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Rain Water Harvesting of Sant Gadge Baba Amravati University campus in Amravati - A Case Study

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Abstract: People usually make complaints about the lack of water. During the monsoons lots of water goes waste into the gutters. And this is when Rain water Harvesting proves to be the most effective way to conserve water. We can collect the rain water into the tanks and prevent it from flowing into drains and being wasted. It is practiced on the large scale in the metropolitan cities. Rain water harvesting comprises of storage of water and water recharging through the technical process.

The Rainwater harvesting is the simple collection or storing of water through scientific techniques from the areas where the rain falls. It involves utilization of rain water for the domestic or the agricultural purpose. The method of rain water harvesting has been into practice since ancient times. It is as far the best possible way to conserve water and awaken the society towards the importance of water. The method is simple and cost effective too. It is especially beneficial in the areas, which faces the scarcity of water. This paper presents rainwater harvesting as case study Of Sant Gadge Baba Amravati University, Amravati, Maharashtra, which proves to be the effective and promising way of supplying rain water to all the university campus throughout the year.

Keywords: Rain water Harvesting, Ground water, recharge, runoff, trench, Sant Gadge Baba Amravati University, Amravati

I. CASE STUDY FOR SANT GADGE BABA AMRAVATI UNIVERSITY

A. Site description

The Sant Gadge Baba Amravati University, Amravati (SGBAU) campus is located in Amravati district, near Tapovan near about 1km. from old by-pass. It is located near newly constructed Express way. The sant gadge baba amravati university (SGBAU) campus is located in the northeast of the Amravati district. Amravati District is a District of Maharashtra state in central India. The district is situated between 20°32' and 21°46' north latitudes and 76°37' and 78°27' east longitudes. The district occupies an area of 12,235 km². The master plan of SGBAU is shown in figure 1.

The site for rainwater harvesting is located at Sant Gadge Baba Amravati University, Amravati. The project of roof as well as surface rainwater harvesting has been undertaken in Amravati University on a large extent. Various building are covered under this project. These include Finance Department, Engineering Department Microbiology Department of Ph.D. cell, Girls hostel and also Kendriya Mulyankadan Kendra having area of 500 sq. m. alone.

B. Climate

Amravati has a tropical wet and dry climate with hot, dry summers and mild to cool winters. Summer lasts from March to June, monsoon season from July to October and winter from November to March. One can face extreme weather variations over here with very hot summers and very cold winters. Summer starts from March end and becomes unbearable during April-May with temperature touching almost 47°C. Till June end, the weather is extremely hot and dry. South western monsoon is bringing the heavy rainfall from the month of July to October. Temperature starts to fall from 37°C to 20°C.

C. Geology

About 73 percent of Amravati tahsil is covered by basaltic lava flows of the Deccan Traps belonging to the Upper Cretaceous to Eocene age. The remaining part is underlain by other soft rock formations, particularly the Alluvium, Lameta beds, Gondwana Sediments and unclassified metamorphic rocks along the river Pedhi (Tributary of Purna) which occupies 20% area. The horizontally disposed basaltic lava flows of the Deccan traps are the major geological formations occurring over about 652 sq.kms. area in the taluka. The Vesicular and Amygdaloidal zeolitic basalt and massive basalt flows are generally separated by red/ green boles and clay layers. The average flow thickness range is 10 to 30 m.

Alluvium : About 20% part of the Amravati taluka along the Pedhi basin is occupied by alluvial deposits. The alluvium consists of clay, sand and silts with thickness ranging from 10 to 15 m with a wide aerial extension spread over 184 sq. kms. It is of recent age, and lying over the Deccan Traps.

D. Rainfall

The rainfall in this area is moderate generally starting from mid-June and continuing up to October. The average annual rainfall in the area is 782.00 mm, most of which is received during South-West monsoon. The recharging of bore well takes place for up to 4 months only.



The average annual rainfall for the last ten years when compared with the normal annual rainfall, it is observed that the average annual rainfall for the last ten years of the district is much less than the normal annual rainfall. Thus the rainfall has definitely decreased in the district over the period of time.



E. Hydrogeology

The total area of the University is about 477 acres. The soil mainly consists of basalt stone. Due to presence of basalt stone, the absorption capacity of the soil is very less.

In Amravati taluka, Ground water occurs in upper weathered and fractured parts of Deccan Trap Basalt mostly down to 15-20 m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones. The upper weathered and fractured parts form phreatic aquifer and ground water occurs under water table in unconfined conditions. At deeper levels, the ground water occurs under semiconfined conditions. The Pohra and Ner Pinglai hills and rugged Basalt terrain does not form potential aquifer due to limited thickness of weathered material.

II. RAIN WATER HARVESTING

Rain water harvesting is the technique of collection and storage of rain water at surface or in sub-surface aquifers, before it is lost as surface run-off. The augmented resource can be harvested in the time of need. Artificial recharge to ground water is a process by which the ground water reservoir is increased at rate exceeding that under natural conditions of replenishment. An old technology is gaining popularity in a new way. Rain water harvesting is enjoying a renaissance of sorts in the world, but it traces its history to biblical times.

A. Design Considerations

The important aspects to be looked into for designing a rainwater harvesting system to increase ground water resources are: -

- 1) Hydrogeology of the area including nature and extent of aquifer, soil cover, topography, depth to water level and chemical quality of ground water.
- 2) The availability of source water, one of the prime requisite for ground water recharge, basically assessed in terms of non-committed surplus monsoon runoff.
- 3) Area contributing run off like area available, land use pattern, industrial, residential, green belt, paved areas, roof top area etc.
- 4) Hydrometeorological characters like rainfall duration, general pattern and intensity of rainfall

III. METHODS OF RAIN WATER HARVESTING

Roof Top Rain Water /Storm runoff harvesting through ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away- from the surface. Commonly used recharging methods are,

- 1) Recharging of bore wells
- 2) Recharging of dug wells.
- 3) Recharge pits
- 4) Recharge Trenches
- 5) Percolation tank
- 6) Check Dam/ Cement Plug/ Nala Bund
- 7) Recharge shaft
- 8) Dugwell Recharge

A. Rain Water Harvesting through Percolation Tank

Percolation tank is an artificially created surface water body, submerging in its reservoir a highly permeable land so that surface runoff is made to percolate and recharge the ground water storage. Percolation tank should be constructed preferably on second to third order streams, located on highly fractured and weathered rocks which have lateral continuity downstream. The recharged area downstream should have sufficient number of wells and cultivable land to benefit from the augmented ground water. The purpose of the percolation tanks is to recharge the ground water storage and hence seepage below the seat of the bed is permissible. For dam's up to 4.5 m height, cut off trenches are not necessary and keying and benching between the dam seat and the natural ground is sufficient.

B. Roof Top Rainwater Harvesting through Recharge Pit

Recharge pits are small pits of any shape rectangular, square or circular, constructed with brick or stone masonry wall with weep hole at regular intervals, to of pit can be covered with perforated covers. Bottom of pit should be filled with filter media.

C. Roof Top Rain Water Harvesting through Recharge Trench

Recharge trench as shown in figure 2 is provided where upper impervious layer of soil is shallow. It is trench excavated on the ground and refilled with porous media like pebbles, boulder or brickbats. It is usually made for harvesting the surface runoff. Bore wells can also be provided inside the trench as recharge shafts to enhance percolation. The length of the trench is decided as per the amount of runoff expected. This method is suitable for small houses, playgrounds, parks and roadside drains.

D. Roof Top Rain Water Harvesting through Existing Tubewells

In areas where the shallow aquifers have dried up and existing tubewells are tapping deeper aquifer, roof top rain water harvesting through existing tubewell can be adopted to recharge the deeper aquifers. PVC pipes of 10 cm diameter are connected to roof drains to collect rain water. The first roof runoff is let off through the bottom of drain pipe. After closing the bottom pipe, the rain water of subsequent rain showers is taken through a T to an online PVC filter. The filter may be provided before water enters the tube-well. The filter is 1-1.2 m in length and is made up of PVC pipe. Its diameter should vary depending on the area of roof, 15 cm if roof area is less than 150 sq. m and 20 cm if the roof area is more. The filter is provided with a reducer of 6.25 cm on both the sides. Filter is divided into three chambers by PVC screens so that filter material is not mixed up. The first chamber is filled up with gravel (6-10 mm), middle chamber with pebbles (12-20 mm) and last chamber with bigger pebbles (20-40 mm). If the roof area is more, a filter pit may be provided. Rain water from roofs is taken to collection/desilting chambers located on ground. These collection chambers are interconnected as well as connected to the filter pit through pipes having a slope of 1: 15. The filter pit may vary in shape and size depending upon available run off and are back-filled with graded material, boulder at the bottom, gravel in the middle and sand at the top with varying thickness (0.30-0.50 m) and may be separated by screen. The pit is divided into two chambers, filter material is one chamber and other chamber is kept empty on accommodate excess filtered water and to monitor the quality of filtrated water. A connecting pipe with recharge well is provided at the bottom of the pit for recharging of filtered water through well.

E. Recharging of bore wells:

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be seed for recharge. Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchment, intensity of rainfall and recharge rate as discussed in design parameters. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure first one or two shower should be flushed out through rain separator to avoid contamination. This is very important, and all care should be taken to ensure that this has been done.

F. Rain Water Harvesting through Dugwell Recharge:

Existing and abandoned dug wells may be utilized as recharge structure after cleaning and desilting the same. The recharge water is guided through a pipe from desilting chamber to the bottom of well or below the water level to avoid scouring of bottom and entrapment of air bubbles in the aquifer. Recharge water should be silt free and for removing the silt contents, the runoff water should pass either through a desilting chamber or filter chamber. Periodic chlorination should be done for controlling the bacteriological contaminations.

Rainwater from the rooftop is diverted to dug wells after passing it through filtration bed. Cleaning and desilting of dug well should be done regularly to enhance the recharge rate. The filtration method suggested for bore well recharging could be used.

IV. GROUNDWATER YIELD UTILIZATION

Ground water is the only source of water for various uses in the campus. There are 17 bore wells out of which 8 are very high yielding. The yield of the wells is ranging between 2000 to 150000 liters. The total quality of water stored in 1-year ranges from about 8-9 lakh liters.

Details of existing water sources due to rain water harvesting in Amravati University Campus was described in table no.1 and the quantity of water yield from various storages was described in table no. 2.

The total depth of bore well ranges from 44 m to 136 m while the diameter of bore wells ranges from 0.1 m to 6 m. the bore well near Zoology Building can supply water for up to 16 hours per day. The ground water is utilized in various building like hostel residential quarters, canteen and many more. The water is available in such a plenty that there is no need of purchasing the water from government.

A. Depth of water level

In the area the ground water is ranging between 5 to 10 m below the ground level. The water level in bore well was observed at 10m below the ground level. In bore well, water level was observed at 17m. below ground level in non-pumping state. The area is situated at lowest point according to gradient. If the gradient is considered as zero, the highest gradient available here is 18m.

University has incurred an amount (Grant) of Rs. 12 lakhs on the project of rain water harvesting are continuing the expenditure, University has also implementing surface rain water harvesting So they constructed Kolhapuri Bandhara, village tank, Percolation tank. The topography of university is such that they have made use of natural rain fall on surface of Ground. They also constructed swimming tank, water for swimming tank is taken from Bore Well. At Present University is Supplying water for Girls Hostel Building in Campus, boys hostel canteen Building, Rest House swimming Tank etc. University has no water supply from out-side source. They are using water collected by rain water harvesting.

V. CONCLUSION

In Sant Gadge Baba Amravati University, Amravati, Maharashtra rain water harvesting project is really very beneficial and fruitful. It fulfills all their demands on this water only. There is no any other supply than this ground water source.

By Roof-top and surface Rain water harvesting there are a lot of environmental benefit. Rain water harvesting is very important which helps to improve the quality of ground water, reduce the soil erosion and reduce the ground water pollution. It increases the ground water table. Rain water harvesting is an effective economical concept for recharge of ground water. The main objective of Roof Rain water harvesting is to make water available for future use. Capturing and storing rain water for use is particularly important in dry land, hilly and urban area.

Table: 1 Details of existing water sources in Amravati University Campus, Amravati

Sr. no	Open well/ Bore well code No	Location of open/Bore well	Diameter of Bore/open well (Average in meters)	Total Depth in meters	Water column available in march end in meters	Installed pumps in number with H. P	Average period of water supply in hours per day	Approximately Total supply of water in liters	Remarks
1	2	3	4	5	6	7	8	9	10
01	Open well No.1	Near Nursery in Sr. No 1	5.70	9.85	1.00	5 H.P-2Nos	3.00	40,000	
02	Well No 4	Near Administrative Building	4.30	7.80	0.80	3 H.P-1No	1.5	2,000	
03	Well No.5	Botanical garden	5.00	10.00	Nil	3 H.P-1 No	--	---	
04	Well No.6	Near Computer Building	5.50	9.00	1.00	3 H.P-1 No 5 H.P-1 No	3.00	50,000	
05	Well No.9	Orange garden	5.90	11.90	0.40	7.5 H. P	2.00	2,000	
06	Well No.12	Sport sector	2.70	4.00	0.50	5 H. P	½	---	
07	Well No.15	Near Boy's Hostel	3.30	9.30	0.80	5 H. P	½	5,000	
08	Well No.18	Botany Building	3.00	9.00	1.00	5 H. P	1	4,000	
09	Well No.19	Near Zoology Building	6.00	10.00	5.00	5 H.P-2 No1 H.P-1	1	80,000	
10	Well No.2	Confidential Building	3.00	8.00	1.00	---	14 2	---	
11	Well No.8	Near Orange garden	3.00	6.50	0.60	---	--	---	Not in use
12	Well No.20	Orange garden	5.00	15.00	6.00	5 H.P	--	1,50,000=00	
13	Bore well. No.2	Orange garden	100mm	60.00	---	5 H. P	1	10,000	Frequently
14	Bore well.	Orange		60.00		3 H. P	½		

	No.3	garden	--do--		---				
15	Bore well. No.4	Orange garden	--do--	65.00	---	3 H. P	1		
16	Bore well. No.5	Orange garden	--do--	60.00	---	---	--		
17	Bore well. No.6	Orange garden	--do--	60.00	---	5 H. P	½		
18	Bore well. No.12	Orange garden	--do--	60.00	---	5 H. P	½		
19	Bore well. No.7	Botanical Garden	150mm	68.00	---	5 H. P	3	15,000	
20	Bore well. No.8	Sport Sector	100mm	70.00	---	5 H. P	3	15,000	
21	Bore well. No.9	Near cycle stand (Applied Electronics)	100mm	70.00	---	5 H. P	3	15,000	
22	Bore well. No.11	Behind cycle stand	100mm	70.00	---	1.5 H. P	4	20,000	
23	Bore well. No.13	Near value's hostel	150mm	136.00	---	5 H. P	4	20,000	
24	Bore well. No.15	Near Boys hostel	100mm	71.60	---	1 H. P	4	5,000	
25	Bore well. No.16	Near V.C Bungalow	100mm	62.00	---	2 H. P	2	45,000	Not in Use
26	Bore well. No.17	Girl's Hostel	150mm	62.00	---	2 H. P	2	5,000	
27	Bore well. No.18	S.C Girls Hostel	150mm	134.00	---	---	---	---	Not in Use

Table No. 2 Types of Storage

Sr. No	Type of Storage	Capacity Approx.	Remark
01	Reservoir No. 1	2,38,500 Cu.	All these projects help to increase ground water level
02	Reservoir No. 2	83,000 Cu.	--do--
03	Bandhara No. 1	14.00 lakh liters	--do--
04	Bandhara No. 2	32.00 lakh liters	--do--
05	Bandhara No. 3	42.00 lakh liters	--do--
06	Field Tank 5 Nos.	10.00 lakh liters	--do--
07	Field Pits 6 Nos.	05.00 lakh liters	--do--



Information Board near central valuation centre



Bandhara



Information Board near main Building



Collected water in well

Some of the images of rain water harvesting project in Sant Gadge Baba Amravati University, Amravati, Maharashtra.

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