Scalable Cloud Technique for Multi-Farm Data Acquisition and Analysis

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Abstract

Agriculture is important for food security, and proper fertilizer utilization is critical for attaining high levels of crop productivity as well as enhancing soil quality. Nevertheless, farmers struggle to know what type and how much fertilizer to use for differing crops and in varying seasonal or landscape context. Therefore, we present a crop fertilizer recommendation system based on machine learning which incorporates historical crop production data, seasonal crop information and fertilizer recommendations developed by experts. The system incorporates two feature selection techniques (Boruta and RFE) to develop a set of key and relevant features that impact fertilizer requirements, and then develops CatBoost model classifiers (fertilizer type) and regression models (fertilizer amount). The system also provides a JSON based nutrient knowledge base to provide crop specific information, and the required nitrogen, phosphorus, and potassium needs and when to apply them. The machine learning models and artifacts were deployed in a user application built in Streamlit, which allows users to upload a CSV file for bulk predictions and provides a type of fertilizer recommended and a summary table of nutrients. The system not only enhances prediction performance but also builds a model that provides explainable predictions to support sustainable data driven agricultural practices.

Keywords

Fertilizer Recommendation, Precision Agriculture, Machine Learning, Crop Prediction, Smart Agriculture, Sustainable Farming.