www.gondwanags.org.in
Research Article

ISSN : 2455-1953
JGSR
Journal of Geosciences Research
Vol. 10, No.2, July, 2025, pp. 139-150

Unravelling Artificial Groundwater Recharge Sites Using AHP and GIS Techniques in Kareepra Panchayath, Ithikkara River Basin, Kerala, India

Ajayakumar A.[1]*, Manju S. Nair[2], Rajesh Reghunath[1] and Dhanil Dev S.G[1]

[a]*Department of Geology, University of Kerala, Trivandrum - 695 581(KL), India*
[b]*Department of Economics, University of Kerala, Trivandrum -695 581(KL), India*
*(*Corresponding Author, E-mail: ajayakumargeology@gmail.com)*

Abstract

The study focuses on identifying optimal sites for artificial groundwater recharge in Kareepra Grama Panchayath, located in the northwest part of the Ithikkara River Basin, Kerala, India. Employing a combination of Analytic Hierarchy Process (AHP) and Geographic Information Systems (GIS), alongside Participatory Rural Appraisal (PRA) and Participatory Rural Mapping (PRM) methods, the study aims to address groundwater recharge needs. The research integrates various thematic layers-slope, relative relief, drainage density, land use, sand percentage, available space, geology, geomorphology, and lineament density-into a multi-criteria decision analysis. Results indicate that areas categorized as moderately stable and highly stable are most suitable for recharge activities. Validation with water yield data confirmed the accuracy of the site selection. The study also provides site-specific recommendations for different artificial recharge structures, including infiltration pits, percolation ponds, injection wells, and pond-cum-injection wells.

Keywords: Artificial Groundwater Recharge, Analytic Hierarchy Process (AHP), Geographic Information Systems (GIS), Kareepra Panchayath, Participatory Rural Appraisal (PRA), Groundwater Management

Introduction

Groundwater plays a vital role in sustaining ecosystems and supporting socio-economic development, particularly in regions like India, where it is a primary source of freshwater. With an estimated annual consumption of 230 cubic kilometres, India is among the largest consumers of groundwater globally (Fienen *et al.*, 2016). The natural recharge of groundwater resources is significantly influenced by climatic and geological factors, which, when combined with unsustainable extraction practices, have led to issues such as drought, declining river and well water levels, and changes in land cover (Levintal *et al.,* 2023). Despite these challenges, current groundwater management practices often overlook the contributions of local stakeholders, focusing predominantly on expert-driven approaches.

The inclusion of stakeholders in groundwater management is essential for developing comprehensive strategies that address both ecological and social dimensions. Enhanced recharge facilities can mitigate the depletion of groundwater resources, making it imperative to integrate scientific methodologies with local knowledge (Rahaman *et al.,* 2019). Decision support tools, including GIS-based analyses and scenario planning, have proven effective in optimizing water resource management by reducing uncertainty, increasing transparency, and incorporating stakeholder perspectives (Bekessy and Selinske, 2017).

The Kareepra Grama Panchayath within the Ithikkara River Basin in Kerala, India, presents a case where sustainable groundwater management is urgently needed. Monitoring of 111 observation wells over a year revealed that this region experiences significant seasonal fluctuations in the water table, with the deepest levels recorded in Kareepra. This study aims to identify suitable sites for artificial recharge within the panchayath using a hybrid approach that combines participatory mapping and GIS-based Analytic Hierarchy Process (AHP) techniques. By involving local stakeholders in the decision-making process, the research seeks to develop a sustainable, community-driven approach to groundwater management that can be replicated in similar contexts.

Artificial recharge has emerged as a crucial strategy for replenishing depleted groundwater reserves. Identifying suitable sites for recharge is critical to the success of these programs, ensuring that interventions lead to meaningful improvements in groundwater levels (Gururani *et al.,* 2023). This study contributes to the body of knowledge on groundwater management by offering a validated methodology for site selection, grounded in both scientific analysis and community participation.

Study Area

The study area, Kareepra Grama Panchayath is situated in the northwestern part of the Ithikkara River Basin, spanning the Kollam

(Received : 26 September 2024 ; Revised Form Accepted : 08 May 2025)
https://doi.org/10.56153/g19088-024-0226-76