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A Study on Utilization & Cost Optimization of Sustainable Resource in Vimeet Campus

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***Abstract*: Watershed management & rainwater harvesting plays a vital role in reducing soil erosion & water conservation. Several districts in coastal Maharashtra face the perennial problem of water storage despite of getting heavy rains during the monsoons lack of water is particularly acute problem during the months after the monsoon seasons. This study aims to cater the water scarcity by implementing watershed management & rainwater harvesting systems, to model & analyze watershed & Rainwater harvesting project in our college area to fulfil water requirement.**

Keywords: Watershed management, rainwater harvesting

I. INTRODUCTION

Watershed management is a concept which recognizes the judicious management of three basic resources of soil water and vegetation, on watershed basis, for achieving particular objective for the well being of the people". It includes treatment of land most suitable biological as well as engineering measures. Watershed management is also a term used to describe the process of implementing land use practices and water management practices to protect and improve the quality of the water and other natural resources within a watershed by managing the use of those land and water resources in a comprehensive manner. Watershed management involves determination of alternative land treatment measures for, which information about problems of land, soil, water and vegetation in the watershed is essential. In order to have a practical solution to above problem it is necessary to go through four phases for a full scale watershed management- Recognition phase, Restoration phase, Protection phase, Improvement phase. The Integrated Watershed Management Programme (IWMP) one of the Flagship programme of Ministry of Rural Development is under implementation by the Department of Land Resources since 2009-10 after integrating three area development programmes namely: Desert Development Programme (DDP), Drought Prone Area Programme (DPAP) and Integrated Wastelands Development Programme (IWDP). The concept of rainwater harvesting involves „tapping the rainwater where it falls". A major portion of rainwater that falls on the earth's surface runs off into streams and rivers and finally into the sea. An average of 8-12 percent of the total rainfall recharge only is considered to recharge the aquifers. The technique of rainwater harvesting involves collecting the rain from localized catchment surfaces such as roofs, plain / sloping surfaces etc., either for direct use or to augment the ground water resources depending on local conditions. Construction of small barriers across small streams to check and store the running water also can be considered as water harvesting. In Urban areas, the roof top rainwater can be conserved and used for recharge of ground water. This approach requires connecting the outlet pipe from rooftop to divert the water to either existing wells/ tube wells/bore well or specially designed tank. The urban housing complexes or institutional buildings have large roof area and can be utilizing for harvesting roof top rainwater to recharge aquifer in urban areas. The runoff from the terrace of the college building is channelized through three recharge wells located at three different locations, each measuring 1x1x2 m. All the rooftop rainwater outlets, except that from the Tutorial Block, discharge into storm water drains and then to the recharge structures. In the Tutorial Block, a network of pipes linked through chambers take the rainwater to the recharge wells. To facilitate groundwater recharge, total structures is provided with 15m deep bore wells of 150mm diameter. Layer of bricks filled inside the recharge well ensures proper filtration of harvested water.

The filtration is a technique used for two main purposes. The first is to remove solid impurities from a liquid .the second is to collect desired solid from solution from which it was precipitated or crystallized. The use of sand and gravel as filter media for water supplies can be split into three basic filter types: slow sand filters, rapid filters and roughing filters. Apart from desalination and reverse osmosis, slow sand filters are perhaps the most effective single treatment for purifying drinking water supplies. They are use on a large scale as part of the water supply for large cities, as part of systems for small villages and on a much smaller scale they can be adapted for use in individual households. Rapid sand filters are normally require a subsequent chlorination process and are thus of less use for small village supplies unless the raw (untreated) water supply is of a reliably high quality.

II. LITERATURE REVIEW

1. **Patel Shivraj(2013)'Watershed Management in Rural Area –A Case Study'** He coated that Plenty of water is available during rainy season, Particularly in Konkan region where more than 3000 mm rainfall is available. But in this region slope of river bed is so steep and all the rain water flows towards the outlet very fast and results in scouring land, it is major problem. After the rainy season around month of December the water scarcity starts in most of the hamlets

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comprising of advises or tribal, and water demand increases. As large amount of ground water is drawn out from under ground, reduction of ground water table which in turn reduces water level in wells. To cater this problem of water storage in rural areas, the technique of water shed management is best suited.

2. V.A. Swami (2011) 'Model Watershed Management Plan for Shivapur Village' He made proposals (1) Simple technical constructions such as farm ponds, check dams, bunds on streams and around the farms, contour trenches on sloping lands, terracing etc. (2) Agronomical measures such as strip cropping, crop rotation, economical irrigation practices etc. (3) Clearing the wells and water bodies from silt, improving the village ponds etc. (4) Recharging ground water artificially by rain water harvesting etc.

3. **Jankar P (2013) a case study of watershed management for madgyal village'** In the Madgyal some measures have been adopted to recharge the ground water resources, but it has been found that these measures don't work with full capacity in some cases. In the Madgyal watershed area, demand of water for agriculture and drinking purpose is increasing rapidly depleting water resources coupled with overpopulation. Efforts are made to divert large amount of rainwater to recharge ground water resources. He concluded that, The extra water required for domestic purpose in Madgyal village is 74245m^3 to fulfill this demand watershed management technique need to be implemented.

4. Mrs.VidulaArun Swami, 'Watershed management – A means of sustainable development - a case study' This paper presents case study where large amount of rainwater is directed to recharge ground water resources. SomwarPeth is a small village located at distance of 15 Kms. from Kolhapur city. Under Social Forestry Department, some measures have been adopted to recharge the ground water resources, but it has been found that these measures don't work with full capacity in some cases. Hence it is planned to take such engineering and biological measures which will direct this extra runoff to ground water storage. The most significant feature of the work is that if such technologies are developed and adopted at larger scale in rural areas, it will prevent thousands of villages of the country from water supply by tankers.

III. OBJECTIVE

Watershed management is renowned technique for conservation of water. But due to expenditure behind it, it is not yet accepted by the society. The purpose of this project is to find out the suitability in terms of cost for the ViMEET campus. This assessment includes the investigation of current literature, conduction of surveys required for the watershed management. This also includes the designing of the same watershed management system in the same campus and cost analysis of the system.

Objective of the study

1. Collection of the data of site selected as ViMEET campus, so as to analysis the cost expenditure.
2. Design of watershed management system & rainwater harvesting system for ViMEET campus.
3. Estimating total construction cost required for watershed tank & rainwater harvesting tank by PWD DSR method.
4. Cost comparison between construction cost & annual expenses on water.

IV. METHODOLOGY

Research Methodology includes description in detail about study of the ViMEET campus and designing the suitable watershed management system for the campus that includes the following points.

1. Collection of data of surrounding site conditions.
2. Preparation of contour map of selected site.
3. Profile levelling is used to select the water outlets.
4. Constructing the suitable structures at water outlet points.
5. Preparation of the estimates of structures proposed.

V. DATA COLLECTION

(A)Basic Requirement of water

The information about students and faculty members staying in hostel is been provided by Vishwaniketan hostel in charge. The students not staying in hostel is been provided by account section.

Table 1.Basic Requirement of water (As per IS 1172-1993 in lpcd)

Sr.	Students Detail	No. of Students	Req./Student	Amount of Water (Lt)
1	Student staying in Hostel	205	135	27675
2	Student Non-Hostelite	1387	30	41610
Total				69285

(B)Actual Supply of water

The data of supply of water to vishwaniketan college has been collected from the estate department of the college. And in this the water is been supplied by the help of tankers, which are daily needed. In it canteen part is been taken separately as it includes cooking and washing of utensils.

Table 2.Actual Supply of water (Per month)

Sr.	Purpose	Requirement	Total Amount(lit)
1	(a) For Drinking Purpose	1724×20	34480
	(b) For Domestic Purpose	73×15000	1095000
Total (a + b)			1129480
2	(A) Actual water Supply / day	1129480/ 30	37650
	(B) Water supply for canteen (Per day)	1387×20	27740
Total (A + B)(Per day)			65390

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(C) Rainfall Data

Rainfall was high with average rainfall of 3336.36 mm for past 10 years. The highest rainfall in last 10 years was 3921.4mm in 2009 and lowest rainfall was 2289.4mm in 2015.

Table 3.Rainfall data of 10 years

Year	2007	2008	2009	2010	2011
Rainfall (mm)	3293.5	3489.9	3921.4	3148.6	3234.2
Year	2012	2013	2014	2015	2016
Rainfall (mm)	3375.3	3913.5	3031.8	2289.4	3670.30

(D)Data Collection For Rainwater Harvesting

This data is been taken with reference of area of terrace or rooftop, so that this water could be use for domestic purpose. As this water gets run away or percolate in ground, so it is of no use. So we adopt rainwater harvesting so that we can collect that water, and use it.

Table 4. Annual water harvesting potential

Sr.	Data Collected for Rainwater Harvesting	
1	Area of catchment	2220 Sq.m
2	Average annual rainfall	3336.79 mm
3	Runoff coefficient	0.25
4	Annual water harvesting potential =2220×3.33×0.25	1848150 lit
5	Approximate requirement of water/day	30000 lit

(E) Present Expenses On Water Annually

1. In a week from Monday to Saturday, there is a requirement of 3 tankers per day & on Sunday it is limited to 2 no. of tanker.
2. 1 tanker = 10,000 liters capacity which cost Rs.900 therefore total monthly water requirement

= 10,000 x 20 tankers x 4 weeks

= 8,00,000 liters which costs approx Rs. 72,000

3. Annually = 96,00,000 lit.

(96,00,000/8,00,000)*72000= 8,64,000

4. Annually expenses on water = Rs. 8,64,000

VI. DESIGN OF WATERSHED MANAGEMENT SYSTEM & RAINWATER HARVESTING SYSTEM FOR VIMEET CAMPUS.

In this system we have designed five water tanks for storage of water, two filtration tank (5.6×3.8×3), storage tank (5.5×3.7×6), watershed tank (4.6×3×6) & rainwater harvesting tank (5.5×3.7×4) collected from rainwater harvesting and watershed Dimension of first tank.

VII. ESTIMATING TOTAL CONSTRUCTION COST

The rates which are being taken are as per DSR 2015-16 PWD Alibaug. And it also includes the profit of contracter, electrical charges, contingencies and work charged establishment.

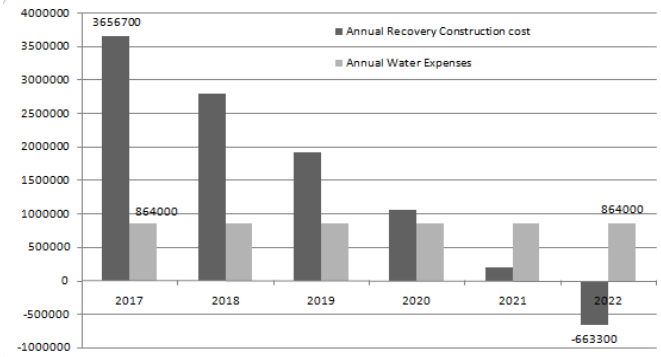
Table 5. Abstract sheet

Sr.	Description	Rate	Quantity	Total amount
1	Excavation	217	377.12	81835.04
2	P.C.C	5126	15.35	78684.10
3	RCC concreting	8769	161.74	1418298.06
4	Backfilling.	70.40	79.38	5588.35
5	Total steel	54784	19.04	1043354.98
6	Pipes	700	218	152600
7	Pump 3 Pump of 10 H.P 2 Pump of 5 H.P	 35000 20000	 3 2	 105000 40000
	Total			2925360.53
	Contingencies 5 %			146268.02
	Work charged establishment 2 %			58507.21
	W.S. & Electric Charges 8 %			234028.84
	Contractors profit 10 %			292536.05
	Total cost			**36,56,700/-**

VIII. *COST COMPARISON*

In this chart we get know the cost comparison between total construction cost & annual water expenses. In 2017 initially the system is been constructed and the construction cost is Rs. 36,56,700. Whereas annual expenses on water is approximately Rs.8,64,000. But this construction cost is been recovered further as the initial cost of construction is more but after yearly expenses on water the construction cost reduces or recovers. For prolong use this watershed and rainwater harvesting project is benefited to college in terms of its cost as well as recharging of ground. So when this construction cost gets recovered fully & when our actual benefits starts by taking into consideration the cost of project & expenses we see that this construction cost recovers in 2022, where after their are no expenses on water and so it is used freely afterwards.

Chart 1. Cost comparison between construction cost & annual expenses on water



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VI. RESULTS AND DISCUSSION

(A)Location of Tank from Contour Sheet

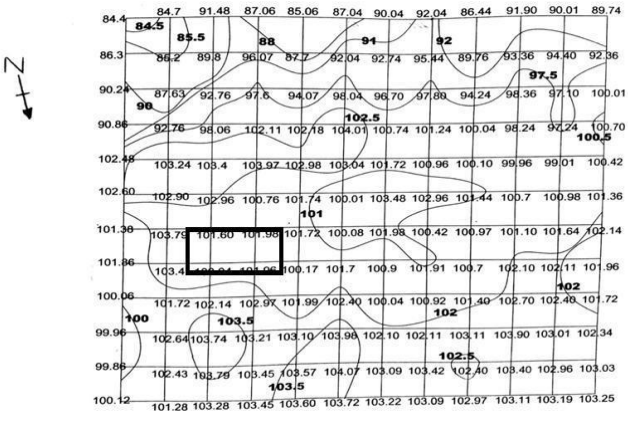

Image 1. Location of tank

(B)Distribution layout

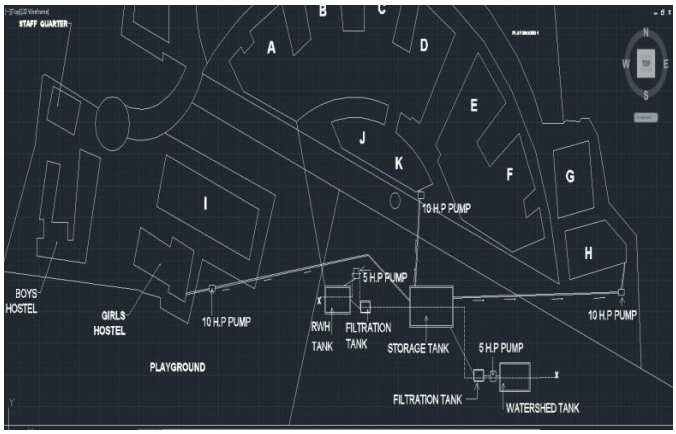

Image 2. Distribution layout

(C) Cost analysis shows that the construction cost is being recovered in five years and afterwards the water is being used as free of cost.

(D) Total estimated cost of this project is Rs. 36,56,700 to overcome this investment it will take 5 years . After five years total cost will be recovered. Thus it will surely justify the investment and it could give further benefits that is using water at low cost.

(E)Sectional Layout

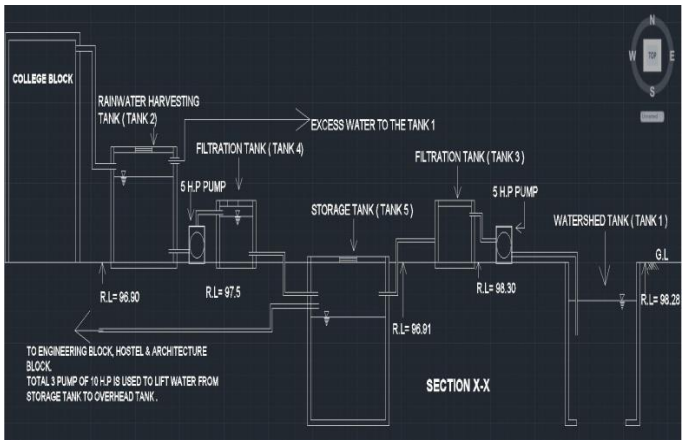

Image 3. Sectional layout of System

IX. CONCLUSION

Plenty of water is available in rainy season, particularly in Konkan region where more than 3000 mm rainfall is available. After the rainy season around the month of December water scarcity starts & water demand increases. As large amount of ground water is drown out from underground, reduction of ground water table occurs which interns reduces water level in well.

To cater this problem of water storage in ViMEET areas, the technique of watershed management & rainwater harvesting is best suited. By this method ground water table increases thus providing sufficient water during summer season & reducing the call of tankers on which a lot of money is spent. The initial cost of the project is high but it is economical. The structure of tank is made by using R.C.C which can last for many years. The construction cost can be recovered in five years & afterwards it can be used, free of cost. That's the Aim of my project. As it can save lot of money which is spend on water.

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