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ARTIFICIAL GROUNDWATER RECHARGE THROUGH RAINWATER HARVESTING At DIT

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ABSTRACT
Rainwater Harvesting is the accumulation and storage of rain water for reuse on site, rather than allowing it to runoff. The harvested water can be used as drinking water, longer term storage and to recharge ground water. A proposal for rain water harvesting for ground water recharge for Dr. D. Y. Patil Institute of Technology, Pimpri (DIT) has been prepared by studying all required parameters at site. Cost estimation of the proposed work has been done in detail. Implementation of the method has been done at one of the four proposed locations. In this paper the proposed work at DIT, cost estimation and actual work at site has been presented.

KEYWORDS: rain water harvesting, storm water, recharge pit, cost estimation.

INTRODUCTION
Rainwater harvesting (RWH) is an environmentally sound solution to address issues brought forth by large projects utilizing centralized water management approaches.[1] The rainwater harvesting structures refers to all small structural interventions to impound excess runoff from agricultural fields and runoff from small natural catchments either for direct use by humans and cattle or for aquifer recharge.[2] From the archaeological and historical reports of rain water harvesting and water management worldwide, the climatic rain water harvesting link can be understood.[3] In many areas of the world, the major-element chemical loads of water entering surficial (unconfined) aquifers in the last several decades have been dominated by constituents derived directly or indirectly from agricultural practices and additives.[4]

Groundwater is often the main source of both drinking and irrigation water, and thus rapidly decreasing groundwater levels calls for new methods to restore water availability.[5] Human health and welfare, food security, industrial development and the ecosystems on which they depend, are all at risk, unless water and land resources are managed more effectively in the present decade and beyond. With the growing demand of water, recharging of aquifer is fulfilled the need of the water crisis for future generation.[6] The ground water has been considerably amplified and the salinity of water has been declined, thus improving the quantity and quality of water. The artificial recharge methods are proving to be effectual in maintenance and replenishment of the aquifers.[7]

The selection of the ground water recharge technique depends upon the hydrological frame work of that particular area. The various methods can be broadly categorized as follows:
1. Direct Surface Techniques
2. Direct Sub surface technique
3. Combination surface-sub surface technique
4. Indirect techniques [8]

ARTIFICIAL GROUND WATER RECHARGE AT DIT
Dr. D. Y. Patil Institute of Technology, Pimpri is a leading Engineering Institute located in the industrial built of Pimpri-Chinchwad in Maharashtra. The total strength of campus including students and staff is more than 3000. Thus, with this present strength and also with the future expansion, campus should also increase its facilities and maintenance requirements. The storm water gets collected in the campus area. Due to topography of the area there is no proper passage for the water to seep into the ground and also due to concrete surface there is stagnation of water in the campus.

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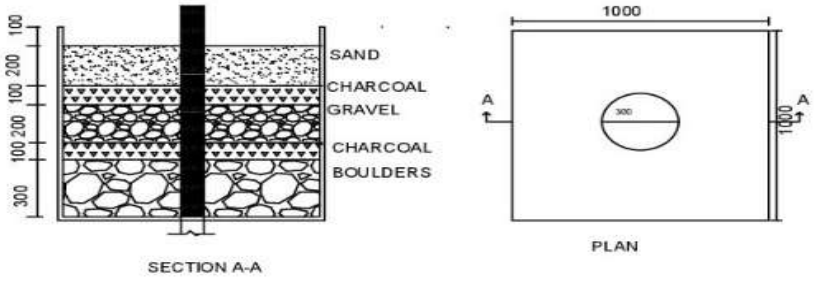
The detailed study of nature of ground water and the different set ups for ground water recharge techniques is done. The required setup is constructed on selected site. Along with this the cost estimation of the work is carried out.

The Direct sub surface technique has been adopted. The method consists of a deep bore well, recharge pit, filter chamber filled with filter materials. The implementation of this system recharges the ground water table and thus this can be further used for irrigation or for our daily requirements. The water from the storm water drainage is allowed to pass through the vertical filter provided in the recharge pit. The water gets purified so that it cannot contaminate the ground water table. Then this purified water is allowed to pass through the perforated pipe and this recharges the ground water table. The recharge pit is shown in figure1.



(All dimensions are in mm)
Figure1: Recharge Pit

DESIGN OF RWH SYSTEM AT DIT

Calculations are for 1 storm, considering intensity of storm as 25 mm/hr. The available catchment area for runoff is 1935.9 m^2. Assuming average rainfall intensity of 50 mm for 2 hours, runoff coefficient 0.8 and storm duration 2 hours.

By using rational formula, Q = C I A .The discharge calculated from the formula for open area is 0.0387 m^3 /sec. the total runoff volume is the product of peak runoff rate and storm duration. Thus the total runoff volume is 278700 Liters.

To recharge this volume of water into ground the 4 recharge setup locations in college campus of recharge pit of size 1m×1m×1m are proposed. Among the four setup locations, two locations already have the bore well installed while at other two locations bore well needs to be installed.

IMPLEMENTATION AT DIT

As per the design, recharge pits are proposed at 4 locations, out of which the work has been completed at one location as follows and shown in figure2.

Figure2a: Excavation at the site

Figure2b: Layers of 40mm Boulders

Figure2c: Layer of 20mm Gravels

Figure2d: Layer of Charcoal

Figure2e: Layer of River Sand

Figure2f: PVC Pipe with perforations

Figure2g: Final Setup

1) Setup details
   Specifications:-
   1. Dimension of Recharge pit:- 1m×1m×1m
   2. Layers of Recharge pit:-
      i) Boulders: - Layer of boulders is of 300mm. The absorption capacity of boulder is 3 to 5%. The effective particle size is 40mm.
      ii) Gravels: - Layer of gravels is of 200mm. The absorption capacity of gravels is 3 to 5%.The effective particle size is 20mm.
      iii) Coal: - Layer
      iv) Capacity of river sand is 3 to 5%.

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v) Depth of bore of coal is of 100mm. The absorption capacity of coal is 10 to 20%. It is used to remove contaminants and impurities using chemical adsorption. This material is useful in removal of chlorine, particles such as sediments, volatile organic compounds, taste and odour from water.

3. Sand: - Layer of river sand is of 200mm. Sand has the power of removing dissolved matter from water. The absorption well: - 240ft.
4. PVC Perforated Pipe: - We used line perforation to restrain the entry of small sand particles. The depth of perforated pipe is 1.2m from top.

The recharge pit should be filled with the aggregates and coal, to recharge silt and chemical free water. Hence the materials used in the pit is the layer of 40 mm aggregates at bottom then the layer of coal over it the layer of 20 mm aggregates is placed followed by the layer of coal and at the top the layer of river sand. The material should be filled depth wise in the pit and with proper compaction.

COST ANALYSIS AND ESTIMATION

The cost for Proposed RWH at DIT has been estimated. It is to be noted that bore wells are present at two locations where as new bores will be required at remaining two locations. Cost calculations are present in Table1.

Table1: Cost estimation for RWH at DIT

Item No.	Item	Unit	Rate(Rs)	Quantity	Total Cost (Rs)
1	Excavation of bore hole	Per ft	80.00	240	19200.00
2	Labour charges	Per day	500.00	3 no.	1500.00
3	Materials:-				
	i.40mm aggregates	m^3	900.00	0.3	270.00
	ii.20mm aggregates	m^3	900.00	0.2	180.00
	iii. River sand	m^3	2050.00	0.2	410.00
	iv. Coal	m^3	200.00	0.2	40.00
	v. PVC Pipe	m	73.3.00	6	439.80
				Total	**=22039.80**

The cost of recharge setup excluding installation of bore well is Rs. 2400/-
The total cost proposed for RWH system at DIT is Rs.48879.6/-.

CONCLUSION

Recharge of ground water table is a gradual process. The direct sub surface method is easy to apply practically on site. The site conditions and rain water data analysis shows that four recharge pits are required for RWH at DIT site. The total cost estimated for this proposal is Rs.48879.6/-.

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