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Design of Roof top Rainwater Harvesting in Suggata Village – Bangalore North

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Abstract: Water is the most important resource on the earth, it requires for various activities in our day-to- day life At the rate in which India's populace is expanding. India will without a doubt supplant China from its main position of most thickly populated nation of the world. This will prompt high rate of utilization of most significant characteristic asset "Water" bringing about expansion of weights on the allowed freshwater assets and supply of it is decreasing at a rapidly safe on this planet. Keeping in mind the end goal to ration and take care of our day-to-day demand of water prerequisite, we have to think for elective savvy and moderately simpler mechanical strategies of conserving water. The technical aspect of this study is rainwater harvesting collected from rooftop which is considered to be catchment for Suggatta village. The study starts by collecting some important researches on rainwater harvesting and studied them. After proper field planning work conducted to Suggata for proper visualize the situation of village and to measure the dimension of roof catchment area. Then other required data are collected i.e. hydrological, rainfall and meteorological data. The collected water from different types of roofs is tested for physical, chemical as well as biological aspects. The volume of water will calculate for determining to provide combined water tank for the people of Suggata village. Water harvesting potential for the village will calculate, and on the basis of tank capacity with suitable design will be considered. The key factor of this study is the filter unit which will be design efficient and economical and feasible to implement in the village or anywhere.

Keywords: Rooftop harvesting, filter design, groundwater recharge.

I. INTRODUCTION

1.1 Present water scenario in Suggatta village

At present people in Suggatta village depends their water requirements through local water supply tankers to the tune of 50% involving huge expenditure and the remaining 50% is met through the ground water abstraction structures located in the village. This is due to not taking sustainable measures for recharge to groundwater in the village. Suggatta with an area of 50 acres is a perfect location to implement the rain water harvesting and artificial recharge to ground water through different conservation structures over a period of time.

Spare Water and Save Nation from Water Crisis and Saving Rainwater Saves Money", helps the Environment. The more water is utilized, the less the need to utilize chlorinated or other treated faucet water. The more we utilize water, the less that will go into storm sewers where it is blended with oil and other harmful buildups from boulevards, parking areas. With rooftop harvesting, most any surface — tiles, metal sheets, plastics, but not grass used will intercept the flow of rainwater. To provide a household with high-quality drinking water and year-round supply for gardens, livestock, and irrigation, etc. rainwater harvesting is a need of the hour.

Rooftop harvesting collecting/water reaping is the strategy through which rain water is caught from the roof top catchments and water is put away in tanks, wells and stores. Collected rain water can be put away in sub-surface ground water repository by receiving manufactured energize strategies to meet the family unit needs through capacity in tanks. Groundwater asset gets normally revived through permeation. Be that as it may, due to in separate improvement and fast urbanization, uncovered surface for soil has been decreased definitely with

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resultant diminishment in permeation of water, in this way draining ground water asset. Water reaping is the way towards expanding the normal filtration of water in to the underground development by some counterfeit strategies. "Cognizant gathering and capacity of water to take into account requests of water, for drinking, local reason and water system is named as Rainwater Harvesting."

Fig. 1: Showing the Mechanism of Rooftop Rainwater Harvesting.

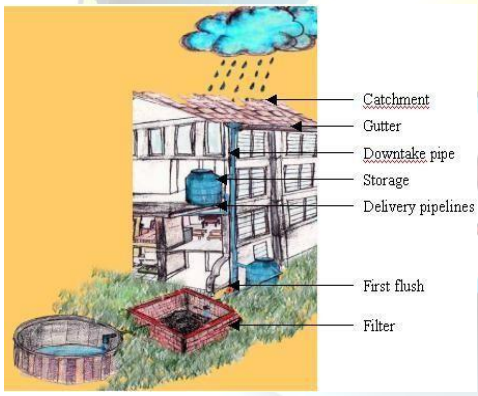

Fig. 2: Components of Rooftop Rainwater Harvesting.

1.2 Components of rooftop rainwater harvesting:

- Roof catchment
- Gutters
- Down pipe
- First flushing pipe
- Filter Unit
- Storage Tank

1.3 *Benefits of rainwater harvesting system*

After harvesting the rooftop water following benefits willgain:

- Rainwater is a relatively spotless and absolutely freewellspring of water.
- Rainwater is enhanced for landscape plants and gardens since it isn't chlorinated.
- It can supplement other sources of water supply such as groundwater or municipal water connections.
- It reduces the water supply cost.
- It can give a great move down wellspring of water for crises.
- It is socially adequate and naturally capable.
- It utilizations basic innovations that are economicaland simple to keep up.
- Reduced surge streams and topsoil misfortune.
- It is free; the only cost is for collection and use.
- It lessens the pollution of surface water with residue, composts and pesticides from water run-off outcome in cleaner lakes, waterways, seas and different recipients of tempest water.
- It is utilized as a part of those regions whichconfront lacking water assets.
- It can be utilized to energize groundwater.

1.4 *Need for rainwater harvesting*

In the todays condition the need for rain water harvesting and its need is explained below:

- As water is ending up rare, it is simply the need of the day to accomplish independence to satisfy the water needs.
- As urban water supply system is under colossal weight for providing water to consistently expanding populace.
- Groundwater is getting exhausted andcontaminated.
- Soil disintegration coming about because of theunchecked spillover.
- Health perils because of utilization of contaminatedwater

II LITERATURE REVIEW

Literature review related to the rainwater harvesting was carried out. The subjective research strategies were utilized to gather information on the utilization, task and support of water collecting systems. Kahinda

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et al. (2008) defined RWH as the collection, storage and use of rainwater for small-scale productive purposes. Crotchety (1991) defined it as the collection of runoffs for productive use. Oweis (2004) defined it as the concentration of rainwater through runoff into smaller target areas for beneficial use. Mati et al. (2006) defined RWH as the deliberate collection of rainwater from a surface known as catchment and its storage in physical structure or within the soil profile.

According to Krishnaveni et.al. (2016) Hydrologic design of rainwater harvesting system at Anna University, Chennai. This work is supportable system by planning a potential rain water reaping system in Anna university a basic spot of the city where a thousand populaces move in and out each day in the situation of the college water supply seems, by all accounts, to be in risk of occasional going away expanded water preservation will keep up a copious water supply later on. In this way computed the possible water to be harvest. Then dependable rainfall data was calculated. Then the demand calculations are done including net inflow and sump capacity, number of sumps. Also, they infer that this examination give valuable data to facilitate advancement of water reaping practice in Chennai and in addition for other parched and semi-dry areas of the world.[9]. According to Nawale et.al. (2015) the work carried out on rainwater harvesting systems in Pune city: The prime objective of this work was proper maintenance in will bring effective utilization of this system. For conditions of rainwater harvesting system, they interpret that it was evident that there was the existence of sources which would dilute the rainwater and what's more, in the meantime First flush redirection strategy which was of nearly significance to water gathering was not being used. For support of water reaping system, they decipher that it was obviously clear that water collecting system are in great condition as the rooftop, drains, channels are appropriately kept up. For Frequency of cleaning water collecting system, they decipher that cleaning ought to be accomplished more than once in a year. [3]. According to Patel et.al. (2014) the work carried out on Rooftop rainwater harvesting at SPSV Campus, Visanagar: Gujrat – A case Study. Their study majorly focuses on rooftop rainwater harvesting of the study area as Sankalchand Patel Sahakar Vidyadham (SPSV) Campus. The prime objectives of their work was to fulfill the scarcity of the water campus and then need to be use it for domestic and drinking water supply. In methodology they've determined some applications such as (1) what the captured water be used for (2) how much water can be captured (3) the collection Surface (4) Calculation of the volume of rainfall also (5) Rainfall data collection (6) Determination of catchment area (7) Hydrological analysis (8) Computation of volume of runoff per year. it was finally concluded that implementation of rainwater harvesting project to the campus of S.P.S.V. will be the best approach to fight with present scenario of water scarcity in all aspects, whether it is from financial point of view or from optimum utilization of land surface.[12]

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According to Pawar et.al. (2014) The work carried out on rooftop rainwater harvesting of Renavi village in Sangli district of western Maharashtra: Article presents that the success story of rooftop rainwater harvesting. The potential assessment of the village revealed that, approximately 20 days, lakh liters of water collected from rooftops, will satisfy the demand of a population of 1300 for at least 78 days. This estimation was as per the united nation standards. A total of Rs. 6, 04,000 was invested as contribution by Government agencies and villagers for the Funding of rainwater harvesting program based on rainfall data is collected. Coefficient of runoff for the area is computed. The houses with and without roof top rainwater harvesting structures was been estimated and lastly ground water quality assessment from the

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open well and bore wells was calculated. From this work concluded that the rain water harvesting measures helps in fulfilling the domestic water need as well improving the ground water level by few meters. On the other hand, in some states of India such as Andhra Pradesh, Madhya Pradesh, Gujarat and Rajasthan the level of fluoride in ground water was above the permissible limit [13]. According to Solanki et.al. (2015) The work carried out on rainwater harvesting in KJCOEMR at KJEI campus, Pune: In this research paper they have plot a planning of rainwater harvesting in K.J. Educational institute situated in Tal- Haveli, Pune district, Maharashtra. Authors calculated the coefficient of runoff as per the areas such as urban area, single family residence, cultivated areas and forest. Then the volume of runoff in K.J. campus was been calculated. A study was planned to design a percolation pit to harvest rain water and recharge ground water aquifers so as to improve or maintain the ground water quality of well located in K.J. campus receives torrential rains during monsoon season. Three underground tanks can be situated would be beneficial for the desired purpose as per schedule. And finally, it was concluded that implemented the rainwater harvesting project to the K.J. building in the KJEI campus to fight with present scenario of water scarcity in all aspects, from financial as well as optimum utilization of land Resource.[15].

III METHODOLOGY

Problem Statement

The main objective of this study is to develop roof top rain water harvesting system for direct use. It also improves the yield of the existing bore wells and water quality. The source for this development is the effective utilization of rain water falling on the roof tops otherwise it will be going as run off. Generally, the objectives of the roof top rain water harvesting structure is, To meet the ever-increasing demand for water, To reduce the runoff, To augment the ground water storage and control decline of water levels. To reduce ground water pollution. To improve the quality of ground water. To reduce the soil erosion. Involve civil engineering department for impact assessment of ground water.

Objectives

- To study the rainwater harvesting potential of Suggatta village.
- To understand the participatory approach of collective action of people in rooftop rainwater harvesting.
- To conserve, preserve and use rainwater.
- To identify suitable design in for harvesting system.
- To use most efficient and effective rooftop rainwater harvesting system at Suggatta village.
- To raise the underground water table by recharging the collected rooftop water.
- To study the design of water tank and filter unit.
- To augment ground water table and arrest ground water decline.
- To beneficiate water quality in aquifers

Table.1: Showing Climatological Parameters of the study area.

Month	Temperature		R.H %		Rainfall	PET	W.Speed
	Max.	Min.	830hrs	1730hrs	mm	mm	Kmph
Jan	26.7	15.0	77	40	3.3	117.4	10.4
Feb	29.7	16.5	67	29	10.2	130.0	9.7
Mar	32.3	19.0	63	24	6.1	166.2	9.4
Apr	33.4	21.2	70	34	45.7	158.2	9.0
May	32.7	21.1	75	46	116.5	156.5	11.8
Jun	28.9	19.7	82	62	80.1	126.5	17.1
Jul	27.2	19.2	86	68	116.6	115.7	17.5
Aug	27.3	19.2	86	66	147.1	114.2	15.2
Sep	27.6	18.9	85	62	142.7	108.2	12.1
Oct	27.5	18.9	83	64	184.9	105.1	8.2
Nov	26.3	17.2	78	59	54.3	98.3	8.5
Dec	25.7	15.3	78	51	16.2	102.9	9.6
Annual	28.8	18.4	77	50	923.7	1500.	11.5

Table. 2: Statistical Analysis of Rainfall Data for the study area.

Scope of the Study

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Month	Mean (mm)	Std. Dev. (mm)	Coeff. Var. (%)	Highest Rainfall		Lowest Rainfall		Rainfall as % of annual
				(mm)	Year	(mm)	Year	
Jan	1.2	3.9	333.1	18.6	1986	0	1971	0.13
Feb	7.4	16	216.2	57.9	2000	0	1972	0.78
Mar	13.4	25.5	189.7	101	1981	0	1972	1.42
Apr	37.3	31.8	85.3	96.8	1976	0	1994	3.94
May	102.4	44.6	43.6	200.6	1999	0	1994	10.82
Jun	92.1	64.9	70.4	226.5	1983	16	1981	9.73
Jul	106.3	60.5	56.9	246.3	1975	36	1997	11.24
Aug	138.8	79.4	57.2	383.8	1998	45	1984	14.67
Sep	224.3	111	49.5	516.6	1986	80.3	1994	23.71
Oct	153.4	80.2	52.3	325	1997	10	1988	16.21
Nov	51.6	51.1	99	181	1991	1	1996	5.45
Dec	17.9	23.1	129.2	82.1	1993	0	1974	1.89

- Observation of water level from the existing of dug wells and bore wells.
- Collection of water samples from select dug wells and bore wells and gets tested for its suitability for domestic use.
- Collection of data related water utilization.
- Collection of different hydro-geological information connected to groundwater storage such as historical water levels etc., surface geological data, hydro-chemical data, hydro meteorological data from state/central agencies, to evaluate the behaviors of ground water storage in past and use the interpreted trend to predict future status on account of developmental activity.
- Draw mitigation plan to protect the natural hydrological regime by implementing the conservation measures.

Study Area

The Suggatta village is located 1.5 kms west of Hunasamaranahalli on Bangalore-Hyderabad National Highway (NH-7). The institute encompasses 100 acres of land falling in Latitude N 13o 08' 30" – Longitude E 77o 36' 00" falling in Survey of India Topo sheet No. 57G/12. The study area is well connected with network of roads, railways and airport.

IV PHYSIOGRAPHY AND DRAINAGE

The study area forms as a part of southern plateau of Indian subcontinent. It is an undulatory terrain and at certain places it exhibits rocky ridges of granitic gneisses. The area is 906-915m above mean sea level and the major drainage in the areas is Vrishabavathi and Pinakini and ultimately joins river Arkavathy. The major part of the study area is covered by red soil. The maximum temperature is 38o C during March=April and it falls gradually to around 26o C during Dec-Jan. Various climatological parameters are shown in Table -1. The area remains humid throughout the year and the wind speed attains a maximum during southeast monsoon period ranging from 15 to 17 km per hour.

V LAND USE AND SOIL

The soils predominantly covering the area are laterite soils and laterite gravelly soils. The laterite soil is in the weathered form of laterite and is softer and easy to excavate. The data on infiltration tests conducted in parts of Bangalore North taluk show the final rate of infiltration varying from 3.60-5.40 cm/hr for the lateritic gravel soil. Major part of the area is covered by red soils.

VI RAINFALL

Rain fall is the primary source of ground water and other sources are seepage from surface water bodies. An attempt has been made to study rain fall, its distribution and periodicity based on statistical approach (Table 2). The monthly normal rain falls ranges from 0.8 mm in January to 187mm.

In September. The average annual rainfall is 946.1mm. Monthly and annual rainfall statistics, seasonal statistics for the Yelahanka Rain gauge station.

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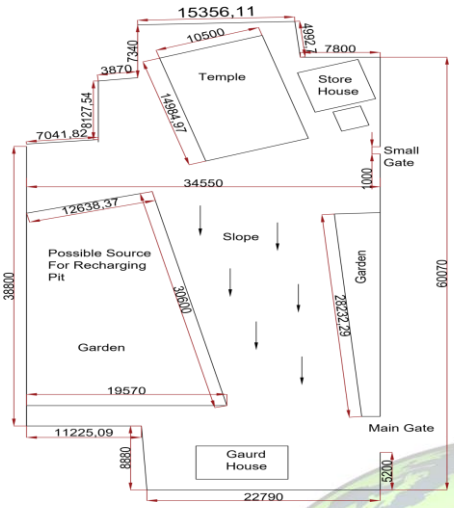

Fig.1: Showing Plan of Public Buildings selected for implementation of Rainwater Harvesting in Suggatta Village.

Rainfall Normal

Normal are essentially averages pertaining to a period of sufficiently long duration. In table 1 Statistical Analysis of Rainfall Data for the study area and in table-2 are given the monthly and annual Normal, highest & lowest rainfall and seasonal percentages.

Rainfall Analysis

The monthly normal rainfall ranges from 0.8mm in January to 187mm during September. The station annual average works out to 946.1mm. Field study was conducted for one week to collect basic information regarding the existing sources of water, number of borewells in operation to supply water and present population of the village. After collecting basic information four structures have been identified to adopt rooftop rainwater harvesting, in this four two are residential building and other two are public buildings (Primary school and Temple). One of the buildings rain water planning is suggested here (Fig. 3)

VII CONCLUSION

Suggatta village has got scope to develop well planned rainwater harvesting by implementing different conservation structures for direct use and indirect benefit. Due to rapid urbanization and over exploitation of ground water in North Bangalore in general and Suggatta village in particular, it is high time to plan for sustainable management of ground water development, failing which the present ground water structures in the village will become defunct and dry in course of time. Sustainable ground water development ensures both quantity and quality in the village. Implementing rainwater harvesting in the village will arrest decline of water levels and discharge of bore wells. The rainwater harvesting programmer is economically and financially beneficial to the village in a big way.

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