	0.7-0.9
Ground surface	0.6-0.8
Covering concrete brick pavement	0.5-0.6
Untreated ground	0.0-0.3
Catchments soil on slopes less than 10 % rocky natural catchments	0.2-0.5

Source - "Economic aspects of rainwater harvesting case study on D. Y. Patil knowledge city" by Mr. Satyajit Mahajan, Prof. Ashish Waghmare

COLLECTION OF WATER FROM ALL THE ROOF AREAS:

Table no. 4: Quantity of rain water collected from roof top

Sr. No.	**Name of Department**	**Qty of rain water collected**
1	Vitthal Niwas	65978.7
2	Jivan Niwas	41745.132
3	Vandana Niwas	118683.63
4	Mukktai Niwas	72176.83
5	Gokulnandan Niwas	62832.5
6	Shri Bhairavnath High school	982400.9
7	Jadhav Niwas	84850.0
8	Tuljai Niwas	70458.336
9	Shiv Sadan	63101.025
10	Parwati Niwas	40098.24
11	Krushani Niwas	72176.83
	Total Quantity of Water	**16,74,501.593lit**

ESTIMATE OF RAINWATER HARVESTING:

Name of Work: Design Of Rainwater Harvesting
Location Of Work: Dharur Village Dist: Dharashiv
Design Period Of Project: 25 years
Population of Village: 566 people
Total Estimated Cost Of Project: 19, 54,956 ₹

Add 3 % Contingencies Charges: 58,648.68 ₹.
Total Cost of Project: 20, 13,604.68 ₹.

DESIGN OF STORAGE TANK:

The design of storage tank is done by using IS Code : 15797-2008 {Indian Standard Roof Top Rainwater Harvesting Guidelines }

Formula By IS Code: IS **15797:2008**

Volume of Storage Tank = No .of Dry Days X No. of people X demand during dry days.

$$V = tXn \times q \text{ (lpcd)}$$

Where, V = Volume of tank in Liters
t = Length of the dry seasons(Days)
n = No. of people using the tank.
q = Consumption in liters per capita perv day.

According to Our Case Study, We have
t = 90 days , n =450 ,q = 40 lpcd
So, V = 90 X 450 X 40
V =16, 20,000 Lit.

Dimension of Storage Tank Designed: Length = 22m, Width = 12 m , Depth = 6.2 m

DESIGN OF COLLECTION SYSTEM

The conveyance system of PVC pipes conduct has been adopted for the rain water bank of the proposed department building.

Table 5 Details of pipe

Pipe	**Size**
Main	160 mm
Sub-main	110 mm

RESULT AND DISCUSSION:

This study was very important to solve the water related problem of that city. The main problem has been observed in summer season i.e. from February to June in every year. So to avoid this draught condition some analysis has to be done and have to take some preventive measures. Before taking preventive measures it is required to done the analysis. First step was to collect the data of rainfall and roof area for the analysis. After collecting data, quantity of water collected from the roof top is calculated. Considering this quantity storage capacity of underground water tank is substituted and size for the same is calculated. Simultaneously design of collection system, distribution system is calculated.

Environmental Impact: The rainwater harvesting system has contributed to the conservation of local water resources by reducing reliance on groundwater and surface water. It has also played a vital role in mitigating soil erosion and managing storm water runoff, which is critical for maintaining the ecological balance in the area.

Economic Benefits: This project has led to economic benefits for the community by reducing water expenses associated with purchasing water from external sources. The financial burden on households has significantly decreased, contributing to improved livelihoods.

$$\text{Benefit Cost Ratio} = \frac{\text{Proposed Total cash Benefit}}{\text{Proposed Total cash Cost}} < 1.0$$

$$\text{Benefit Cost Ratio} = \frac{4,00,000}{20,13,604} = 0.198$$

Social and Community Impact: Access to clean and abundant water has positively impacted the daily lives of the villagers. It has improved sanitation, hygiene, and overall quality of life. Additionally, the project has enhanced community cohesion through collaborative efforts in maintaining and operating the rainwater harvesting system.

Sustainability: To ensure the long-term sustainability of the rainwater harvesting system, maintenance plans have been put in place. Community members have been trained to conduct routine maintenance activities, ensuring the continued functionality of the storage tanks and distribution systems.

Recommendations: As the project has proven its effectiveness, we recommend considering its expansion to other villages facing similar water scarcity challenges. Moreover, continued monitoring and evaluation are essential to track the system's performance and make necessary improvements over time.

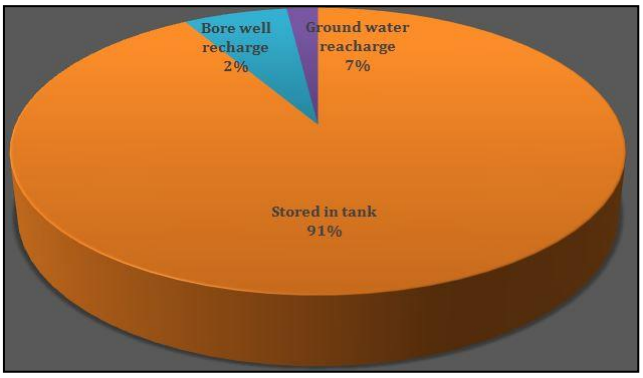

Fig 6 Graphical representation of Utilization of rain water Top of Form

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