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Artificial Recharge and Rainwater Harvesting

Rain water harvesting plays a major role in augmenting the groundwater aquifers, which would cater to the needs of the future generations - by Kapil Gupta

One of the growing for the scientists and engineers worldwide, engaged in the development and management of groundwater resources, is to manage efficiently this depleting resource. The key to successful groundwater recharge and discharge processes. Under suitable conditions it is possible to supplement the natural recharge of an aquifer and so add to its safe yield capacity. This process is called artificial recharge. Precisely, artificial recharge is the process by which the groundwater reservoir is augmented at a rate exceeding that under natural conditions of replenishment. Any man-made scheme or facility with the objective to add water to an aquifer may be considered as an artificial recharge system.

Sustainability of drinking water sources has become one of the major issues of rural drinking water supply sector. In this endeavor, role of government sector is being shifted from actual implementing authority to that of a facilitator. Since rainwater harvesting and artificial recharge can play a major role in providing sustainability to drinking water sources, such activities can be taken up on a large scale by local communities as various kinds of rainwater harvesting structures through ages have been proved to be quite useful to the society constructed in different parts of the country worldwide.

Community Participation

People living in a settlement, share common interests, common resource and feel that they belong to a singular community. Communities, as also groups within a community, differ greatly in the extent to which they influence decisions that affect the use of common resources available and, therefore, the extent to which they are sharing the common resources.

The provision of water supply requires money, materials, labour and time. Most importantly, it requires people to build, operate, and maintain for continued use by the options available, the relative advantages and disadvantages of each option, are capable of making the choice, and finally own up the responsibility of maintaining the facility created.

Participatory approaches aim to achieve the following:

- Local support for programme including the involvement of local leadership
- Voluntary generation of ideas and intervention by community members
- Ownership of programme by community members

- Participation in decision making by disadvantaged groups in society, particularly women
- Community organizational structures for the management of intervention
- Removal of obstacles to collaboration
- Training of local animators

In the present context, community participation in rainwater harvesting projects is essential at least in the following areas:

At the planning process: The basic parameters can be explained to the community representatives, so that they understand the options available and can weigh the advantages and disadvantages of each option. Similarly, they must also decide between individual household facilities and community facilities.

At the implementation stage: Community can take charge of the material transportation to the site, and to the extent possible be involved in actual execution of the project. This will ensure a shared sense of ownership of the project.

Operation and maintenance: Routine operation and maintenance must be taken over by the communities themselves.

Sharing of harvested water: This is crucial, since this is an area which has the potential for serious conflict. Following agreed norms for abstraction and discipline by each and every member of the community is absolutely essential, and this is possible only if the community is involved.

Evaluation and modification of design: If the community members and its leaders have been involved at the above stages earlier, this step should be smooth and spontaneous. Once the benefits are realized, the community should develop the capability to reflect critically and improve upon the design.

Methods of Artificial Recharge

There are many reasons why water is deliberately placed into storage in groundwater reservoirs. A large number of artificial recharge schemes are designed to conserve water for future use. Other such projects recharge water for such objectives as control of saltwater intrusion, filtration of water, control of subsidence, disposal of wastes and for secondary recovery of crude from oil fields.

Artificial recharge methods can be further classified into two broad groups: direct methods and indirect methods. Direct methods can again be classified into surface spreading techniques and subsurface techniques. The most widely practiced methods of artificial recharge of groundwater employ different techniques of increasing the contact area and resident time of surface water with the soil so that maximum quantity of water can infiltrate and augment the groundwater storage. Under the surface spreading techniques various methods available are flooding, ditch and furrows, surface irrigation, stream modifications and finally the most accepted one and suitable for small community water supplies are runoff conservation structures. Under the subsurface techniques injection wells and gravity head recharge wells are common ones.

Indirect methods of artificial recharge adopts the technique of induced recharge by means of pumping wells, collector wells and infiltration galleries, aquifer

modifications and groundwater conservation structures, which require highly skilled manpower and other resources.

Direct methods

The following considerations become important before undertaking artificial recharge through surface spreading techniques.

- The aquifer to be recharge should be unconfined permeable and sufficiently thick to provide storage space
- Surface soil should be sufficiently permeable to maintain high infiltration rate
- Vadose zone should be permeable and free from clay lenses, which may cause perched water conditions
- Groundwater levels in the phreatic aquifer should be deep enough to accommodate the water table rise to avoid possible water logging condition
- The aquifer material should have moderate hydraulic conductivity so that the recharged water is retained for sufficiently long period in the aquifer and can be used at the time of need. Very high permeability results in the loss of recharged water due to subsurface outflow where as very low permeability may come in way of desired recharge rate.

Topography plays an important role in controlling the recharge rate. Areas with gently sloping land without gullies or ridges are most suited for surface water spreading techniques.

Rooftop Rainwater Harvesting

In rooftop rainwater harvesting, the rainwater is collected from roof of the buildings and stored in groundwater reservoir for beneficial use in future.

Advantages

- Provides self sufficiency to water supply
- Reduces the cost of pumping
- Reduces soil erosion in urban areas
- Less expensive and simple and can be adopted by individuals
- Utilizes the rainfall runoff
- Improves the quality of existing groundwater through dilution
- Removes bacteriological and other impurities from sewage and wastewater so that the water is suitable for re-use
- Rainwater may be harnessed at place of need and may be utilized at time of need
- In costal areas, it provides good quality water as well as helps in maintaining balance between the fresh saline water aquifers
- In islands, it provides the most preferred source of water for domestic use
- In desert, it provide relief to people

Design of recharge techniques abandoned Dug Well

- A dry/unused dug well can be used as a recharge structure
- The recharge water is guided through a pipe to the bottom of well or below the water level to avoid scouring of bottom and entrapment of air bubbles in the aquifer
- Before using the dug well as recharge structure, its bottom should be cleaned and all the fine deposits should be removed
- Recharge water should be silt free
- It should be cleaned regularly
- It is suitable for large building having the roof area more than 1,000 sq.m
- Periodic chlorination should be done for controlling the bacteriological contaminations.

Abandoned / Running Hand Pump

- An abandoned / running hand pump can be used for recharge
- The structures are suitable for the small building having the roof area upto 150 sq.m
- Water is diverted from rooftop to the hand pump through pipe of 50 to 100 mm. Diameter
- For running hand pump a closing valve is fitted in conveyance system near hand pump to avoid entry of air in suction pipe
- Recharge water should be silt free
- During recharging, the water extracted from hand pump should be utilized after proper chlorination

Recharge Pit

- Recharge pits are constructed for recharging the shallow aquifer
- The size varies as 1 to 2 m wide and 2 to 3 m deep
- After excavation, the pits are refilled with pebbles and boulders
- Water to be recharged should be silt free
- Cleaning of the pit should be done periodically
- It is suitable for small buildings having the rooftop area upto 100 sq.m
- Recharge pit may be of any shape i.e. circular, square or rectangular
- If the pit is of trapezoidal shape, the side slopes should be steep enough to avoid silt deposition

Recharge Trench

- It is constructed when permeable strata of adequate thickness is available at shallow depth
- It is a trench of shallow depth filled with pebbles and boulders
- These are constructed across the land slope
- The trench may be 0.5 to 1m wide, 1 to 1.5m deep and 10 to 20 m long depending upon the availability of land and rooftop area

- It is suitable for the buildings having the roof area of 200 to 300 sq.m
- Cleaning of trench should be done periodically

Gravity Head Recharge Well

- Borewells / tubewells can be used as recharge structure
- The technique is suitable where land availability is limited and when aquifer is deep and overlain by impermeable strata
- The rooftop rainwater is channeled to the well and recharges under gravity flow condition
- Recharge water should be silt free
- The well can also be used for pumping
- Most suitable for the areas where groundwater levels are deep
- The number of recharging structures can be determined in limited area around the buildings depending upon rooftop area and aquifer characteristics

Recharge shaft

- A recharge shaft is dug manually or drilled by the reverse / direct rotary method
- Diameter of recharge shaft varies from 0.5 to 3 m depending upon the availability of water to be recharged
- It is constructed where the shallow aquifer is located below clayey surface
- Recharge shaft is back filled with boulders, gravels and coarse sand
- It should end in more permeable strata
- Depth of recharge shaft varies from 10-15 m below ground level
- It should be cleaned regularly by scraping the top layer of sand and refilling it periodically

Conclusion

Rainwater harvesting plays an important role in not only managing the temporary crises faced by the humankind but also it augments the groundwater aquifers, which would cater to the needs of the future generations. Practicing rainwater harvesting at the community level has now become very essential for sustainable development.

About the Author

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