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File size:	7.99M
Page count:	236
Word count:	68,418
Character count:	398,321
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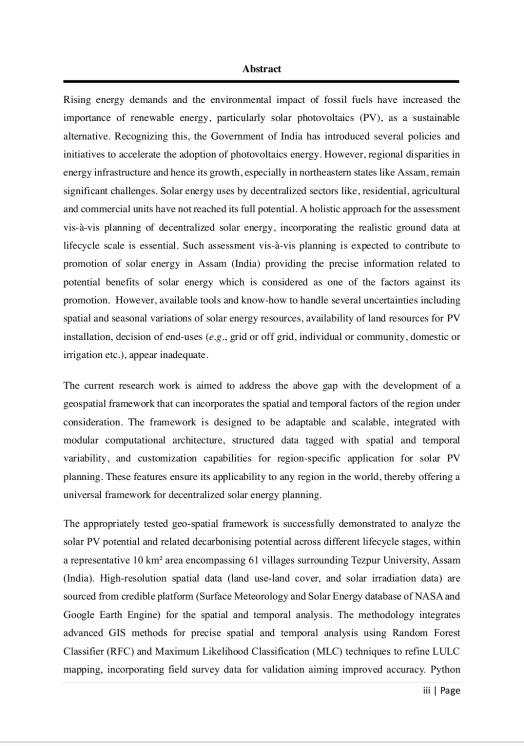

Abstract

Rising energy demands and the environmental impact of fossil fuels have increased the importance of renewable energy, particularly solar photovoltaics (PV), as a sustainable alternative. Recognizing this, the Government of India has introduced several policies and initiatives to accelerate the adoption of photovoltaics energy. However, regional disparities in energy infrastructure and hence its growth, especially in northeastern states like Assam, remain significant challenges. Solar energy uses by decentralized sectors like, residential, agricultural and commercial units have not reached its full potential. A holistic approach for the assessment vis-à-vis planning of decentralized solar energy, incorporating the realistic ground data at lifecycle scale is essential. Such assessment vis-à-vis planning is expected to contribute to promotion of solar energy in Assam (India) providing the precise information related to potential benefits of solar energy which is considered as one of the factors against its promotion. However, available tools and know-how to handle several uncertainties including spatial and seasonal variations of solar energy resources, availability of land resources for PV installation, decision of end-uses (*e.g.*, grid or off grid, individual or community, domestic or irrigation etc.), appear inadequate.

The current research work is aimed to address the above gap with the development of a geospatial framework that can incorporates the spatial and temporal factors of the region under consideration. The framework is designed to be adaptable and scalable, integrated with modular computational architecture, structured data tagged with spatial and temporal variability, and customization capabilities for region-specific application for solar PV planning. These features ensure its applicability to any region in the world, thereby offering a universal framework for decentralized solar energy planning.

The appropriately tested geo-spatial framework is successfully demonstrated to analyze the solar PV potential and related decarbonising potential across different lifecycle stages, within a representative 10 km² area encompassing 61 villages surrounding Tezpur University, Assam (India). High-resolution spatial data (land use-land cover, and solar irradiation data) are sourced from credible platform (Surface Meteorology and Solar Energy database of NASA and Google Earth Engine) for the spatial and temporal analysis. The methodology integrates advanced GIS methods for precise spatial and temporal analysis using Random Forest Classifier (RFC) and Maximum Likelihood Classification (MLC) techniques to refine LULC mapping, incorporating field survey data for validation aiming improved accuracy. Python

A Comprehensive GIS-Based Framework for Photovoltaic Energy Planning and Management in Rural Assam

by Bharat Terang

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File name: r_Photovoltaic_Energy_Planning_and_Management_in_Rural_Assam.pdf (7.99M)
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