iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4215

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Artificial Recharge of Ground Water in Layered Soils

Maaz Allah khan[1], Mohd. Anas[2], Mohd. Saifullah[3], Mohd. Yaamin Siddiqui[4], Masooduzzaman[5]
[1, 2, 3, 4, 5]*Azad Institute of Engineering & Technology*

Abstract: Artificial recharge of ground water is achieved by putting surface water in basins , furrows where it infiltrates into the soil and moves downward to recharge aquifers. It is increasingly used for short or long term underground storage. Artificial recharge requires permeable surface soils. To design a system for artificial recharge of groundwater infiltration rates of soil must be determined and the unsaturated zone between land surface and aquifer must be checked for adequate permeability and absence of polluted areas. The aquifer should be sufficiently transmissive to avoid excessive building of ground water mounds. Knowledge of these conditions requires field investigations and if no fatal flaws are detected test basins to predict systems performance. Water quality issued must be evaluated especially with respect to formation of clogging layers on basin bottoms or other infiltration surfaces and to geochemical reactions in the aquifer. Clogging layers are managed by desilting or other pretreatment of water. Recharge wells should be pumped periodically to backwash clogging layers.

I. INTRODUCTION

Ground water recharge is the replenishment of an aquifer with water from land surface. It is usually expressed as an average rate of mm of water per year, similar to precipitation.in contrast to natural recharge artificial recharge is the use of water to replenish artificially the water supply in an aquifer. Estimates of recharge are normally subject to large uncertainities and spatial and temporal variability. artificial recharge is a way to store water underground in times of water surplus to meet demands in time of shortage. Artificial recharge is a process by which excess surface water is directed into the ground either by spreading on the surface, by using recharge wells or by altering natural conditions to increase infiltration to replenish an aquifer.

A. Why Artificial Recharge

Average annual water resouces in our river basins are estimated as 1869 billion cubic metres (BCM) of which utilizable resources are of the order of 1086 BCM. Out of this 690 BCM is available as surface water and the remaining 396 BCM as ground water. the source of all this water is rain or snow. the huge ground water storage of 396 BCM is the result of rain and snowmelt water percolating through various layers of soils and rocks. However, the amount of percolation varies greatly from region to region and within the same region from place to place depending upon the amount and pattern of rainfall , characterstics of soils and rocks , the nature of terrain and other climatic factors like temperature and humidity. As a result ,availability of water from sub surface storages varies considerably from place to place.

In most low rainfall areas of country the availability of utilizable surface water is so low that people have to depend largely on ground water for agriculture and domestic use. Excessive ground water pumping in these areas, especially in some of the 91drought prone districts in 13 states, has resulted in alarming lowering of ground water levels. The problem has been further compounded due to large scale urbanization and growth of megacities which has drastically reduced open lands for natural recharge. In hard rock areas there are large variations in ground water availability even from village to village. In order to improve the ground water situation it is necessary to artificially recharge the depleted ground water aquifers. the available techniques are easy, cost effective and sustainable in long term . many of these can be adopted by the individuals and village communities with locally available materials and manpower.

B. Advantages Of Artificial Recharge

1) No large storage structures needed to store water. Structures required are small and cost effective.
2) Enhance the dependable yield of wells and hand pumps.
3) Negligible losses as compared to losses in surface storages.
4) Improved water quality due to dilution of harmful chemical/salts.
5) No adverse effects like inundation of large surface areas and loss of crops.
6) No displacement of local pollution.

7) Reduction in cost energy for lifting water especially ehere rise in ground water level is substantial.

C. Identification Of Areas For Recharge

1) The first step in planning a recharge scheme is to demarcate the area of recharge. Such an area should, as far as possible be a micro watershed (2000-4000 ha) or a mini watershed (40-50 ha). However localized schemes can also be taken up for the benefit of a single village. In either case the demarcation of area should be based on the following broad criteria :
2) Where ground water levels are declining due to over exploitation.
3) Where substantial part of aquifer has already been desaturated i.e regeneration of water in wells and hand pumps is slow after some water has been drawn.
4) Where ground water quality is poor and there is no alternative source of water.

D. Sources Of Water For Recharge

Before undertaking a recharge scheme it is important to first assess the availability of adequate water for recharge. following are the main sources which need to be identified and assess for adequacy :

1) Precipitation (rainfall) over the demarcated area.
2) Large roof areas from where rainwater can be collected and diverted for recharge.
3) Canals from large reservoirs from which water can be made available for recharge.
4) Natutal streams from which surplus water can be diverted for recharge, without violating the rights of other users.

E. Infiltration Capacity Of Soil

It is an important factor that governs the rate of saturation of vadose zone and thereby the efficacy or or otherwise of a recharge scheme. Infiltration capacity of different soil types are done by field tests by state agricultural departments. This data together with maps showing infiltration rates is usually available in their departmental reports published periodically and are available with the district agriculture officer.

F. Aquifer Suitability

It directly depends upon storage coefficient ,availability of storage space and permeability. if permeability is very high it resulted in recharged water loss due to sub surface drainage whereas recharge rate is reduced by low permeability. To have a good recharge rate and to retain recharge water for sufficient period , moderate permeability is needed. the favourable places for recharge were older alluvium, buried channels, alluvial fans, dune sands . the rocks which are capable of allowing high intake of water were fractured , weathered. The rocks formed by lava flows usually have large local pockets, which can take recharge water are basaltic rocks.

II. QUALITY OF SOURCE WATER

A. Chemicals and salts

Problems which arise are mainly related to quality of raw waters available for recharge which requires treatment before being used in recharge installation.

Changes in soil structure and biological phenomena are also related to it. For source water and ground water the chemical and bacteriological analysis is essential.

B. Sediment load

The water used in recharge projects should be free from silt. Silt may be defined as content of undissolved solid matter neasured in mg/L, which do not exceeds 0.1m/hr.

III. METHODS OF ARTIFICIAL RECHARGE

A. Flooding

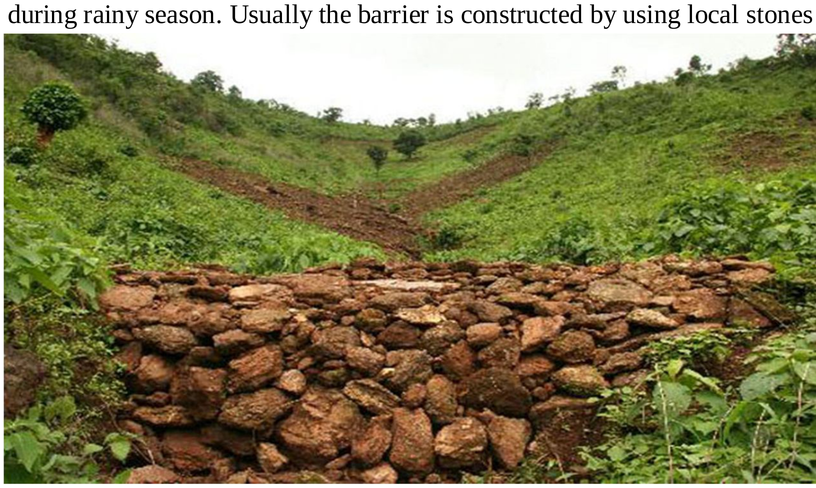
This technique is very useful in selected areas where a favourable hydrogeological situation exists for rechrging the unconfined aquifer by spreading the surplous surface water from canals over large area for sufficiently long period so that it recharges the ground water body. This technique can be used for gently sloping land with slope 1to 3.

B. Recharge basin

Artificial recharge basins are either excavated or enclosed by levees. They are commonly built parallel to ephemeral or intermittent stream channels. The water contact area in this method is quite high which typically ranges from 75 to 90 percent points of total recharge area. In this method efficient use of space is made.

C. Gully plugs

These are smallest runoff conservation structures built across small gullies and streams rushing down the hill slopes carrying drainage of tiny catchments during rainy season. Usually the barrier is constructed by using local stones and earth.

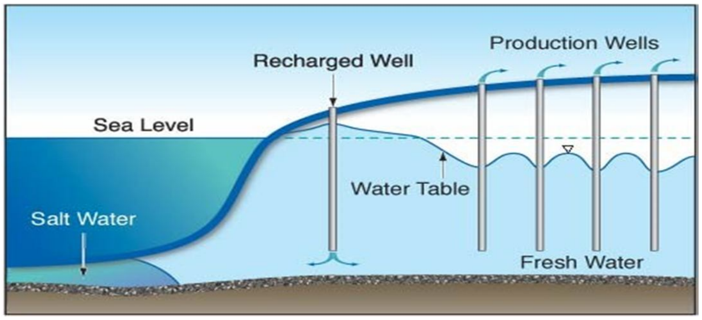


D. Bench terracing

It helps in soil conservation and holding runoff water on terraced area for longer duration giving rise to increased infiltration recharge.

1) Sub surface techniques

a) *Gravity head recharge wells:* Bore wells and dug wells used for pumping may also be alternatively used as recharge wells whenever source water becomes available . in certain situations such wells may also be constructed for effecting recharge by gravity inflow. In areas where water level are currently declining due to overdevelopment using available structures for inducing recharge may be immediately available economic option.



b) *Connector wells:* These are special type of recharge wells where due to difference in potentiometer head in different aquifers water can made to flow from one aquifer to other without any pumping . the aquifer horizons having higher heads start recharging aquifer having lower heads.

c) *Recharge pits:* Recharge pits are structures that overcome the difficulty of artificial recharge of phreatic aquifer from surface water sources. These are excavated of variable dimensions that are sufficiently deep to penetrate less permeable strata. A canal trench is a special case of recharge pit dug across a Canal bed . an ideal site for canal trench is influent stretch of a stream that shows up at dry patch. As in case of other water spreading methods the source of water used should be as silt free as possible. One variation of recharge pit is a contour trench extending over long distances across the slope.

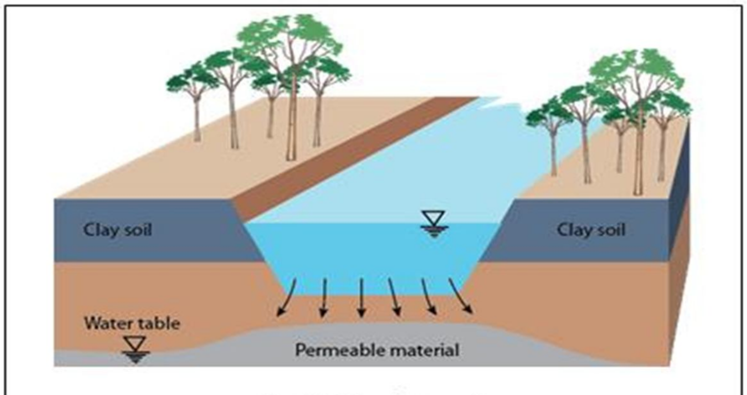


Fig. 29.5 Recharge pit

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

E. Dendritic Pattern

From the main canal the water is diverted to a series of small ditches spread in a dendritic pattern. the ditches are divided continuously until all the water is infiltrated in the ground.

F. Recharge Of Dug Wells & Hand Pumps

There are thousands of dug wells in alluvial areas which have gone dried or the water levels have declined considerably. these dug wells can be used as structures to recharge the ground water reservoir. To directly recharge the dried aquifer storm water, canal water can be diverted to these structures. With the help of this process losses due to soil moisture will be very less. Including silt content the quality of source water be such that it does not effect ground water qualtity. In urban and rural areas the rain water can be conserved with the help of rainwater harvesting system and can be used to recharge ground water.

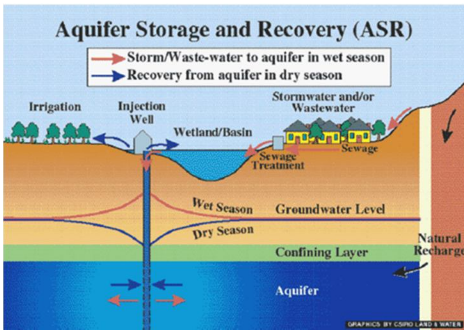
G. Artificial Recharge Through Injection Wells

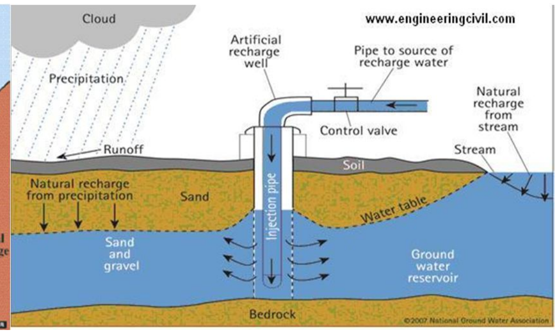
These are structures which are similar to tube wells, yet their purpose is to increase the ground water storage of a confined aquifer by pumping in treated surface water under pressure. At places where there is shortage of water this method is very helpful.

1) *Injection method:* By providing a conduit access water is led directly into depleted aquifers such as tube wells. For artificial recharge of confined aquifers recharge by injection is the only method with poorly permeable overburden. The chances of transit and evaporation losses is minimum and the recharge is instantaneous. It is highly efficient in case of highly fractured hard rocks and karstic limestone but very high permeability is not suitable. To prevent clogging of injection structures by bacterial growth it is ensured that water should be pure. It can also be used as a "Pressure Barrier Technique" to arrest saline water regression. It is always better to construct it closer to source to save cost of water conveyance. This technique was first used at temple town of Bhadrachallam in Andhra Pradesh during 1987 to provide safe drinking water. the effectiveness of induction of water in injection well is determined by:

a) Pumping rate
b) Permeability of aquifer
c) Distance from stream
d) Type of well
e) Natural ground water gradient

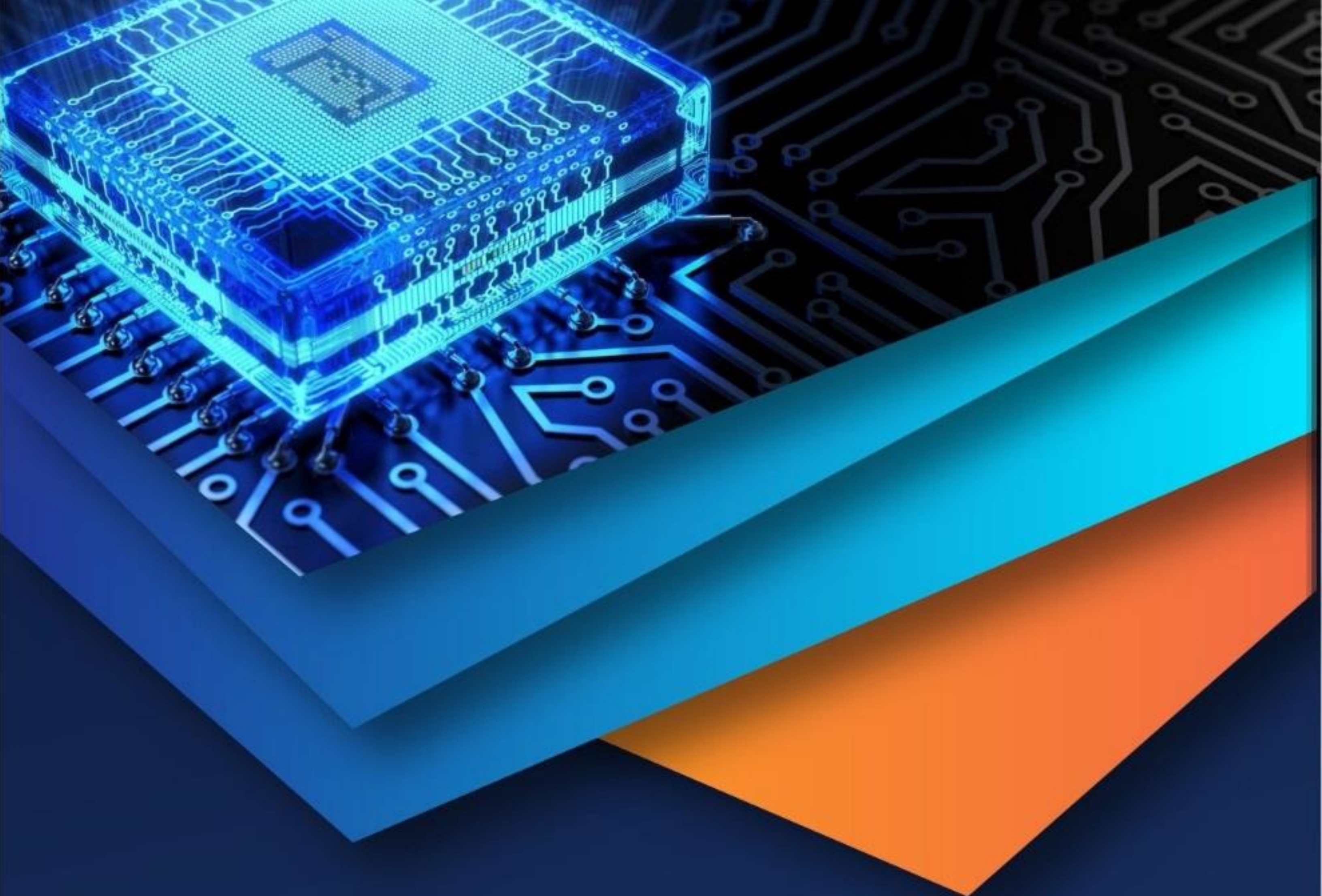
For recharging a single aquifer in alluvial areas injection well is provided. Proper operation and maintenance are necessary to project the recharge well from clogging.





REFRENCES

[1] Central ground water board ministry of water resources guide on artificial recharge to ground water
[2] A review on artificial recharge of ground water in india by Debu Mukherjee
[3] Revised guidelines with amendments for artificial recharge of ground water through dug wells. Sources MoWR letter No. 11/6/2007-GW
[4] Artificial ground water recharge chap9.pdf
[5] Nayantara nanda kumar and Niranjan ayagari 1997. artificial recharge of ground water
[6] Sophocleous M.A and J.A schloss estimated annual ground water recharge
[7] O'hare , M.P, Fairchild, D.M, hajali P.A canter L.W 1986. Artificial recharge of ground water. Proceedings of second international symposium on artificial recharge of ground water
[8] Philips, steven P. the role of satureated flow in artificial recharge projects, U.S geological Survey. Placer hall 6000J street, sacramento, California 95819-6129
[9] Rapiur districat Madhya Pradesh and their ground water recharge C.G.W.B,1992 work shop.
[10] Manual on artificial recharge of ground water 1994. Technical series – M, No.3, central ground water board, Faridabad, march 1994, 215p.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY