

Title: Revolutionizing Soil Testing with Sensors and AI

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ABSTRACT

Advancements in sensor technologies and artificial intelligence (AI) are transforming traditional soil testing methods, enabling rapid, accurate, and cost-effective assessments. This lecture explores the integration of proximal sensors, such as portable X-ray fluorescence (PXRF) spectrometry, soil spectroscopy and spectral imaging, with AI for soil property characterization. Highlighting my research, I will discuss the application of PXRF in assessing heavy metals and nutrients, the use of hyperspectral and multispectral imaging for spectral characterization, and the innovative role of smartphone-integrated devices in mapping soil fertility parameters. These cutting-edge technologies have been pivotal in improving soil management practices, particularly in developing high-resolution digital soil maps for precision agriculture. AI-driven models further enhance the predictive power of these sensors, providing actionable insights for sustainable land use. Case studies from my work in India and beyond will illustrate the practical implications of these tools, from addressing soil contamination risks to optimizing nutrient management. By bridging the gap between field and lab, this approach represents a paradigm shift towards a more sustainable and data-driven future in soil science.