

**DESIGN AND IMPLEMENTATION OF AN IOT-BASED SOIL pH
MONITORING AND AUTOMATIC LIQUID FERTILIZATION SYSTEM
FOR OIL PALM NURSERIES**

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ABSTRACT

Oil palm (Elaeis guineensis Jacq.) is highly dependent on maintaining stable soil acidity (pH) levels during the nursery phase. Conventional maintenance practices with limited real-time monitoring often result in inconsistent fertilization and delayed responses to acidic soil conditions. Therefore, this study designed an Internet of Things (IoT)-based system for soil pH monitoring and automatic liquid fertilization using the Waterfall method. The system integrates a NodeMCU ESP32 microcontroller, an analog pH sensor, a DC water pump actuator, and a MySQL-based website interface. The test results showed that the system operated properly, collecting data every 3 seconds. When the detected pH level fell below the critical threshold (< 6.5), the fertilization pump was automatically activated for 3 seconds, followed by a 2-minute delay to prevent excessive fertilizer application. The implementation successfully automated manual maintenance processes and provided accurate, centralized agronomic evaluation data.

Keywords: Monitoring System, Soil pH, Oil Palm, IoT, ESP-32, Website.