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NEXT-GENERATION RICE AREA MAPPING: COMBINING ADVANCED GEOSPATIAL TOOLS AND MACHINE LEARNING – A REVIEW

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Abstract

Accurate estimation of rice crop area and production is essential for effective agricultural planning, food security assessment, and market regulation. Remote sensing technologies have demonstrated considerable potential for large-scale rice area mapping and yield forecasting due to their ability to provide timely and spatially consistent data. However, operational implementation remains constrained by challenges such as frequent cloud cover during critical phenological stages, the complexity of image preprocessing, and variability in landscape characteristics across regions. Recent developments in machine learning, particularly the application of algorithms such as Random Forest and Support Vector Machines, have shown promise in improving classification accuracy, reducing the dependency on extensive ground truth data, and enabling automated analysis of multi-temporal satellite imagery. Despite these advances, a significant research gap persists in the form of non-standardized methodologies, inconsistent performance across geographies, and limited integration of heterogeneous data sources. This review synthesizes current advancements in geospatial and machine learning techniques for rice area mapping, with an emphasis on their comparative performance, data integration strategies, and scalability. Bibliometric analysis has been included to identify significant publications, research trends, and contributors. The analysis delivers a data-driven insight on the progression and significance of connected research. The innovative aspect of this study lies in its comprehensive evaluation of emerging tools and frameworks, offering insights into their practical applicability and potential for standardization. The review highlights the need for harmonized analytical architectures and validated protocols to support the development of reliable, transferable, and operational rice mapping systems at regional to global scales.

Key words: machine learning, microwave data, paddy crop area, random forest, remote sensing

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