

Identification and Assessment of Suitable Sites for Solar Farm development using GIS Based Multi Criteria Analysis in Somali Region, Ethiopia: A decision support approach

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ABSTRACT

As the world transitions from nonrenewable to renewable energy sources, the emphasis on sustainable energy solutions becomes increasingly critical to address environmental and climatic challenges. Ethiopia, endowed with significant potential in hydro, solar, wind, and geothermal energy, presents a unique opportunity for renewable energy development. This study aims to assess suitable sites for solar farm development in the Somali Region of Ethiopia, leveraging GIS-based Multi-Criteria Analysis (MCA). The findings reveal substantial solar energy potential in the region, with annual solar irradiance values ranging from approximately 1.772 kWh/m² to 2.476 kWh/m². Despite this abundance, much of the potential remains untapped. Recently, the Ethiopian government's ten-year strategic plan has shifted focus towards investing in renewable energy, particularly solar power. To effectively harness this resource, it is crucial

to identify and select optimal sites for solar power plants or mini-grids. The study employs the Analytical Hierarchy Process (AHP) within a GIS framework to evaluate various factors relevant to site suitability, including solar energy potential, slope, aspect, land use/land cover, and proximity to infrastructure such as roads, the main electric grid, distribution lines, and rivers/streams. AHP is effective for determining the relative weights of each criterion, allowing for comprehensive analysis. Using linear overlay techniques, the evaluation combines spatially distributed weighted criteria to generate a site suitability map categorized into high, moderate, low, and very low suitability. Results indicate that approximately 11.51% of the study area is highly suitable for solar farm development, while about 77.63% is moderately suitable. Overall, nearly 89.14% of the area is deemed suitable for deploying solar mini-grids with some modifications and investments. Conversely, around 10.85% of the region is classified as less or very low suitable due to factors hindering solar farm installation. This analysis highlights the potential for solar energy development in the Somali Region and provides a framework for decision-makers to prioritize investments in renewable energy infrastructure, ultimately contributing to sustainable energy goals in Ethiopia.

Keywords: *Renewable energy, Analytical Hierarchy Process (AHP), Multi criteria, Site suitability, Solar energy potential*