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Study on Artificial Ground Water Recharge Improvement Technique

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Abstract: Measuring the transformation of groundwater charging from the introduced renewable energy program is important to assess future water availability. Water scarcity is one of the major problems that still needs to be addressed and water scarcity is becoming a global problem. Water demand is growing as the population grows. Although 75% of the earth's surface is covered with water, only a small percentage of it is suitable for human consumption. Over-demand has put a strain on our water resources. In many areas groundwater, which makes up about 20 percent of our fresh water, is widely used for human, agricultural and industrial uses. In India, the problem of groundwater is most prevalent in areas with high agricultural economies, although it is higher in urban areas. Underground recycling methods can be used to supplement our water resources. Different methods, depending on the weather and location, can be used. In arid areas, for example, wetlands can also be used to manage water resources. In this paper, we have reviewed and summarized various studies to suggest various ways to recycle groundwater. There is a need for groundwater replenishment through methods such as water distribution, refilling wells, boreholes, wells and much more. The choice of a particular method is determined by geographical, geological and soil conditions; Non-renewable recharge as a means of strengthening the natural groundwater supply turns out to be much needed for groundwater management. The main purpose of this study was to identify and design residential accommodation facilities. Based on our study, it suggests that this method of disposing of wastewater in rural areas is effective and provides a high effect of re-charging the groundwater table. By using this method, the problem of unsanitary conditions near houses is prevented and mosquito production is avoided. Therefore, this type of disease arose because of poor hygiene and mosquitoes are avoided. This approach provides a healthy lifestyle for living people.

Keywords: Groundwater recharge, artificial recharge system, Recharge Pit

I. Introduction

Groundwater recycling is aquifer replenishment of surface water. It is usually expressed as the average annual water level, similar to rainfall. In addition to rainfall, other underground rechargeable sources are water flow in a pond or pond, recurrent irrigation flow (from both canals and fields), flow within the aquifer, and city recurrence. In contrast to re-ecology (caused by natural causes); automated re-use of water to automatically supplement the groundwater supply. In all aspects of groundwater resource testing, the recharge rate is one of the most difficult to obtain with confidence. Rendering rates are usually subject to considerable uncertainty as well as local and temporary variability. The growing demand for water has raised awareness about the use of artificial recharge to supplement groundwater. Simply put, artificial recharge is the process by which the surface water is directed to the ground - either by overflowing it, by using recycling sources, or by changing environmental conditions to increase penetration - to fill the aquifer. Refers to the flow of water through systems produced from the surface of the earth to underground aquifers where they can be stored for future use. Performance recharge (sometimes called scheduled re-charging) is a way to store groundwater during water surplus to meet demand in times of shortage.

Methods of Ground Water Recharge

There are various methods used to charge groundwater in urban and rural areas. In urban areas, rainwater harvesting from the roofs of buildings, in paved and unpaved areas is spilled. This water can be recycled in the aquifer and can be used productively when needed. The rainwater harvesting system needs to be designed in such a way that it does not occupy a large collection area and a recycling system. On the other hand, in rural areas, rainwater harvesting is considered by considering water areas as a unit. Groundwater distribution methods are common as the space for such systems is largely available and the amount of recycled water is large. The following water saving strategies may be used on slopes, rivers, streams, ridges, and mountains.

Methods Used In Urban Areas

Recharge Pit: In alluvial areas where precipitators are exposed to the surface or in shallower areas, rainwater harvesting can be done using recycling holes. This process is suitable for buildings with a roof area of 100 sq.m. These are designed to recharge the shallow aquifers. Recharge The holes can be of any shape and size. They are usually built 1 to 2 m. width and 2 to 3 m depth. The pits are filled with boulders (5-20 cm), stones (5-10mm) and coarse sand (1.5- 2mm) in a structured manner. Stones are low, stones in the middle of coarse sand at the top so that the mud that will come with the flowing water is placed on top of the coarse sand and can be easily removed. In a small roof area, the pit can be filled with broken bricks / stone blocks. There should be a net on the roof so that the leaves and any other solid debris do not get into the hole. A dismantling / collecting chamber can also be provided on the floor to prevent the flow of fine particles into the recycling hole. The top layer of sand should be cleaned periodically to maintain a high recharge rate. By-pass arrangement should be provided before the collection room to reject the first showers.

TUBE WELL: In areas where shallow shallow aquifer and existing tubing springs draw deep aquifer, rainwater harvesting from an existing tubing source can be taken to fill deep groundwater. 10 cm wide PVC pipes are attached to the roof drains to collect rainwater. The first roof flow is drained under the drainpipe. After closing the underground pipe, rainwater for subsequent rain showers is taken with a T to the online PVC filter. A filter can be provided before water enters the tubing wells. The filter is 1 –1.2 m. in length and made of PVC pipe. Its width should vary depending on the roof area, 15 cm if the roof area is less than 150 sq. M. M and 20 cm if the roof area is above. The filter is provided with a 6.25 cm reduction on both sides. The filter is divided into three chambers with PVC screens so that the filter material does not overlap. The first room is full of stone (6-10mm), the middle room with stone blocks (12-20 mm) and the last room with large stones (20-40 mm). If the roof area is above, a filter hole can be provided. Roof rain from the roof to the collection rooms is located on the ground. These collection chambers are connected and connected to the filter hole by a slope of 1:15 slope. The filter hole can vary in shape and size depending on the flow available, filled in the back with limited material, stone bottom, center stones and sand at various thicknesses (0.30-0.50 m), and can be separated. on screen. The well is divided into two chambers, filters in one room and one room is kept empty to accommodate excess water and to monitor the quality of the filtered water. A connecting pipe with a rechargeable spring is provided at the bottom of the well to re-filter the water filtered by the well.

RECHARGE TRENCH: Renewable trenches are suitable for buildings with a roof area of 200-300 sq. M. and where shallow branches are found in the depths. The trench can be 0.5 to 1 m wide, 1 to 1.5m. depth and 10 to 20 m. longer depending on the availability of water to be charged. These are filled with boulders (5-20cm), stones (5-10 mm) and coarse sand (1.5-2 mm) in an orderly fashion - low stones, stones in the middle of coarse sand to form mud. the contents that will come with the flow will be coarse sand on top of the sand layer and can be easily removed. A match should be provided on the roof so that leaves and any other debris / debris could be prevented from entering the trenches and a landing / collection room could also be provided on the floor to prevent the flow of fine particles into the trench. By-pass arrangement should be provided before the collection room to reject the first showers. The top layer of sand should be cleaned periodically to maintain a high recharge rate.

RECHARGE WELL: In areas where topsoil can be infiltrated and more roof water or runoff is available during a very short period of heavy rainfall, drainage is used to store water in the filter area and to re-charge it in groundwater. through specially designed recycling sources. This method is best suited for areas where the open horizon is less than 3m below ground level. The 100-300 wide rechargeable spring is located at a depth of at least 3 to 5 m below the water level. Based on local lithology, the fountain mix is designed with a sharp pipe against a shallow and deep aquifer. A 1.5 - 3m wide side ditch with a height of 10 to 30 m, depending on the availability of water is constructed from a central recharge source. The number of rerun sources in the canal can be determined based on the availability of water and the precise localization of the rocks. The trench is filled with boulders, rocks and coarse sand to act as a filter for refilling resources. If the aquifer is located at a depth of us more than 20 meters, a shallow hole 2 to 5 meters wide and 3-5 meters deep may be constructed depending on the availability of flow. Inside the shaft a fully researched 100-300 mm dia is constructed to re-insert the available water into the deep groundwater. Below the shaft, filter filters are provided to avoid overloading properly.

II. METHODS USED IN RURAL AREAS

GULLY PLUG: Gully Plugs are built using local stones, clay and trees in small ravines and streams running down slopes that carry water into canals during the rainy season. Gully Plugs help save soil and moisture. Gully plug sites can be selected whenever there is a local break to allow for sufficient water accumulation behind the belts.

CONTOUR BUND: Contour bunds are effective ways to conserve soil moisture in a wet environment for a long time. These are suitable for areas with low rainfall where the rainwater runoff can be blocked by building wetlands in a sloping area across the frame of equal height. Flowing water is captured before it reaches a variable speed by maintaining proper space between the belts. The space between the two contour bunds depends on the slope, area and accessibility of the soil. To reduce soil penetration, closing should be a separation of bonds. Contour bonding is suitable for areas with moderate slopes without the use of terracing.

GABION STRUCTURE: This is a type of test dam that is usually built in small streams to maintain the flow without being immersed in water beyond the course of the stream. A small crossing of a stream is made by inserting stones found in the area with steel cords and fixed to the river bank. The height of such structures is 0.5 m and is often used in streams with a diameter of less than 10 m. The extra water flowing into this reservoir will act as a source of recharge. The muddy river water at the right time is placed between the rocks. With the growth of the plants, the bund becomes less invasive and helps to keep the surface water flowing long enough after the rains to fill the groundwater.

PERCOLATION TANK: The Percolation tank is a source of artificial surface water, which dips into its reservoir, so that flowing water can flow and charge the groundwater reservoir. The piercing tank should be best constructed on second to third order sticks, which are found on very cracked rocks and in bad weather, with continuous downstream currents. The drainage area at the bottom of the stream should have a sufficient number of wells and cultivated soil to benefit from the expanded groundwater. The size of the percolation tank should control the percolation level of the strata in the tank bed. Usually percolation tanks are designed with a final volume of 0.1 to 0.5 MCM. It is necessary to design the tank to provide a water column of the pond usually between 3 & 4.5 m. Piercing tanks usually have clay dams with only a stone structure to spill. The purpose of the piercing tanks is to recharge the underground storage area and that is why the flow under the bed seat is permissible. For dams up to 4.5 m high, cut trenches are not required and a lock and bench placement between the dam seat and natural ground is sufficient.

CHECK DAM/ CEMENT PLUG/ NALA BUND: Test dams are built on small streams with a steep slope. The selected area should have a sufficient bed frame that is easily accessible or weatherproof to facilitate short-term storage of stored water. The water stored in these buildings is usually confined to the distribution channel and the height is usually less than two meters and additional water is allowed to flow into the wall. To avoid washing away from excessive water flow, water cushions are provided on the lower side of the river. In order to use the maximum flow rate in the stream, a series of such test pools can be constructed for re-charging at the district scale. Clay-filled concrete cement bags are also used effectively as a barrier to small nalas. In places, deep trenches are dug across the nala and asbestos sheets are laid on both sides. The space between the rows of asbestos sheets across the nala is filled with clay. Thus, a low-cost testing dam was built. On the upper side of the clay, packed concrete bags can be packed on a sloping surface to provide stability in the structure.

GROUND WATER DAMS/SUBSURFACE DYKE: An underground dam or underground dam is an underground obstacle that crosses a stream, which slows down the flow of the foundation and holds water upstream and downstream. In doing so, water levels in the upper part of the groundwater table rise and fill the dry part of the aquifer. The site where the sub-surface dyke is proposed should have a shallow waterproof layer and a wide valley and a narrow outlet area. After selecting a suitable site, a ditch 1-2 m wide is dug across the width of the stream and onto the inaccessible bed. The trench can be filled with clay or a brick / concrete wall of up to 0.5m. Below the lower level. To ensure water resistance, 3000 PSI PVC sheets with a strength of 400 to 600 gauge or polythene film with a low density of 200 gauges can also be used to cover the cut dyke surface. As water is stored inside the aquifer, ground immersion can be avoided and the area above the dam can be used even after the dam is built. No evaporation of the lake water and no immersion of the soil in the pond occurs. A catastrophic fall such as the collapse of dams can also be avoided.

DUGWELL RECHARGE: Existing and abandoned excavated wells may be used as a charging facility after similar cleaning and demolition. Charging water is directed through a pipe from the sink room to the bottom of the well or below the water level to avoid cleaning the floor and clogging the air bubbles in the aquifer. Rechargeable water should be free of silt and in order to remove mud, flowing water should pass through a leaky room or filter room. Periodic chlorination should be performed to control bacterial contamination.

RECHARGE SHAFT: This is a very effective and inexpensive way to recharge an unsealed aquifer covered with inaccessible strata. The shaft shaft may be dug manually if the strata is naturally non-bending. The width of the shaft is usually more than 2 m. The shaft should keep the system more accessible below the inaccessible strata. It may not touch the water table. The unloaded shelf should be filled in the back, first with stones / stones followed by stones and coarse sand. In the case of a loaded shaft, rechargeable water may be supplied through a small conductor pipe that reaches the top of the filter packet. These rechargeable structures are especially useful in valley lakes where a shallow clay layer prevents water from entering the aquifer. It seems that during the rainy season the tanks are full but the water from these tanks does not rot due to the mud and the source of the tubes and the wells dug nearby are still dry. The water from the lakes in the valley is evaporated and is not available for profitable use. By building a charging shaft in the thighs, the remaining water can be charged in the groundwater. Recharge shafts 0.5 to 3 m. width and 10 to 15 m. depth is constructed depending on the availability of quantum of water. The top of the shaft is kept above the level of the tank bed which is best at half the level of full supply. These are also filled with rocks, boulders and coarse sand. At an angle of 1 or 2 m deep, bricklaying work is done to stabilize the structure. In this way, more than 50% of the accumulated water in the district tank will be recycled into groundwater. Sufficient water will remain in the tank for home use after recharging.

III. Aim And Objectives Of Work

AIM: To study practical methods to improve groundwater recharge.

OBJECTIVES: The objectives of the study are as follows;

- Increase groundwater storage (long term & season).
- Improved water quality through purification.
- Controlling the effects of climate change.
- Maintain declining groundwater levels.
- This method allows re-charging of a nearby groundwater source.
- Local materials will be used to build the design economically.
- In order to apply the design, only a small area is required.
- The village has no water.
- The house is free of mosquitoes, which reduces the risk of various diseases.
- Creates a healthy environment.
- Non-environmental, controls soil erosion and flooding and provide adequate soil moisture even in summer.
- Groundwater charging stores water during the wet season for use during dry season when the need is very high.

IV. Application Of Proposed Project To Society

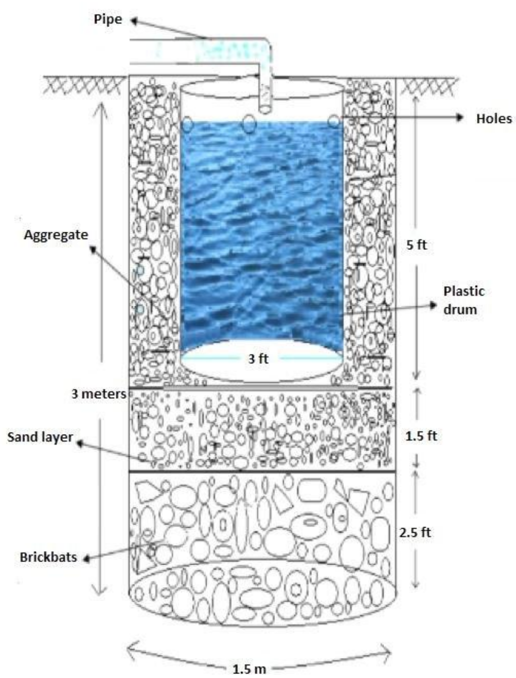
The application of the project is as follows;

- This method allows recharging the nearest groundwater source.
- Locally available materials will be used for the construction of design economically.
- For the installation of the design, a small area is only required.
- The village becomes drainage free.
- The village becomes mosquito-free which enables to lower the risk of various diseases.

- It creates healthy environmental surroundings.
- It is environment friendly, controls soil erosion and flood and provides sufficient soil moisture even during summer months.
- Groundwater recharge stores water during the wet season for use in the dry season when demand is the highest.
- The quality of the aquifer water can be improved by recharging with high-quality injected water.
- Recharge can significantly increase the sustainable yield of an aquifer.
- Recharge methods are environmentally attractive, particularly in arid regions.
- Most aquifer recharge systems are easy to operate.

V. Design Of Ground Water Recharge Pit

Based on a study conducted in the Hingna district, the low-cost recharge method was adopted as an effective and efficient underground recharge. A diagram of a low budget rehabilitation plan is shown in the form of a size designed in Figure 13. Charging pits were able to build in the back of each house in Hingna village. Rainwater is collected from the house and transferred to recycled boreholes to fill groundwater. The rehabilitation budget is 2000 rupees per immersion pit and built within two days with the help of two staff members.



Occasions of annual rainfall in Nagpur city that saw over 1,000 mm rains in last 12 years

Year	Annual (in mm)
2010	1,443.5
2011	999.2
2012	1,234.7
2013	1,666.5
2014	825.3
2015	1,282.3
2016	1,487.0
2017	1,094.7
2018	1,171.2
2019	1,279.7
2020	1,574.4
2021*	1,246.3

** The rainfall data is upto September 28. City may receive more rains in coming days.*

Fig. 1 Schematic diagram of the low budget recharge pit   Fig. 2 Annual rainfall data of Hingna, Nagpur (https://www.thehitavada.com/Encyc/2021/9/29/City-witnesses-trend-of-increasing-annual-rainfall-in-last-one-decade.html)

We have considered a building with a 100 m2 flat terrace. Rainfall in the Hingna valley of 2021 is found at 1246.3 mm shown in Table 1. Simply put, this means that if the terrace floor is deemed waterless, and all the rain that falls on it is stored without evaporation, then there will be rainwater terrace floor height 1246.3 mm.

Area of the terrace = 100 sq. m

Height of annual rainfall = 1.2463 m (1246.3mm)

Volume of rainfall over the plot = Area of plot X Height of rainfall

= 100sq.m X 1.2463 m

=125 cu.m (1,25,000 liters)

Assuming that only 50 percent of the total rainfall is effectively recharged, Volume of water = 62,500 liters

This study proposes a 1.5 m wide and 3.3 m trench depth and 3 feet of drum width equal to 1.2463 mm of rainfall per year (According to the Nagpur Rainfall 1 data table) in the 100-square-foot area. Then the digging is done by hand. Reusable plastic drum used to collect Rainwater, make 10 holes in the perimeter of the drum with 7 rows with a diameter of 14 mm each.

Next, fill the trench with the help of the brick and stone trade layers with mesh internet within a length of 2 mm, the thickness of each layer is 200 mm. Water is heavily filtered with the help of this method. Filling involves a depth of about 15 to 25 cm after the shape of the barrel, which was used to collect rainwater. Thereafter a height of 10 to 15 cm of sand layer is provided after mixing.

VI. ADVANTAGES OF ARTIFICIAL GROUND WATER RECHARGE:

Performed recharge has a few potential benefits;

- It does not have a negative impact on the community such as evictions, loss of rare agricultural land etc.
- Technology is relevant and often well understood by both professionals and the general public.
- Non-environmental, controls soil erosion and flooding and provides adequate soil moisture even in summer.
- Groundwater charging stores water during the wet season for use during the dry season when the need is very high.
- Groundwater level can be improved by recharging with high quality injectable water.
- Relocation can significantly increase sustainable aquifer yields.
- Recycling methods are environmentally friendly, especially in arid areas.
- Most aquifer recharge programs are easy to use.
- In many river valleys, controlling the flow of excess water to fill the aquifer reduces drowning problems.
- Technology is relevant and often well understood by both professionals and the public.
- Very few specialized tools are needed to dig the wells.
- For high-strength rock formations, a few additional materials may be needed (concrete, soft stones or coral rock blocks, steel rods, etc.) to form wells.
- Groundwater charging stores water during the wet season for use during the dry season, when the demand is very high.
- Groundwater level can be improved by recharging with high quality injectable water.
- Relocation can significantly increase sustainable aquifer yields.
- Recycling methods are environmentally friendly, especially in arid areas.
- Most aquifer recharge programs are easy to use.
- In many river valleys, controlling the flow of excess water to fill the aquifer reduces drowning problems.
- Recharging with more salty water or treated wastewater improves the quality of salt-water aquifers, facilitating agricultural water use.

VII. DISADVANTAGES OF ARTIFICIAL GROUND WATER RECHARGE:

Artificial recharge has several potential disadvantages;

- There are many problems related to the use of replacement techniques. These include inefficiencies related to factors such as recovery efficiency (e.g., not all additional water can be recovered), cost effectiveness, risk of contamination due to low-quality rechargeable injections, groundwater shut-off, and lack of information about the long-term effects of the recycling process. . Therefore, careful consideration should be given to selecting the appropriate re-charging location for a specific location.
- In the absence of financial benefits, regulations, or other guidelines to encourage landowners to manage their wells properly, resources can become corrupt and ultimately become sources of groundwater pollution.
- Possibility of groundwater pollution due to surface runoff is injected, especially in agricultural areas and roads. In most cases, the excess water flow was treated before the injection.
- Recharge can degrade an aquifer unless the quality control of injected water is sufficient.
- Unless a large volume of water is injected into an aquifer, groundwater filling may not be economically viable.

- Aquifer hydrogeology should be investigated and understood before any future recycling project can be started. In karst areas, diary-tracer studies can help in obtaining this information.
- During the construction of water traps, soil and vegetation disturbances can cause environmental damage to the project area.

VIII. RESULT

This study identifies the need for water in the Hingna valley and the installation of a cheap immersion system to rehabilitate groundwater worth about 2000 rupees, operating for about 10-15 years. It can recharge in each House approximately 62,500 liters per year.

IX. CONCLUSION

Based on our study, it suggests that this method of disposing of wastewater in rural areas is effective and provides a high effect of re-charging the groundwater table. By using this method, the problem of unsanitary conditions near houses is prevented and mosquito production is avoided. Therefore, this type of disease arose because of poor hygiene and mosquitoes are avoided. This approach provides a healthy lifestyle for living people.Appropriate measures should be taken to prevent saltwater infiltration into coastal groundwater. In such areas, special groundwater drainage rules should be applied to avoid over-pumping and the effect of lowering the groundwater table.The use of this technology requires knowledge of geological conditions; rock formation of moderate access is highly desirable, as low storage capacity and high accessibility do not allow for adequate storage of recharged water. The estimated cost of recycled water also limits its use in increasing domestic water, as it is not economically viable for irrigation purposes in India. There is a wide range of research on affordable ways to recycle water under low maintenance around the world. The participation of organs of state, farmers and communities is essential for the success of the program.

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