Eco-Efficient Fertilizer Optimization for Enhanced Crop Productivity using Random Forest Algorithm

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Abstract: *Agricultural productivity is crucial for global food security, and optimizing fertilizer usage is a key factor in enhancing crop yield while maintaining environmental sustainability. This study proposes an eco-efficient fertilizer optimization model using the Random Forest algorithm, a powerful machine learning technique, to improve fertilizer application strategies. The model analyzes various soil properties, crop requirements, and environmental factors to predict the optimal fertilizer composition and quantity. By leveraging historical agricultural data, the algorithm identifies patterns that lead to increased crop productivity with minimal environmental impact. The proposed approach enhances efficiency by reducing excessive fertilizer use, mitigating soil degradation, and minimizing greenhouse gas emissions. Experimental results demonstrate that the model outperforms traditional fertilizer application methods by improving yield prediction accuracy and resource utilization. This research provides a data-driven framework for precision agriculture, ensuring sustainable farming practices and enhanced food production.*

Keywords: Machine Learning, Python