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PRECISION AGRICULTURE: CULTIVATING A SMARTER FUTURE WITH EARTH OBSERVATION AND MACHINE LEARNING

Abstract

The looming challenge of feeding a growing population while preserving our planet's resources demands innovative solutions. Enter the transformative partnership of Earth Observation (EO) and Machine Learning (ML), along with sophisticated predictive analytics, propelling agriculture towards a future of precision and sustainability. However, gleaning actionable insights from this vast sea of information requires intelligent interpreters. Here's how ML and predictive analytics step in beyond with their ability to discern subtle patterns in imagery such as The Spectral Angle Mapper (SAM) to predict minerals, SAM collects detailed information across hundreds of wavelengths, providing a unique fingerprint of Earth's surface composition.. ML can identify early signs of pests, diseases, and nutrient deficiencies, whereas methods mentioned have been used before for predicting pest presence in cotton fields in Greece. But beyond mere identification, time regression analysis can unlock insights into historical trends and predict future outbreaks, enabling proactive interventions before widespread damage occurs.

By analyzing soil moisture, weather forecasts, and crop growth stages, ML algorithms can be used to recommend precise irrigation, fertilizer application, and planting schedules. This minimizes waste and maximizes yield, ensuring crops get the resources they need while protecting precious water and nutrients. Additionally, linear regression models can quantify these relationships, offering farmers a clear understanding of the impact of each resource on yield. ML models, trained on historical data (including weather patterns and yield variations) and real-time EO, can accurately forecast crop yields at various stages. This empowers farmers to make informed decisions about planning, logistics, and market opportunities, leading to greater stability and profitability. Moreover, Support Vector Regression (SVR) demonstrates potential for improved irrigation water requirement prediction in arid regions. This study highlights the effectiveness of SVR in identifying complex, non-linear relationships between multiple variables like relative humidity, wind speed, and soil evaporation, as demonstrated in irrigation water requirement (IWR) prediction for green beans. This capability can lead to more accurate crop yield predictions, potentially enhancing agricultural efficiency and water resource management in environments. Increased crop yields and reduced losses contribute to global food security, especially in areas struggling with limited resources. Data-driven insights equip farmers with the knowledge to make informed decisions,

improve profitability, and adapt to changing climatic conditions, ensuring the long-term success of their operations.