ABSTRAK

STUDI HUBUNGAN ANTARA VARIASI *IRRADIANCE* HARIAN, STABILITAS *OUTPUT* PV, DAN KESEIMBANGAN EKOSISTEM IKAN DI SISTEM AQUAPONIK MENGGUNAKAN PENDEKATAN *DEEP LEARNING*

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Variasi *irradiance* harian berdampak langsung pada stabilitas daya panel surya (PV) dan kualitas lingkungan dalam sistem aquaponik. Penelitian ini mengkaji hubungan antara fluktuasi *irradiance*, *output* PV, dan keseimbangan ekosistem ikan menggunakan model *Convolutional Neural Network - Long Short-Term Memory* (CNN-LSTM). Data *irradiance* dan parameter air dikumpulkan melalui sensor, kemudian diproses dan dianalisis untuk memprediksi daya PV. Evaluasi dengan MSE, MAE, dan R^2 menunjukkan bahwa model mampu memberikan prediksi yang akurat. Hasil menunjukkan adanya korelasi antara penurunan daya PV dan gangguan parameter suhu dan pH air, yang berpengaruh pada ekosistem ikan. Studi ini menegaskan bahwa pendekatan *deep learning* efektif dalam menjaga stabilitas sistem aquaponik berbasis energi terbarukan.

Kata Kunci: CNN-LSTM, *Output* PV, *Irradiance*, Aquaponik, *Deep Learning*, Ekosistem Ikan.

ABSTRACT

A STUDY ON THE RELATIONSHIP BETWEEN DAILY IRRADIANCE VARIATION, PV OUTPUT STABILITY, AND FISH ECOSYSTEM BALANCE IN AQUAPONICS SYSTEMS USING A DEEP LEARNING APPROACH

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Daily irradiance variation directly affects photovoltaic (PV) power stability and environmental conditions in aquaponic systems. This study examines the relationship between irradiance fluctuation, PV output, and fish ecosystem balance using a Convolutional Neural Network - Long Short-Term Memory (CNN-LSTM) model. Irradiance and water parameter data were collected via sensors, processed, and analyzed for PV power prediction. Evaluation using MSE, MAE, and R^2 shows the model's high prediction accuracy. Results indicate a correlation between PV drops and disturbances in temperature and pH levels, affecting fish ecosystem stability. This study confirms that deep learning is effective for maintaining aquaponic system stability under renewable energy constraints.

Keywords: CNN-LSTM, PV *Output, Irradiance, Aquaponics, Deep Learning, Fish Ecosystem*.