

Carbon Sequestration Estimation in Paddy Fields Using Synthetic Aperture Radar (SAR) Data in Sri Lanka

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Abstract

Soil organic carbon (SOC) is essential for keeping soil healthy, improving crop growth, and tackling climate change. In rice-growing areas such as those in Sri Lanka, knowing how SOC is distributed helps farmers adopt sustainable practices and make better decisions for climate-smart agriculture. Traditional lab methods to measure SOC are accurate but take a lot of time, cost a lot of money, and are not practical for studying large areas. Recently, remote sensing tools, especially Sentinel-1 Synthetic Aperture Radar (SAR), have become useful because they can monitor soil reliably even through clouds, which is ideal for tropical regions. Looking at recent research, it's clear that combining SAR data with optical satellite images and using machine learning or deep learning can predict SOC more accurately than older methods. While studies in other countries show promising results, in Sri Lanka most research still depends on optical images or simple statistical methods, which are less effective in cloudy and diverse paddy landscapes. These studies also show that using advanced AI approaches can improve SOC and crop mapping. From this review, we identified some important gaps, SAR-based deep learning hasn't been applied much in Sri Lankan rice fields, there is limited field data for validating models, and prediction uncertainties are often not measured. Our research aims to address these gaps by integrating multi-temporal Sentinel-1 SAR data with deep learning models and validating predictions using field-collected SOC samples. This approach will provide more accurate and understandable SOC maps, helping support climate-smart and sustainable rice farming in Sri Lanka.

Keywords: Soil organic carbon, Synthetic Aperture Radar, Machine learning, Paddy fields, Sri Lanka