

ABSTRAK

SISTEM CERDAS BERBASIS IOT DAN *MACHINE LEARNING* UNTUK REKOMENDASI TANAMAN DAN PEMUPUKAN BERBASIS KONDISI TANAH SECARA *REAL-TIME*

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Penelitian ini bertujuan untuk mengembangkan sistem rekomendasi tanaman berbasis kondisi tanah menggunakan teknologi *Internet of Things* (IoT) dan algoritma *Decision Tree*. Sistem memanfaatkan sensor tanah 8-in-1 untuk memperoleh data kondisi tanah secara *real-time* yang meliputi suhu tanah, kelembaban tanah, *electrical conductivity* (EC), pH, kandungan nitrogen (N), fosfor (P), kalium (K), dan tingkat kesuburan tanah (*fertility*). Data penelitian dikumpulkan dari beberapa lahan pertanian dan perkebunan di Kabupaten Banyuasin, Sumatera Selatan, yang terdiri atas lima jenis tanaman, yaitu kelapa sawit, kelapa, padi, jagung, dan pisang. Tahapan penelitian meliputi pengumpulan data, *preprocessing*, proses klasifikasi menggunakan algoritma *Decision Tree*, serta pengujian model menggunakan metode *Nested Cross Validation*. Untuk memperoleh model terbaik, dilakukan perbandingan dengan beberapa algoritma klasifikasi lainnya, yaitu *Random Forest*, *Support Vector Machine* (SVM), *K-Nearest Neighbor* (KNN), *Gaussian Naive Bayes*, *XGBoost*, dan *Logistic Regression*. Evaluasi model dilakukan menggunakan metrik *accuracy*, *precision*, *recall*, *F1-score*, dan *confusion matrix*. Hasil penelitian menunjukkan bahwa algoritma *Decision Tree* memberikan performa terbaik dengan nilai *accuracy* sebesar 95,6%, *precision* sebesar 95,2%, *recall* sebesar 95,7%, dan *F1-score* sebesar 95,8%. Hasil tersebut menunjukkan bahwa algoritma *Decision Tree* mampu mengidentifikasi hubungan antara karakteristik kondisi tanah dan jenis tanaman secara akurat serta menghasilkan aturan keputusan yang mudah dipahami. Dengan demikian, sistem yang dikembangkan mampu memberikan rekomendasi tanaman berdasarkan kondisi tanah secara efektif sehingga diharapkan dapat membantu petani dalam menentukan jenis tanaman yang sesuai dengan kondisi lahan untuk mendukung peningkatan produktivitas pertanian dan efisiensi pengelolaan lahan.

Kata Kunci: *Internet of Things* (IoT), Sensor Tanah 8-in-1, *Decision Tree*, *Machine Learning*, Rekomendasi Tanaman, Kondisi Tanah.

ABSTRACT

IOT AND MACHINE LEARNING-BASED INTELLIGENT SYSTEM FOR REAL-TIME SOIL CONDITION-BASED CROP AND FERTILIZATION RECOMMENDATIONS

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This study aims to develop a soil-condition-based crop recommendation system utilizing Internet of Things (IoT) technology and the Decision Tree algorithm. The system employs an 8-in-1 soil sensor to acquire real-time data on soil conditions, including temperature, moisture, electrical conductivity (EC), pH, nitrogen (N), phosphorus (P), potassium (K), and fertility levels. Data were collected from various agricultural and plantation sites in Banyuasin Regency, South Sumatra, covering five crop types: oil palm, coconut, rice, corn, and banana. The research stages included data collection, preprocessing, classification using the Decision Tree algorithm, and model testing via Nested Cross-Validation. To identify the optimal model, a comparison was conducted against other classification algorithms: Random Forest, Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Gaussian Naive Bayes, XGBoost, and Logistic Regression. Model evaluation utilized metrics such as accuracy, precision, recall, F1-score, and the confusion matrix. The results demonstrate that the Decision Tree algorithm achieved the best performance, with an accuracy of 95.6%, precision of 95.2%, recall of 95.7%, and an F1-score of 95.8%. These findings indicate that the Decision Tree algorithm can accurately identify the relationship between soil characteristics and crop types while generating easily interpretable decision rules. Consequently, the developed system effectively provides crop recommendations based on soil conditions, offering potential assistance to farmers in selecting crops suited to their land, thereby supporting increased agricultural productivity and efficient land management.

Keywords: *Internet of Things (IoT), 8-in-1 Soil Sensor, Decision Tree, Machine Learning, Crop Recommendation, Soil Conditions.*