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Land restoration effectiveness assessed by satellite-based remote sensing technologies as a new monitoring approach

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Abstract

To assess the effectiveness of land restoration efforts, traditional methods are often time-consuming, require special skills, expensive, subjective. One of the traditional methods to evaluate restoration effectiveness is direct field observations- used to estimate the condition of the vegetation, soil, and overall ecosystem. These methods primarily can indicate the extent of organic recovery, and accumulation of soil nutrients, particularly their depth and how biodiverse it is. Advanced technologies e.g. satellite-based remote sensing provide more accurate, efficient, and data-driven evaluations. Spectral indices are known indicators for estimating the status of vegetation health, nutrient cycles in soil, soil quality, and biodiversity. Remote sensing is a powerful tool that, when combined with field observations via machine learning and spectral-induced approaches, provides effective results for assessing the land restoration of ecosystems. While the implementation of the indicators can be done and analyzed. This study examines that there is potential for multispectral imagery across visible and near-infrared regions collected by satellite data to prove the effectiveness of restoration activities as a sustainable ecosystem method assessing the values and properties of vegetation indicators. In this context, this study will demonstrate that using Landsat or Sentinel satellite's multispectral imageries was employed to monitor the restoration effects during a time series of seasons on multiple Mediterranean pilot areas. One of the pilot areas is Food Forest in Bethlehem of Galilee, Israel. Since 2017, the owners started to enhance biodiversity and regenerate soil, adopting agroforestry principles. We have achieved significant results while applying the vegetation indicators as compared to a control area that is adjacent to it where traditional agriculture is practiced without any treatment. Additionally, notable findings were when indicators were applied on planted forests in Heraklion, Greece where no active restoration was applied, demonstrating the effectiveness of natural processes. Spectral information is used to evaluate plant robustness, biomass, health, and vegetation diversity values. By calculating the top-down satellite-based indicators on multiple areas in the Mediterranean region, results show an excellent performance, which shows that deep network-based near-infrared remote sensing technology has a future potential to become an alternative and reliable monitoring method for sustainable ecosystem land restoration.

Keywords: Restoration Actions, Forest, Top-Down Indicators, Satellite-based Remote Sensing, Time-Series.

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