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Sustainable Drainage System in Urban Areas

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Abstract

Water is the gift of nature. Due to industrialization, urbanization and population explosion the requirement of water increases resulted in depletion of water resources. Now a day's water scarcity is a biggest issue throughout the globe. The country which has majority of water resources' will be the richest and most developed country in future. In this point of view two innovative techniques to improve ground water table in urban areas are discussed in this paper. One is modified percolation tank for individual house of the city and other is modified percolation manhole at storm drains within the city. As the cities are developed by constructing concrete roads and paving blocks the infiltration of rain water is restricted. Therefore, by using above mentioned innovative techniques the ground water recharge is possible without extra expenses and it will help to improve the ground water table in urban areas.

Introduction

If everything that exists has a life, then everything that exists needs water and temperature. Man can survive for five weeks without food but a maximum of five days without water. Worldwide 70% of water is used for agriculture on an average, 25% for industry and the remaining for domestic purposes (MuraliKrishna, 1998). Man, needs about 150-300 litres of water every day for domestic purposes, and 75% of the human body is water because of which only the specific gravity is about unity. Among them, groundwater is the primary source of drinking water in both urban and rural India. Besides, it is an important source of water for the agricultural and industrial sector.

Uncontrolled use of the bore well technology in cities has led to the extraction of groundwater of such a high rate that often recharge is not sufficient. The cause of low water availability in many regions is also directly linked to reducing forest cover and soil degradation. Groundwater is best described as the world's real hidden treasure. Groundwater is the earth's largest accessible store of freshwater and constitutes about 94% of all freshwater. The groundwater use in agriculture has increased exponentially, being the most critical factor that changed the lives of millions of farmers.

Although India has substantial groundwater resource availability, its scientific management is necessary, both in the short term and long-term perspective. Therefore, we need to improve the ground water table in urban areas.

So, in this project we will attempt to improve the ground water table in the urban area
with an innovative technique in which we will transfer the grey water and infiltrate it in the soil thus improving the ground water table.

Literature Review

In recent times, urban areas have seen significant development of concrete roads, which has resulted in rainfall runoff not being absorbed into the ground. Consequently, it is imperative to enhance this situation through innovative techniques.

Situations in Urban Areas:

According to the Ministry of Urban Development report (2011) on Household Amenities with respect to Drinking Water Sources and Latrine Facilities in Urban India so far only 72% urban population has water available in its premises while just 32% population receives treated potable water. The status of sanitation is even worse. 18.6% of urban households have no access to any sort of sanitation facilities in their houses. Open defecation is a common sight both in the rural and urban areas. Besides, 12.47 million (18.5%) households do not have a drainage network and 26.83 million (39.8%) households are connected to open drains. This makes the situation scary (Mihir Bholey,2016,25). Ghosh and Sugam (2013) in their report on Urban Water and Sanitation in India underscore that: "Water supply and sanitation utilities in India have suffered from poor design, poor operation and maintenance practices, lack of accountability, poor data and transparency, and inadequate investments. "It's basically the urban poor who bears the burden of unhygienic, inadequate water supply and poor sanitation services. Another impact is to be found on the depletion of groundwater table due to unregulated and unsustainable groundwater pumping. Poor maintenance of the supply line results in a huge amount of leakage and loss of water. (Mihir Bholey,2016,25).

Due to urbanization the development of urban areas is rapidly done in India. The bituminous roads are replaced by concrete roads including paving blocks. Therefore, the infiltration of rain water is prohibited at large scale. Thus, the runoff is discharged towards streams and rivers. Hence, there is an urgent need of infiltration of rain water in to the soil through other means.

Improvement of Groundwater Table:

Generally, much rainwater would go into the drain flowing from the roofs of houses and the street. Rainwater harvesting requires conserving the water and recharging the underground water, which helps when there is water scarcity. When there is an excessive amount of rain, we can collect all the water at the roof and via the piping system, it is transferred to underground water once filtering in order that it can be reused for household purposes. Also, we can send the rainwater flowing on the streets to underground water once the correct filter system is in order so that it might be utilised in the dry seasons. In a few places, the underground water level goes down to the most extent that wells, tube wells are dry in these places. There ought to be a provision of causing rain to travel underground to extend the underground water level in order that it brings water level of wells and tube wells back to traditional (M. Yuva raj,2020,489-490).

Needs of Improvement of Groundwater Table:

Limit the extraction of groundwater to prevent aquifers from being depleted compared to the rate at which they naturally replenish themselves. Encourage the practice of rainwater harvesting as it helps replenish water sources and decreases dependency on groundwater levels. Enhance farming methods by implementing water saving irrigation methods and exploring crop alternatives, with water needs. Protect the purity of groundwater by steering off any pollution that might result from chemicals being released into the ground or the leakage of waste or septic tank contents. Raise awareness about the importance of conserving water in daily activities. Construct recharge wells, recharge ponds, or artificial recharge structures to enhance groundwater replenishment.

Various existing techniques used to improve groundwater table:

1. Institute for Water Conservation, Jal Niketan, 5-Jha-2, Jawahar Nagar, Jaipur has designed the Soil Aquifer Treatment System for managing storm water on roads/paved area in industries and channelizing the same to ground water system in hygienic manner based on hydro informatics in terms of rainfall pattern, rainfall intensity and recharge capacity of sub-surface hydrogeological formations.

2.AICRP, ICAR-CRIDA, Hyderabad has designed the Artificial Well Recharging System For artificial recharge of open wells used for irrigation through runoff generated from farmer's field and roads, collected in trench and conveyed through PVC pipe to the recharge filter primary unit.

3.VNMKV, Parbhani, Maharashtra has designed the Sand and Gravel Filter for Artificial

Groundwater Recharge of tube well/open well through runoff from farmers field (Gaurav Singh Ashok kumar Singh ,2023 , 18-19). 4.Percolation tank is associated in nursing by artificial means created surface water body, submersion in its reservoir an extremely pervious land, in order that surface runoff is created to percolate and recharge the bottom water storage.

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5. Water harvesting" connotes collection and storage of rainwater and also other activities aimed at harvesting surface water and groundwater, prevention of losses through evaporation and seepage (M.Yuva raj,2020,492-495).

Methodology

Modified Infiltration tank:

This method involves the diversion of grey water from sources such as the bathroom, basins, sink, and washing machine through decided pipelines. These pipelines will connect to a separate infiltration tank. This infiltration tank will contain pores filled with filter media, allowing the grey water to pass through and be filtered by the aggregates before being absorbed into the soil. This process will contribute to the enhancement of the groundwater table. Additionally, we will install a pipeline from the main water tank situated at the top of the house to facilitate backwashing it and excess water can be used for gardening purpose.

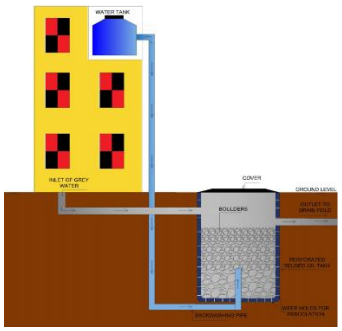

Figure 1: Modified Infiltration tank

Modified Percolation manhole

This method involves the creation of a tank that is filled with filter media, which is strategically placed beneath each manhole within the stormwater drainage system. As stormwater flows into the pipeline from the roads, it initially enters the manholes, where it is subsequently allowed to infiltrate into the soil via the tank. Any surplus water will proceed to the next manholes, where it will similarly infiltrate. Additionally, a screen will be provided at the top of the filter media so that if any organic matter travels with the flow of water, it should be settled on the screen. The screen then can be cleaned manually, this contributes to the enhancement of the groundwater table through the effective use of rainwater.

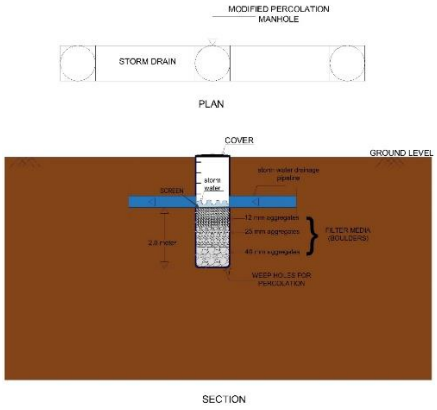

Figure 2: Modified percolation manhole

Conclusion

- The study reveals that the ground water table in urban areas can be improved by providing modified percolation tank at individual house. Where the grey water and rain water should be entered through pipe network which shall be infiltrate into the ground and helps to improve GWT in urban areas.
- On the other hand, the modified percolation manhole should be constructed in storm drains of the urban area by which the storm water should infiltrate in to the ground which helps to improve the GWT in urban areas.
- The people of the urban areas should be educated to construct modified percolation tank in their individual houses.
- The local urban bodies are advised to make it mandatory to all house owners of the city or town. Also, the modified percolation manhole should be mandatory while construction of storm sewers within the city.
- By adopting these techniques, the GWT should be increased and the scarcity of water should be reduced up to certain extent which gives the satisfaction of every citizen to save the water for future generation.

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