

PERANCANGAN SISTEM POMPA AIR TENAGA SURYA UNTUK IRIGASI PERTANIAN DI WONOSARI, KLATEN

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INTISARI

Ketersediaan air irigasi yang stabil merupakan faktor kunci dalam mendukung intensifikasi pertanian di Desa Sekaran, Wonosari, yang sering mengalami keterbatasan pasokan akibat sistem distribusi gravitasi. Penelitian ini bertujuan merancang serta membandingkan kinerja teknis dan keekonomian Sistem Pompa Air Tenaga Surya (SPATS) untuk memenuhi kebutuhan irigasi pada lahan seluas 1,9 hektare.

Metode penelitian menggunakan studi komparatif, dengan merancang beberapa skenario kombinasi teknologi pompa (permukaan Samking SHF-6A dan celup Lorentz PS2-1800 C-SJ42-1) serta modul fotovoltaik (LONGi 550 Wp dan 360 Wp). Simulasi dilakukan dengan perangkat lunak PVSyst, dievaluasi berdasarkan indikator teknis (*Performance Ratio/PR*, *Unused Fraction*, *Missing Water*) dan indikator keekonomian (*Life Cycle Cost/LCC*, *Levelized Cost of Water/LCOW*, *Net Present Value/NPV*, serta *Payback Period/PP*).

Hasil penelitian menunjukkan konfigurasi optimal adalah pompa permukaan dengan 10 modul PV 360 Wp (3,6 kWp) yang mampu memenuhi 100% kebutuhan irigasi selama umur proyek 20 tahun. Sistem ini memiliki efisiensi keekonomian terbaik LCOW sebesar Rp 35,36/m³ dan *Payback Period* 1,51 tahun. Sebagai perbandingan, konfigurasi pompa celup menunjukkan efisiensi energi lebih tinggi ($PR > 56\%$), namun tidak dipilih karena berpotensi menimbulkan defisit suplai air jangka panjang (2,2–3,5%) dan biaya siklus hidup yang lebih tinggi.

Kata kunci: Sistem Pompa Air Tenaga Surya, Irigasi Pertanian, Studi Komparatif, Analisis Tekno-Ekonomi, PVSyst

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DESIGN OF A SOLAR-POWERED WATER PUMP SYSTEM FOR AGRICULTURAL IRRIGATION IN WONOSARI, KLATEN

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ABSTRACT

The stable availability of irrigation water is a key factor in supporting agricultural intensification in Sekaran Village, Wonosari, which often experiences supply limitations due to its gravity-fed distribution system. This research aims to design and compare the technical and economic performance of Solar Water Pumping Systems (SWPS) to meet the irrigation needs for a 1.9-hectare farmland.

The research method employed a comparative study, designing several scenarios combining pump technologies (the Samking SHF-6A surface pump and the Lorentz PS2-1800 C-SJ42-1 submersible pump) with photovoltaic modules (LONGi 550 Wp and 360 Wp). Simulations were conducted using PVSyst software and evaluated based on technical indicators (Performance Ratio/PR, Unused Fraction, Missing Water) and economic indicators (Life Cycle Cost/LCC, Levelized Cost of Water/LCOW, Net Present Value/NPV, and Payback Period/PP).

The results show that the optimal configuration is the surface pump with 10 PV modules of 360 Wp (3.6 kWp), which can meet 100% of the irrigation demand over the project's 20-year lifespan. This system achieved the best economic efficiency with an LCOW of IDR 35.36/m³ and a Payback Period of 1.51 years. In comparison, the submersible pump configuration showed higher energy efficiency (PR > 56%) but was not selected due to its potential for long-term water supply deficits (2.2–3.5%) and higher life cycle costs.

Keywords: Solar Water Pump, Agricultural Irrigation, Comparative Study, Techno-Economic Analysis, PVSyst

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