ABSTRAK

INTEGRASI *FNN-ATTENTION ENHANCEMENT* PADA SISTEM *GREENWALL AQUAPONIK* UNTUK PREDIKSI *OUTPUT* PV DAN STABILITAS SIRKULASI NUTRISI DALAM PERTANIAN BERKELANJUTAN

(2025: 66 Halaman + 52 Gambar + 3 Tabel + Daftar Pustaka + Lampiran)

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Sistem Greenwall Aquaponik berbasis energi surya merupakan inovasi pertanian berkelanjutan yang menghadapi tantangan fluktuasi irradiance harian terhadap output daya panel fotovoltaik (PV). Penelitian ini mengembangkan model prediktif berbasis Feedforward Neural Network (FNN) dengan peningkatan Attention Enhancement (AE) untuk memprediksi output PV secara akurat serta menjaga kestabilan sirkulasi nutrisi dalam sistem. Data irradiance dikumpulkan menggunakan sensor, diproses melalui tahap normalisasi, dan digunakan untuk melatih model FNN-AE. Evaluasi menggunakan MSE, MAE, dan R^2 menunjukkan bahwa model mampu memetakan pola variatif irradiance dengan baik dan menghasilkan prediksi yang presisi. Hasil ini membuktikan bahwa penerapan kecerdasan buatan dalam sistem aquaponik dapat meningkatkan efisiensi energi, adaptivitas sistem, dan mendukung pertanian cerdas berbasis data. Penelitian ini juga menyoroti pentingnya integrasi teknologi AI dalam manajemen sumber daya energi terbarukan yang efisien. Dengan pendekatan ini, sistem aquaponik dapat beroperasi lebih mandiri, stabil, dan ramah lingkungan, sekaligus mendukung produktivitas pertanian yang berkelanjutan di tengah tantangan perubahan iklim dan keterbatasan lahan.

Kata Kunci: *Greenwall Aquaponik*, Prediksi *Output PV*, *Feedforward Neural Network (FNN)*, *Attention Enhancement (AE)*, *Deep Learning*

ABSTRACT

INTEGRATION OF FNN-ATTENTION ENHANCEMENT IN GREENWALL AQUAPONICS SYSTEM FOR PREDICTING PV OUTPUT AND NUTRIENT CIRCULATION STABILITY IN SUSTAINABLE AGRICULTURE

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The solar-powered Greenwall Aquaponic system is a sustainable agricultural innovation that faces challenges due to daily irradiance fluctuations affecting the output power of photovoltaic (PV) panels. This study develops a predictive model based on a Feedforward Neural Network (FNN) enhanced with Attention Enhancement (AE) to accurately forecast PV output and maintain nutrient circulation stability within the system. Irradiance data was collected using sensors, normalized, and used to train the FNN-AE model. Evaluation using MSE, MAE, and R^2 demonstrates that the model effectively captures irradiance variation patterns and delivers precise predictions. These results prove that the application of artificial intelligence in aquaponic systems can improve energy efficiency, system adaptability, and support data-driven smart agriculture. This research also highlights the importance of integrating AI technologies in the efficient management of renewable energy resources. Through this approach, aquaponic systems can operate more independently, stably, and environmentally friendly, while simultaneously supporting sustainable agricultural productivity in the face of climate change challenges and limited land availability.

Keywords: *Greenwall Aquaponik, PV Power Prediction, Feedforward Neural Network (FNN), Attention Enhancement (AE), Deep Learning*