ABSTRACT

Oil palm productivity in Indonesia is often constrained by low soil fertility caused by improper fertilization. Many farmers rely on manual methods that are subjective and not based on actual data, leading to nutrient imbalance, reduced yields, and high production costs. This study develops an IoT- and AI-based monitoring system to process soil data and provide fertilization recommendations.

The system collects soil pH, nitrogen, phosphorus, potassium, and moisture data using RS485 sensors integrated with an ESP32 microcontroller. The data is analyzed with the Support Vector Machine (SVM) algorithm to classify soil fertility into categories of requiring or not requiring fertilizer. The results are stored in an InfluxDB database and displayed through a Grafana dashboard, enabling real-time monitoring both locally via an OLED LCD and remotely via a website.

The implementation results show that the sensor exhibits low error for nitrogen, potassium, phosphorus, moisture, and pH after calibration. The SVM model achieved high accuracy, with precision, recall, and F1-score above 90%. Testing on 30 oil palm samples demonstrated that fertilizer recommendations were accurate in 90% of cases, showing greater consistency compared to manual methods. The system operates automatically for 24 hours, powered by a 6000 mAh battery (lasting up to 30 hours) and a solar panel for recharging. This research supports data-driven agriculture and sustainable management of small to medium-scale oil palm plantations.

Keywords: Oil palm, Soil fertility, Support Vector Machine (SVM), Fertilization.