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RISKS AND IMPACTS OF MANAGED AQUIFER RECHARGE: A REVIEW

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Abstract—Managed aquifer recharge is the intentional recharge of water to suitable aquifers for subsequent recovery or to achieve environmental benefits. For any managed aquifer recharge projects the common problems identified are quality of the source water going to be recharged and clogging of the constructed structure during recharge process. This review paper explains about the major risks and impacts of Managed Aquifer Recharge.
Keywords— Aquifer; Groundwater; Risks of MAR, Impacts of MAR; MAR economics;

I. INTRODUCTION

For any managed aquifer recharge projects the common problems identified are quality of the source water going to be recharged and clogging of the constructed structure during recharge process. In order to avoid these difficulties greater care should be taken in these areas to eliminate human and environmental health problems.

1.1 Quality of the source water

Physical, chemical and bacteriological quality of the raw water that is available for the recharge should be analyzed substantially to ensure that the quality parameters lies within the permitted limit. Physical, chemical and bacteriological quality of the raw water that is available for the recharge should be analyzed substantially to ensure that the quality parameters lies within the permitted limit. According to [7] desired limits of different water quality parameters are shown below.

Parameter	Best results required
Suspended solids	< 1 mg/l
Phosphate	< 1 mg/l
Iron	< 0.5 mg/l
Turbidity	<0.3 turbidity units

Other physical quality parameters are like Electrical conductivity, pH and Total dissolved solids etc. should be in match with potable water quality.

1.2 Clogging of the recharge structure

In order to avoid clogging of the well and to ensure that silt free water is recharged into the aquifer, a filtering unit should be combined with constructed recharge structures. Efficient performance of the filtration unit is essential to get maximum benefits from the installed recharge structures.

1.2.1 Horizontal roughing filter

Horizontal filters have flow in horizontal direction. Unlimited filter length and simple layout are the main advantage of this unit. Flow regulating structures should be installed at the inlet and outlet sections to keep a desired water depth and flow along the filter and to establish an even flow distribution along and across the filter. Filter bed can be divided into three or four compartments and filter medium should be in series as starting with the coarsest to the finest materials, in the flow direction.

[2] developed a multimedia horizontal filter and tested it for pollutant removal efficiency. Gravel, sand and coconut fibre were selected as the media. The hydraulic efficiency of the filter showed a decreasing rate as the sediment level in inflow increased. The filter showed 100% sediment removal in lesser sediment concentrations in inflow water. The filter could remove NO3-, SO42− and total solids (TS) effectively. Removal percentages of Mg2+ and Na+ were also found to be good.

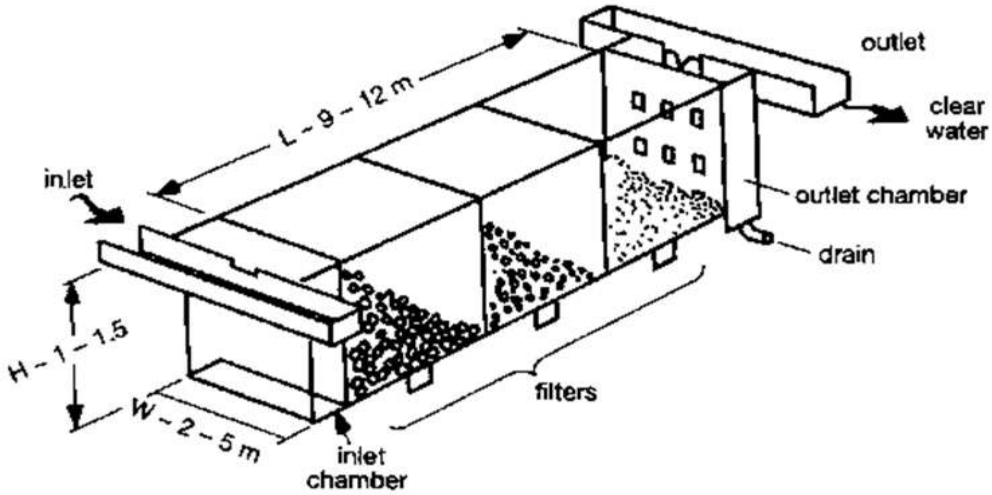

Fig 1: Horizontal roughing filter (Source: Internet)

1.2.2 Vertical roughing filter

In vertical filters, wastewater is applied to the surface of the filter and then drains vertically down through the filter media towards the bottom. The height of a vertical filter bed is limited to 1.0-2.0 m [3].

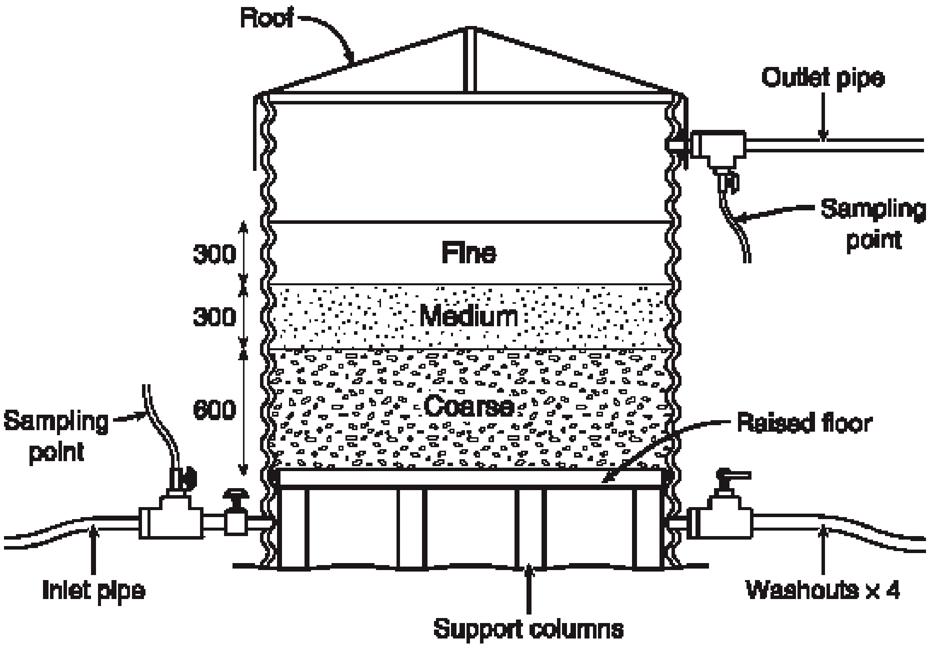

Fig 2: Vertical roughing filter (Source: Internet)

[5] evaluated the performance of two recharge filters having flow patterns in vertical and horizontal directions at CSSRI, Karnal. The results revealed that performance of recharge filter can be improved by arranging filter material horizontally but larger surface area will be required in horizontal filters as compared to vertical to obtain desired filtration rate.

1.3 Impact assessment of MAR

There is a need to classify the benefits of MAR with regards to the performance and impacts separately. The performance of MAR interventions influences impacts at, primary, secondary and tertiary level.

1.3.1 Primary Impacts: Primary objective of any MAR project is on the quantity of the groundwater expected to rise with improved quality. [6] Conducted a study during the period from 2004 to 2007, on the impact of managed aquifer recharge in through bore wells and percolation ponds. In 2007, ground water flow directions were analysed with Visual Modflow ver 4.1 environment, and the results showed that with improved recharge, groundwater flow direction has changed and water is available for all regions of the aquifer [6].

1.3.2 Secondary Impacts: The secondary impact of MAR generates from the effective use of additional groundwater available. It will improve drinking water supply, enhance agricultural production and also reduce energy consumption by avoiding lifting water. In Satlasana, Gujrat aquifer augmenting programmes were conducted under integrated watershed management programme along with the participation of the local bodies. During the impact assessment, they have observed the effect of recharge on agricultural production, yield, intensity of cultivation, changes in the crop calendar etc. compared to post recharge events.

Under the watershed management programme in MAR in Kowan Valley, Maharashtra, [1] in 2006 reported that there was a distinguishable difference in the crop calender, before and after establishment of the programme. There is an increase in supplementary Kharif irrigation and cultivation of more cash crops like sugarcane, potato and other vegetables were started in Rabi season.

Moreover, supplementary factors like quality of seeds, labour availability, climate, fertilizers and soil properties etc. also greatly influence the scale of the secondary benefits of MAR. In addition to the above stated impacts, increase in cropping area, rise in livestock carrying capacity, improved potable water quality, reduced energy use in pumping are also included in secondary impacts.

1.3.3 Tertiary Impacts: Indicators of tertiary impacts are improved level of social status of families and their increased income, rise in value of land holdings, improved education facilities etc. in the recharge zone [4].

1.4 Economic aspects

Failure in implementing MAR is generally caused by the absence of a clear economic analysis of the case before investing to construct and operate the systems. Economic feasibility can be assessed by using cost- benefit analysis (CBA). The value of water stored or treated by MAR systems can be evaluated by different measures of willingness to pay including market price, or alternative cost methods.

Specifically, cost-benefit analysis of MAR systems is site-specific. For attaining economic advantage with MAR system, the water should be used for high value purposes, such as drinking water supply and some industrial and irrigation water supplies.

In agricultural purposes MAR systems should have less cost and the value of water in irrigating crops depends upon the type of crop being grown. Also value of water depends upon the market prices of crops; it should be relatively low for cereal crops and more for high value crops like fruits and vegetables.

MAR systems should be financed by the primary project beneficiaries and maintenance and management should be done in a participatory manner. Like other water projects in general, MAR projects are also often subsidized when beneficiaries are unable to pay the full costs. Hence, for the developing countries.

REFERENCES

[1] Gale, I.N., Macdonald, D. M. J., Calow, R. C., Neumann, I., Moench, M., Kulkarni, H., Mudrakartha, S., and Palanisami, K, 2006. Managed Aquifer Recharge: an asessment of its role and effectiveness in watershed management. British Geological Survey Commissioned Report, 80p.

[2] Manoj, P.S., Senthilvel, S., Tamilmani, D., and Mathew, A.C. 2012. Performance evaluation and modeling studies of gravel-coire fibre-sand multimedia stormwater filter. j. Environ. Technol. 33 (17): 2057-2069.

[3] Patil, V.B., Kulkarni, G.S., and Kore, V.S. 2012. Performance of Horizontal Roughing Filters for Wastewater: A review. Res. J. Environ. Sci. 1 (2): 53-55.

[4] Prathapar,S., Dhar,S., Rao,G.T., and Maheswari,B. 2015. Performance and impacts of managed aquifer recharge interventions for agricultural water security: A framework for evaluation. Agric. Water Manag. 159:165-175.

[5] Satyendra, K., Kamra, S.K., Yadav, R.K., and Bhaskar, N. 2014. Effectiveness of Horizontal Filter for Artificial Ground Water Recharge Structure. j. Agric. Eng. 51 (3): 24-33.

[6] Sayana, V.B.M., Arunbabu, E., Kumar,L.M., Ravichandran,S., and Karunakaran,K. 2010. Groundwater responses to artificial recharge of rainwater in Chennai, India: a case study in an educational institution campus. Indian J. Sci. Technol. 3(2):124-130.

[7] Todd,D.K. 1980. Groundwater Hydrology (2nd Ed.). Wiley India (P.) Ltd, New Delhi, 476p.

