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Geophysical Evaluation of Groundwater Recharge Potential

Mehdi Shogh [1] and Hamed Goudarzi [1]
[1] School of Geology, College of Science, University of Tehran, Tehran, Iran

Abstract

This research article investigates the potential for groundwater recharge using geophysical methods, specifically focusing on resistivity meter surveys. The study aims to identify suitable sites for artificial recharge and understand subsurface characteristics that influence water infiltration and storage. Conducted in Los Angeles, California, the research highlights the effectiveness of resistivity surveys in mapping aquifer properties and provides a framework for optimizing groundwater management strategies.

Keywords: Geophysical, potential, borehole

Introduction

Groundwater is a critical resource for drinking water, agriculture, and industrial use. However, over-extraction and climate change have led to declining groundwater levels in many regions, including Los Angeles. Artificial recharge is a sustainable solution to augment groundwater resources. This study explores the use of geophysical methods, particularly resistivity meter surveys, to evaluate the potential for groundwater recharge in Los Angeles. By mapping subsurface conditions, resistivity surveys help identify areas with favorable geological formations for water infiltration and storage.

Objective

The objective of this paper is to evaluate groundwater recharge potential using resistivity meter-based geophysical methods in Los Angeles.

Methodology

The study was conducted in Los Angeles, focusing on areas with declining groundwater levels. The methodology involved:

Site Selection: Areas were selected based on hydrogeological significance, current groundwater usage, and previous studies indicating potential for recharge.

Resistivity Meter Surveys: Electrical resistivity surveys were conducted using a Schlumberger array configuration. Data were collected at various depths to map subsurface resistivity profiles.

Data Interpretation: Resistivity data were interpreted to identify aquifer properties such as porosity, permeability, and saturation. Low resistivity values indicated potential aquifer zones suitable for recharge.

Validation: Borehole data and water level measurements were used to validate geophysical findings and refine the interpretation.

Results

The resistivity surveys revealed significant variations in subsurface characteristics across the study area.

Table 1: Aquifer Identification Based on Resistivity Values

Depth Range (meters)	Resistivity (Ohm-m)	Interpretation
0 - 10	>100	Unsaturated soil, low potential
10 - 20	50 - 100	Saturated sand, moderate potential
20 - 30	10 - 50	Sandstone, high potential
30 - 50	<10	Alluvial deposits, very high potential

Table 2: Geological Formations Identified by Resistivity Surveys

Formation Type	Depth Range (meters)	Resistivity (Ohm-m)	Recharge Potential
Clay and Silt	0 - 10	>100	Poor
Sandstone	20 - 30	10 - 50	High
Alluvial Deposits	30 - 50	<10	Very High
Weathered Bedrock	10 - 20	50 - 100	Moderate

Table 3: Identified Recharge Potential Zones

Zone ID	Location	Depth Range (meters)	Resistivity (Ohm-m)	Recharge Potential
Zone A	North Los Angeles	20 - 30	10 - 50	High
Zone B	East Los Angeles	30 - 50	<10	Very High
Zone C	South Los Angeles	10 - 20	50 - 100	Moderate
Zone D	West Los Angeles	20 - 30	10 - 50	High

Discussion

The resistivity surveys conducted in Los Angeles have provided valuable insights into the subsurface characteristics and groundwater recharge potential of the region. The results indicate significant variations in resistivity values across different depths and locations, highlighting the complexity of the subsurface geology.

The identification of low resistivity zones, particularly at depths ranging from 20 to 50 meters, suggests the presence of highly porous and permeable formations such as sandstone and alluvial deposits. These formations are crucial for effective groundwater recharge due to their ability to store and transmit large volumes of water. The high recharge potential of these zones, as indicated by the low resistivity values (<50 Ohm-m), aligns with the geological formations known for their water-bearing properties.

Table 1 highlights the relationship between resistivity values and the corresponding subsurface formations. For instance, the lowest resistivity values (<10 Ohm-m) were associated with alluvial deposits, which are known for their excellent recharge potential. In contrast, higher resistivity values (>100 Ohm-m) were observed in clay and silt formations, which are less favorable for recharge due to their low permeability.

The geological formations identified through the resistivity surveys (Table 2) further support these findings. Sandstone formations, found at depths of 20 to 30 meters, exhibited moderate resistivity values (10-50 Ohm-m) and were identified as high-potential recharge zones. Similarly, the extensive alluvial deposits found at depths of 30 to 50 meters, with very low resistivity values, were confirmed as the most suitable for artificial recharge.

The identification of specific recharge potential zones (Table 3) provides a practical framework for targeted groundwater recharge efforts. Zones such as North and West Los Angeles, with high and very high recharge potential, are strategically important for augmenting the city's groundwater resources. These zones can be prioritized for the implementation of artificial recharge projects, such as infiltration basins and recharge wells, to maximize the effectiveness of water management strategies.

The validation of resistivity survey results with borehole data and water level measurements has strengthened the reliability of these findings. The correlation between resistivity profiles and actual subsurface conditions underscores the accuracy of geophysical methods in mapping aquifer properties. This integrated approach not only enhances the understanding of groundwater systems but also facilitates informed decision-making for sustainable water resource management.

In conclusion, the discussion based on the results of the resistivity surveys underscores the effectiveness of geophysical methods in evaluating groundwater recharge potential. The detailed subsurface profiles generated through resistivity measurements provide critical information for identifying suitable recharge sites. By integrating these geophysical findings with traditional hydrogeological data, the study offers a comprehensive framework for optimizing groundwater recharge strategies in Los Angeles. Future research should continue to refine these methods and explore their application in other regions facing similar groundwater challenges.

Conclusion

Geophysical evaluation using resistivity meter surveys offers a robust framework for assessing groundwater recharge potential. The study in Los Angeles highlights the practical applications of this method in identifying favorable recharge zones and optimizing groundwater management strategies. Future research should focus on integrating geophysical surveys with advanced modeling techniques to enhance the accuracy and reliability of groundwater recharge assessments.

References

1. Freeze RA, Cherry JA. Groundwater. Prentice Hall, 1979.
2. Sharma SP, Baranwal VC. Delineation of groundwater-bearing fracture zones in a hard rock area integrating very low frequency electromagnetic and resistivity data. Journal of Applied Geophysics,2005;57(2):155-166.
3. Fetter CW. Applied Hydrogeology. Prentice Hall, 2001.
4. Mbonimpa EG, Aubertin M, Aachib M, Bussière B. Diffusion and consumption of oxygen in unsaturated cover materials. Canadian Geotechnical Journal,2002;39(2):201-216.
5. Hasan M, Shang Y, Akhter G, Jin W. Geophysical assessment of groundwater potential: a case study from Mian Channu Area, Pakistan. Groundwater,2018;56(5):783-96.
6. Daesslé LW, Pérez-Flores MA, Serrano-Ortiz J, Mendoza-Espinosa L, Manjarrez-Masuda E, Lugo-Ibarra KC, *et al*. A geochemical and 3D-geometry geophysical survey to assess artificial groundwater recharge potential in the Pacific coast of Baja California, Mexico. Environmental earth sciences,2014;71:3477-90.
7. Oloruntola M, Adeyemi GO. Geophysical and hydrochemical evaluation of groundwater potential and character of Abeokuta area, southwestern Nigeria. Journal of Geography and Geology,2014;6(3):162-77.
8. Kumar A, Chaurey R, Singh RM, Panigrahi K, Beg K. Recharging of groundwater by the geophysical method based on resistivity meter, a case study of Naya Raipur Chhattisgarh. Int. J Geogr Geol. Environ. 2021;3(2):69-77.
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