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Harvesting and Recharging Rainwater at LDRP-ITR, Gandhinagar

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Abstract

Because of the growth in the demand of fresh water driven by growth in the global population and of the economies, the world may see more than six fold increase in the number of people living in the condition of water stress from 470 million today to 3 billion in 2025. Hence in order to harness and meet our daily demand of water requirement, one need to think of alternative cost effective and relatively easier technological methods of conserving water. Rain water harvesting is one of the best methods fulfilling those requirements.

As entitled the rainwater is harvested and recharged in the LDRP-ITR campus. Rainwater harvesting potential of whole campus was calculated and based on it, various alternatives of harvesting the rainwater and their respective costs were thoroughly studied. The best alternative was selected and thereby implemented in the LDRP-ITR.

Keywords

Global population, water stress, rain water

Introduction

It is estimated that need of water for drinking and other municipal uses will be increased from 3.3 MHm to 7.00 MHm in the year 2020[1]. Similarly the demand of water for industries will be increased by 4 fold i.e. from 3.0 MHm to 12.00 MHm during this period (2014-2020) [1].

Need for Study

Currently 20 hours of pumping is done from 134 m depth from bore well by submersible pump that extract approximately 12,00,000 litres of water every day. The area can be considered as over exploited area as most of the area is paved and hence very less water (runoff) gets infiltrated.

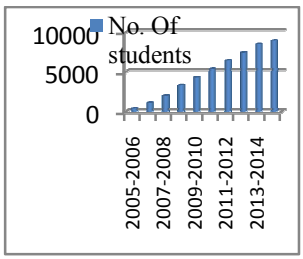

Chart1: Number of Students

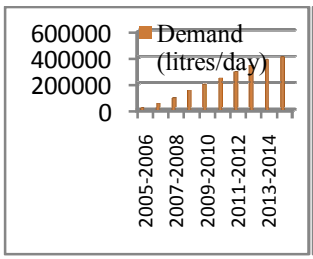

Chart2: Demand of Water

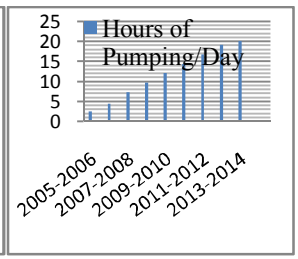

Chart3: Pumping Hours

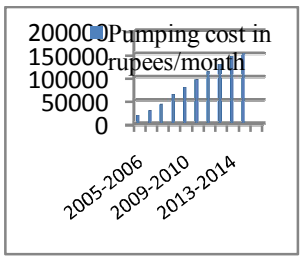

Chart4: Pumping Cost

Above charts shows that the due to increase in number of students in the campus demand for water also increases hence, water pumping hours and pumping cost is increased. Also Chart5 shows the difference in the post monsoon & pre monsoon ground water table levels. Hence there is need for study of rainwater harvesting in the Gandhinagar to maintain the post monsoon & pre monsoon water levels.

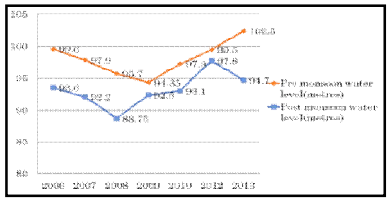

Chart5: Ground water table of previous years of Gandhinagar city

Objective of Study

Main objective is to arrest the rainwater choking up the drains and use it in efficient and reliable manner. The other objective is to fulfill our social duty by harvesting the rainwater and recharging it to deeper aquifers to maintain & bridge the gap between withdrawal & infiltration of ground water.

Alternatives , Analysis and Design

The study areas include the Main building, Workshop, Canteen, Girl's hostel, Boy's hostel-1, Boy's hostel-2, Quarter type-A, Quarter type-B, Guest house, University Bhavan.

Analysis of the Total Rain Water Harvesting Potential of the Campus

Rain water harvesting potential = Area of Catchment X Amount of rainfall X Runoff coefficient

From the data given by the State Water Data Centre, Gandhinagar and as mentioned on the website of www.gsdma.org we have understood that average annual rainfall of

Gandhinagar city is 700 mm. Here considering the evaporation losses, losses due to leakage, the runoff coefficient is taken as 0.80.

RWH Potential for the campus = 12500 X 0.80 X 0.700 = 7000m3 i.e. 70,00,000 liters

Alternative 1, Recharging the rain water by existing recharge well

There are total 9 recharge wells of different depths present in our campus at different locations. But none of these wells are in the condition to recharge the rain water. So re-development of the recharge wells is required in order to recharge the rain water according to the conditions favourable.

Figure 1. Positions of different recharge wells in the campus

Table 3.5, Depth (in feet) of all recharge wells and Details of Research Area

Recharge well No.	Depth	Rain Water to be harvested from
1	300	Roof top rain water from quarter type-A,B and girls hostel
3	200	Roof top rainwater from guest house, university bhavan, boys hostel-2
4	300	Roof top rain water from boys hostel-1 & 2
6	300	Roof top rain water from block-B & block-C of main building
7	200	Run-off rain water from the surrounding open space
8	200	Roof top rain water from workshop and canteen
9	300	Run-off rain water from surrounding parking area-01

Total Cost: Rs. 12,24,676/-

The advantages of the alternative 2 are as listed below:

1. The ground water table will rise to a certain level after some period of time.
2. If recharged properly it can benefit to the existing water source.

The disadvantages of the alternative 2 are shown below:

1. Rain water can get over logged if not designed properly.
2. If not filtered properly recharge well can get clogged after certain period of time.
3. Even by investing such a huge sum of money we will not get direct benefits of rain water and due to unavailability of large area not much amount of rain water will get recharged.

Alternative 2, Recharging the rain water by constructing new recharge well

The parking area-06 would be the best place to develop a new recharge well as it near to the existing bore-well and has maximum unpaved area surrounding it.

Total cost: Rs. 6,67,898/-

The advantages of the alternative - 3 are listed below:

1. The ground water table will rise to a certain level after some period of time.
2. The pumping cost can be reduced if run off is recharged in a proper manner.
3. The infiltration rate of the soil will improve.
4. Surface run-off rain water won't get clogged as it will get recharged in the recharge wells.

The disadvantages of the alternative - 3 are shown below:

1. The danger of contamination of the ground water exists if not filtered properly before discharging it.
2. There won't be much amount of run-off available to be recharged as the area is comparatively smaller to be harvested.
3. The management of our institute will first think of utilizing the present 9 recharge wells rather than investing on new recharge well.

Alternative 3, Harvesting the rain water by constructing new U.G storage tank

U.G storage tank in the parking area-06 behind university bhavan of 6,00,000 litres capacity can be constructed. The rain water from the roof tops of the buildings will get harvested in these U.G tank.

Cost - Rs. 31,65,911

Benefit - 1) Rainwater which usually chokes up the drains will be useful in drinking purpose for the students of the hostels.

2) 6,00,000 litres of water will be saved being extracted from the Tube well.

Hence Benefit/Cost = Less than 1

Alternative 4, Harvesting the rain water through existing U.G. Storage tanks

The existing 5 U.G tanks which fulfil the domestic needs of whole campus can be used to store the rain water from the roof tops of the surrounding buildings.

Cost - Rs. 7,74,043

Benefit - 1) 70,03,000 litres of water will be saved being extracted from the ground during Rainy Days.

2) 50,000*3 = Rs.1,50,000 will be saved every year for a period of 3 rainy months. (If 30% of pumping cost is reduced)

Hence Benefit / Cost = 30,00,000(for design period of 20 years)/ 7,74,043

= 3.87

Alternative 5, Harvesting the roof top rain water through existing U.G storage tanks as well as Recharge wells as per the favorable conditions

Fig 3, shows the proposed design for this alternative

Cost - Rs. 11,88,454

Benefit - 1) 70,03,300 litres of water will be saved during Rainy Days.

2) 35,000*3 = Rs.1,05,000 will be saved every year for a period of 3 rainy months. (If 20-25% of pumping cost is reduced)

Hence Benefit / Cost = 21,00,000(for design period of 20 years)/ 11,88,454

Implementation and Result

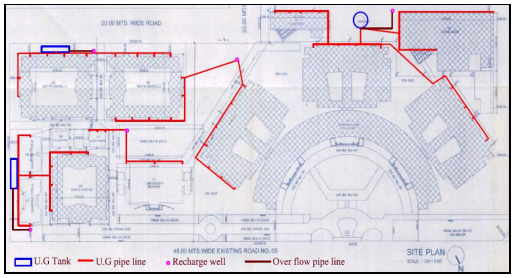

Figure 3. Proposed design for alternative

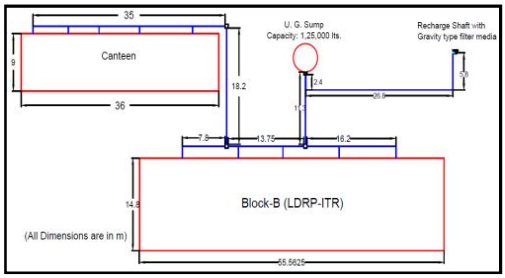

Figure 4. Approved design for alternative 6

Table 4.1, Slope (in inch) provided between Inspection Chambers

Inspection Chamber 1 - Inspection Chamber 2	-
Inspection Chamber 2 - Inspection Chamber 3	1 in 135
Inspection Chamber 3 - Inspection Chamber 4	1 in 85
Inspection Chamber 4 - Inspection Chamber 5	1 in 140

3.1. The whole project is implementation in following stages

Figure. 5: Digging of ground

Figure. 6: Laying of pipe lines

Figure. 7: First flush valve

Figure. 8: Inspection Chamber

Figure. 9: Redeveloping recharge well

Figure. 10: Cleaning of terrace

Final Costing

Table 4.2, Cost of various components of approved RWH system

Sr. No.	Component	Quantity	Rate	Amount
1	P.V.C pipes(160 mm diameter, 6 kg/cm²)	24 No.s	Rs. 3089	Rs. 74088
2	P.V.C pipes(110 mm diameter, 6 kg/cm²)	10 No.s	Rs. 1470	Rs. 14700
3	P.V.C elbow(110 mm diameter)	29 No.s	Rs.57	Rs. 1653
4	P.V.C Ball valve(110 mm diameter)	10 No.s	Rs. 800	Rs. 8000
5	P.V.C Tee(110 mm diameter)	10 No.s	Rs. 80	Rs. 800
6	P.V.C Reducer socket (160 mm * 110 mm dia.)	8 No.s	Rs. 180	Rs. 1440

7	P.V.C coupler(110 mm diameter)	5 No.s	Rs. 40	Rs. 200
8	C.I cover(2 ft.* 2 ft.,27 kg.)	5 No.s	Rs. 1230	Rs. 6150
9	P.V.C Reducer Tee(160 mm*110 mm dia.)	6 No.s	Rs. 570	Rs. 3420
10	P.V.C solution	2 No.s	Rs. 300/lit	Rs. 600
11	C.I jali	10 No.s	Rs.255	Rs. 2550
12	Labour Charge Rs.52175			
	TOTAL	165776		Rs.

Result

The rainfall from the two rooftops was harvested for the period of 46 days from 15th August, 2014 to 30th September, 2014. Thus according to the data 42% of the average annual rainfall of the season was harvested this year [14]. It is made known that the total amount of rainfall that got harvested for the above stated period was 297 mm.

Total catchment area	1130 m2
Run-off coefficient	0.80
Amount of rainfall harvested	0.297

Rainwater harvested and recharged at campus= 1130m2 X 0.80 X 0.297m

= 268.488m3 i.e. 2,68,488 litres

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