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Rainwater Harvesting Site Assessment Using Geospatial Technologies in a Semi-Arid Region: Toward Water Sustainability

Ban AL- Hasani [1,*], Mawada Abdellatif [1,*], Iacopo Carnacina [1], Clare Harris [1], Bashar F. Maaroof [2] and Salah L. Zubaidi [3,4]

[1] Department of Civil Engineering and Built Environment, Faculty of Engineering Technology, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF, UK; i.carnacina@ljmu.ac.uk (I.C.); c.b.harris@ljmu.ac.uk (C.H.)
[2] Department of Geography, Faculty of Basic Education, University of Babylon, Al Hilla 51002, Iraq; basharma@uobabylon.edu.iq
[3] Department of Civil Engineering, College of Engineering, University of Warith AL-Anbiyaa, Karbala 56001, Iraq; salahlafta@uowasit.edu.iq
[4] Department of Civil Engineering, Wasit University, Wasit 52001, Iraq
* Correspondence: b.h.alhasani@ljmu.ac.uk (B.A.H.); m.e.abdellatif@ljmu.ac.uk (M.A.)

Abstract

Rainwater harvesting for sustainable agriculture (RWHSA) offers a viable and eco-friendly strategy to alleviate water scarcity in semi-arid regions, particularly for agricultural use. This study aims to identify optimal sites for implementing RWH systems in northern Iraq to enhance water availability and promote sustainable farming practices. An integrated geospatial approach was adopted, combining Remote Sensing (RS), Geographic Information Systems (GIS), and Multi-Criteria Decision Analysis (MCDA). Key thematic layers, including soil type, land use/land cover, slope, and drainage density were processed in a GIS environment to model runoff potential. The Soil Conservation Service Curve Number (*SCS-CN*) method was used to estimate surface runoff. Criteria were weighted using the Analytical Hierarchy Process (AHP), enabling a structured and consistent evaluation of site suitability. The resulting suitability map classifies the region into four categories: very high suitability (10.2%), high (26.6%), moderate (40.4%), and low (22.8%). The integration of RS, GIS, AHP, and MCDA proved effective for strategic RWH site selection, supporting cost-efficient, sustainable, and data-driven agricultural planning in water-stressed environments.

Keywords: rainwater harvesting; multi-criteria decision analysis; suitable sites; semi-arid regions; sustainable agriculture

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1. Introduction

Although irrigation supports only around 20% of the world's cultivated land, it is responsible for producing nearly 40% of global food output [1]. This highlights its critical role in global food security. However, mounting challenges such as rapid population growth, urban expansion, and climate change are placing increased pressure on already scarce water resources, especially in arid and semi-arid regions (ASARs). These areas frequently suffer from chronic water scarcity and inefficient water resource management [2].