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Optimization of Rainwater Harvesting Sites Selection Using Geospatial Technologies: A Case Study of Ewaso Ng'iro South River Basin, Kenya

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Abstract

Water scarcity poses a critical challenge to socio-economic development and ecosystem services in the East African region, with recent years witnessing severe droughts. In particular Ewaso Ng'iro South River Basin, in the southwest of Kenya has been severely influenced with pastoralists and small holder's farmers being the hardest hit. To address the pressing issue of water scarcity in this region, the study employed a Geographical Information System (GIS)based approach with coupled remote sensing to identify the optimal sites for rainwater harvesting in 2023. The study aimed to establish appropriate criteria for selecting site locations and subsequently utilize these criteria to map potential sites. In the study the site selection criteria integrated both physical and socio-economic variables. Ten variables were identified: Precipitation, land use, soil texture, potential runoff depth, slope, topographic wetness index, Lineament density, drainage density, and considerations for distance from road and town constraints. Potential runoff depth which was an intermediate input was calculated using the Soil Conservation Service Curve Number (SCS-CN) model. A multi-criteria decision-making approach, Analytical Hierarchy Process (AHP) was used to identify viable rainwater harvesting (RWH) sites. Weighted overlay analysis was then used in scaling sites that are potentially suitable for rainwater harvesting. Based on the hydrological and geomorphological standards of the study area, suitable sites for harvest areas were identified and it was divided into five classes in terms of their suitability for water harvesting, namely very low, low, suitable, moderate, and highly suitable for water harvesting. The results indicate five suitability

classes: highly suitable, Suitable, moderately suitable, less suitable and very low suitability. The results indicated that in 2023, 4.30% of the area was highly suitable, 30.12% suitable areas, 25.84% moderately suitable areas, 18.64% less suitable areas and 21.1%very low suitable areas. There results indicate it is possible to harvest and store rainwater in the study area to meet increasing water demand. It can be concluded that the findings of this research can be used to assist in water resources management as an efficient planning tool to ensure sustainable development of the water in Ewaso Ng'iro South river subbasin an area which suffers from water shortages.

Keywords: Rainwater harvesting, Analytical Hierarchy Process, Soil Conservation Service Curve Number, Weighted Overlay