Vel Tech
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(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

Clean Water and Sanitation

WATER REUSE MEASUREMENT

Relevance and Significance of the Work done during the last Two Years

- Developed the sewage treatment plant for treating the wastewater generated from VelTech Institutions.
- Constructed various rainwater harvesting structures at various buildings of Vel TechInstitutions for collecting the rainwater.
- Suggested the techniques to store the treated wastewater for groundwater recharge.
- Suggested the methods to raise the crops using the treated wastewater.

The wastewater generated from the Vel Tech premises is treated with sewage treatment units to match the treated water quality with the BIS inland surface water discharge and Tamil Nadu Pollution Control Board standards.

The treated wastewater is stored in the two-percolation pond of capacity 13.5 Crore litre each. Part of the treated wastewater is used for gardening, and the remaining quantity of treated wastewater is stored in the percolation pond. The generated treated wastewater is not quantified in earlier stages; now, it is quantified as 19 lakh litre per day. Further, it is estimated that the treated wastewater of 7 lakh litre is used for gardening, 6 lakh litre is used for crop cultivation, and the remaining 6 lakh litre is stored in the percolation pond per day. As a result, there is a significant increase in the groundwater table by 1.29 m, 1.20 m, 1.35 m and 1.46 m, respectively, for winter, pre-monsoon, monsoon and post-monsoon season in the year 2022- 23 and the combinedincrease in groundwater table by 1.91 m, 1.79 m, 2.02 m and 2.18 m respectively for winter, pre-monsoon, monsoon and post-monsoon season in the year 2022- 23. The rainwater from the rooftop of each building is collected through the drainage channel and discharged on land, which is not quantified in an early stage. In a later stage, it is quantified as 2.5 lakh litre per annum. The collected rainwater is being sent through the soak pit arrangements for groundwater recharge, and thereby groundwater table level increases significantly along with treated wastewater by 1.35 and 1.46 m, respectively, for winter, pre-monsoon, monsoon and post-monsoon seasons in the year 2022-2023 and the combined increase in groundwater table along with treated wastewater by 2.02 and 2.18 m for winter, pre-monsoon, monsoon and post-monsoon season in the year 2022- 23.

Due to the utilization of 13 lakh litre of treated wastewater per day for gardening and cultivation of crops, the Vel Tech Institutions saved electrical energy to the extent of Rs. 1,125/- per day and Rs. 4,10,625/- per annum. Further, due to the utilization of 5 lakh litres of rainwater per annum through a rooftop rainwater harvesting system, Vel Tech Institutions saved electrical energy of Rs. 400/- per day.

According to the Tamil Nadu Groundwater (Development and Management) Act, 2003, the Vel Tech institutions have implemented three techniques viz.,

a. Wastewater treatment by sewage treatment units,

b. Groundwater recharge by percolation pond and

c. Rooftop rainwater harvesting techniques for groundwater recharge.

1. The wastewater generated from the Vel Tech premises is treated with sewage treatment units. The treated wastewater generated from Vel Tech premises is quantified as 15 lakh litre per day. The treated wastewater of 5 lakh litre is used for gardening, 6 lakh litre is used for crop cultivation, and the remaining lakh litre is stored in the percolation pond per day.
2. The rainwater from the rooftop of each building is collected through the drainage channel by rooftop water harvesting techniques, and it is quantified as 2.5 lakh litre per annum. Further, the collected rainwater is sent through soak pit arrangements for groundwater recharge.

1. **Creation of Irrigation Potential in the Last One Year**

The wastewater generated in the Vel Tech institutions is about 22 lakh litres daily, and the same is treated with the help of sewage treatment units in such a way that the treated water quality is matched with the BIS inland surface water discharge and Tamil Nadu Pollution Control Board standards. The treated wastewater is stored in the two percolation ponds with a capacity of 11 crore litre each. These two ponds are used to store treated wastewater for gardening and growing crops so that the daily bore well extractions of groundwater of approximately 8 lakh litre are reduced. The remaining

A quantity of 14 lakh litre of treated wastewater in the percolation pond is used for recharging the groundwater, which increases the groundwater level in and around Vel Tech premises.

The groundwater extraction is obtained by running 5 hp submersible motor pump. The electrical power consumption for drawing one lakh litre of water from one bore well is 12.5 units of electricity (5 hours running time). There are 9 such bore wells which supply water of 9 lakh litre per day and consume 112.5 units of electricity. The cost of one unit of electrical power consumption is Rs. 10/-; therefore, the cost of electrical power consumption for 130.5 units per day is Rs. 1305/- and annually Rs. 4,76,325/-.

Due to the utilization of rainwater for groundwater recharge, groundwater extraction from bore wells is reduced to 2.0 lakh litre per annum. The corresponding electrical power consumption for taking 2.0 lakh litre from the bore well is 25 units. The cost of electrical consumption of 25 units per annum is therefore Rs. 250/-.

Thus, annual savings in electricity by Vel Tech Institutions is to the extent of Rs.4,10,938/, which indirectly contributes to the growth of the National Economy by saving energy.

Creation of Groundwater Recharge Structure and

Upgradation of Groundwater Level

Water demand is increasing every year due to increased agriculture, population, industry, high standard of living and other purposes, and hence, all feel water scarcity. At present, human beings are compelled to conserve water. Water is a finite source. In the hydrosphere, a roughly constant amount of water is circulated at any given time. Since cyclic hydrologic turn over cannot be increased and solar energy being constant available supply of water is the same always. Hence, economic utilization of available water resources is a must. Under the economic utilization of water resources comes the topic of groundwater recharge.

According to the USGS, only 1.2% of the earth's freshwater is surface water. Around two-thirds of it is tied up in glaciers and ice caps, while groundwater accounts for the other 30%. But as more and more agricultural regions face aquifer depletion, businesses and communities will need to play a more active role in managing and conserving these important water resources.

Groundwater recharge is one important way this can happen. Recharge simply refers to the replenishing of groundwater resources. This process would regularly happen naturally through rain and snowmelt. It can also be artificially induced. The important calculus is that recharge has to happen at a greater rate than water is pumped out of the aquifer.

Groundwater accounts for up to 30% of freshwater resources, but some of the nation's most important aquifers are at risk. Groundwater recharge is a way to replenish those aquifers through better management of natural recharge zones or by developing artificial recharge projects like recharge pounds and injection wells.

These initiatives stand to benefit farmers, ag finance institutions, and municipal users by supporting a more sustainable water supply. More funding will be needed, however, to scale theinitiatives.

Definitions

Recharge: The addition of water to the zone of saturation expressed as rate (mm/yr) or volume (mm3/yr).

Recharge Area: Area in which water reaches the zone of saturation by surface infiltration. An area in which there are downward components of hydraulic head in an aquifer (water-bearing and yielding formation). Infiltration moves downward into deeper parts of a water-bearing formation in a recharge area.

In the case of the water table (unconfined) aquifers, usually the areas occupying higher elevations with deeper water tables constitute the recharge areas, while the topographic low with shallow water tables comprise the areas of discharge. Between the two extremes lie an intermediate transit zone characterised by recharge conditions during a part of the year and discharge conditions in others. In the case of confined aquifers, the recharge area is referred to as the in-take area and is restricted to an outcrop of the formation.

Recharge Basin: A basin or pit excavated to provide a means of allowing water to infiltrate at rates exceeding those that would naturally occur.

Zone of Saturation: A portion of the subsurface environment where all voids are ideally filled with water under pressure is more significant than the atmospheric.

Percolation: Downward movement of water through the unsaturated zone at hydraulic gradients of 1.0 or less than 1.0. The act of water seeping or filtering through the soil without a definite channel.

Artificial Recharge: Augmenting the natural infiltration of precipitation or surface water into underground permeable formations by some methods of construction, spreading water or artificially changing the natural conditions.

Contributing Areas: Recharge areas are those within which water enters an aquifer. However, water may enter a recharge area from adjacent and surrounding terrain. The entire area from which water is tributary to a recharge area is the contributing area.

Water Harvesting: Water harvesting refers to the collection and storage of natural precipitation and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage, and all other hydrological studies and engineering interventions aimed at conservation and efficient utilization of the limited water endowment of a Physiographic unit, such as water shed.

Natural Recharge

The main components of recharge are:

Infiltration and percolation of part of the total precipitation at the ground surface. The exact proportion actually reaching the water table depends largely on the rainfall intensity (I) and infiltration capacity (f p).

Seepage from streams and lakes: - Seepage from streams (influent seepage through the banks and the stream bed), lakes, and other water bodies is another important source of natural recharge. In humid and sub-humid areas where groundwater levels may be high, the influence of seepage may be limited in extent and may be seasonal. However, in arid regions where the entire flow of streams may be lost to an aquifer, seepage may be of major significance.

Underflow from another aquifer: - An aquifer may be recharged by underflow from a nearby, hydraulically connected aquifer. The amount of this recharge depends on the head differential, the connection's nature, and the aquifers' hydraulic properties.

Artificial Recharge

Aquifers will be artificially recharged to increase the natural supply of groundwater. Artificial recharge may be defined as augmenting the natural infiltration of precipitation or surface water into underground permeable formations by some methods of construction, spreading water or artificially changing the natural conditions.

Major objectives of an artificial recharge programme are:

- Storage of excess surface water in the groundwater reservoirs
- Improvement of groundwater quality by surface water mixing
- Purification and reclamation of sewage effluent
- Formation of pressure barriers to prevent seawater intrusion in coastal areas
- Increased agricultural production by dependable water supply
- Reduction in pumping lifts resulting in lower operation costs
- Prevention of land subsidence due to lowering of groundwater table

Advantages of Groundwater Recharge:

1. While recharging, rain and surface water infiltrate the soil, percolate through the various geological formations, and get naturally cleansed.
2. Very few specific tools are needed to dig drainage wells.
3. In rock formations with high structural integrity, additional materials may be required (concrete, soft stone or coral rock blocks, metal rods) to construct the wells.
4. Groundwater recharge stores water during the wet season for use in the dry season, whendemand is highest.
5. Recharge can significantly increase the sustainable yield of an aquifer.
6. Recharge methods are attractive, particularly in arid regions.
7. Most aquifer recharge systems are easy to operate.
8. In many river basins, control of surface water runoff to provide an aquifer recharge reducessedimentation problems.

9. Recharge with less saline surface waters or treated effluents improves the quality of salineaquifers, facilitating water use for agriculture and livestock.

Techniques of groundwater recharge

Two types of groundwater recharge are commonly used with reclaimed wastewater: surface spreading or percolation and direct aquifer injection.

Surface Spreading or Percolation

Groundwater recharge by surface spreading is the simplest, oldest, and most widely applied method of artificial recharge. In surface spreading, recharge waters, such as treated municipal wastewater, percolate from spreading basins of the unsaturated soil and ground (vadose) zone. Infiltration basins are the most common methods of recharging because they allow efficient use of space and require only simple maintenance. Infiltration rates are generallythe highest where soil and vegetation are undisturbed.

Direct Injection of a Groundwater Aquifer

Direct subsurface recharge is achieved when water is placed directly into an aquifer. Indirect injection, highly treated reclaimed water is pumped into the groundwater zone, usually into a well-confined aquifer. Groundwater recharges by direct injection are practiced in the following instances: (a) where groundwater is deep or where the topography or existing land use makes surface spreading impractical or too expensive, and (b) when a direct injection isparticularly effective in creating freshwater barriers in coastal aquifers against the intrusion of salt water.

Groundwater Recharge at Vel Tech Institutions

The wastewater collected from the Vel Tech Institutions and the Vel Tech Hostels is treated with sewage treatment plants. The wastewater is treated to the specification of inland surface water discharge standards mentioned by “BIS and the Tamil Nadu Pollution Control Board”. The treated wastewater is stored in the two percolation ponds for groundwaterrecharge. Sample location points are shown in Fig.1 and Fig.2, respectively.

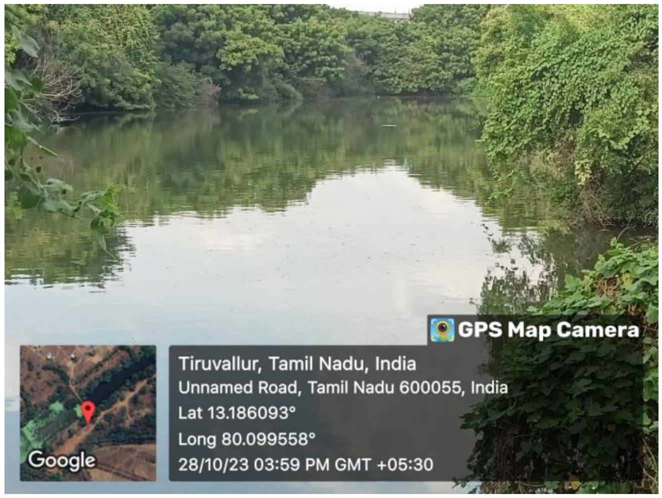

Figure1. Percolation Pond at B3 Hostel (one of the Gent's hostels)

Figure 2. Percolation Pond at the back of Vel Tech (owned by) RS Trust Engineering College

I. Percentage Reduction in the Gap between Irrigation Potential Created andIrrigation Potential Utilized

Initially, there were no structures to store rainwater and treated wastewater for developing irrigation potential. Later, rooftop rainwater harvesting structures, including soak pits and percolation ponds, were created to enhance the irrigation potential. The percentage utilisation of treated wastewater for gardening and irrigation is 50 % daily, and groundwater recharge is 50 % daily. The spilt-up of utilization is for gardening (4 lakh litres) and crop cultivation (5 lakh litres). There is a reduction in bore well extraction of groundwater, and the utilization of treated wastewater for gardening and crop cultivation, resulting in the percentage of the gap between irrigation potential created and irrigation potential utilized. Thus, Vel Tech Institutions are saving electrical energy to an extent of Rs. 1,125/- per day through the effective use of treated waste water and Rs.313/- per annum through rainwater harvesting, thereby contributing to Nation Building.