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Paper ID: PJLSS-25-4094

05-Jan-2025

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The article will be Published in **Volume 23 , 2025 .**

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Author(s) Name: Sentot Purboseno, Lisma Safitri, Hermantoro, Gani Supriyanto, Reni Astuti Widyowanti

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Sentot Purboseno¹, Hermantoro¹, Gani Supriyanto¹, Reni Astuti Widyowanti²

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Article History
Received 00 January 20xx
Revised 00 January 20xx
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Keywords
low carbon, irrigation, solar panels, GHG

ABSTRACT
The shallow groundwater in Umbulrejo Village, Ponjong District, Gunungkidul Regency is promising for dry land farming. Currently, petrol generator-powered pumps used for irrigation increase costs and cause environmental harm through noise and emissions like lead (Pb), CO₂, CO, NOx, and SOx. These emissions contribute to air pollution, global warming, and health risks. The agricultural sector must produce 70% more food by 2050 while reducing its significant GHG emissions. Indonesia's solar energy potential, with an average solar radiation of 5.045 kWh/m²/day, offers a solution. Using Solar Power Plants (SPP) for irrigation in Umbulrejo Village has reduced GHG emissions by 3,071.78 kg CO₂ and saved IDR 3,200,000 in generator rental costs, promoting sustainable, low-carbon agricultural practices.

Acknowledgements

The author would like to express sincere gratitude to PT Virama Karya for funding this research through the 2022 TJSL (Tanggung Jawab Sosial dan Lingkungan/Corporate Social and Environmental Responsibility) Program.

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- James E. Hansen, J.E., Sato, M., Simons, L., Nazarenko, L.S., Sangha, I., Kharecha, P., James, C., Zachos, J.C., Schuckmann, K.V., Loeb, N.G., Osman, M.B., Jin, Q., Tselioudis, G., Jeong, E., Lacs, A., Ruedy, R., Russell, G., Cao, J., Li, J., 2023. Global warming in the pipeline. Oxford Open Climate Change. 2023. Vol. 3. No. 1. <https://doi.org/10.1093/oxfclm/kgad008>
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- Putri, H. P. (2017) Life Cycle Assessment (LCA) Emisi pada Proses Produksi Bahan Bakar Minyak (BBM) Jenis Bensin dengan Pendekatan Metode Analytical Hierarchy Process (AHP). Departemen Teknik Lingkungan Fakultas Teknik Sipil dan Perencanaan Institut Teknologi Sepuluh Nopember. Surabaya.

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This analysis aims to determine the amount of GHG emissions resulting from the operation of the PLTS pump irrigation system and compare it with conventional irrigation systems to assess its effectiveness in reducing the carbon footprint. The steps for the GHG Emission Inventory included data collection and emissions calculation. Data collection was conducted to inventory the energy and fuel consumption of a pump irrigation system, which encompassed the production, transportation, installation, and operational processes powered by fossil fuel electricity. Additionally, the operational costs of solar-powered irrigation pumps were also inventoried for comparison with the conventional pump irrigation system. Afterwards, GHG (CO₂ equivalent) emissions were calculated based on the energy and fuel consumption as activity data and emissions factors, in accordance with IPCC Guidelines for National Greenhouse Gas Inventories.

Results and Discussion

Analysis of Irrigation Water Supply

Research at the Southwest Purdue Agricultural Center compared watermelon yields between two fields: one field received 25.4 mm of water per week through drip tape and mulch, while the other field was not irrigated. The non-irrigated field experienced a yield reduction of about 5%, with average fruit weight decreasing from 7.53 kg to 7.16 kg. Fully grown watermelon plants in the summer require approximately 25.4 mm to 38.1 mm of water per week, based on the average reference evapotranspiration (ET_o). Assuming about one-third of the field is covered with plastic mulch, approximately 34,260 to 51,390 liters of water per hectare per week is needed [15].

Table 1. Pattern of Water Supply for Watermelon Cultivation

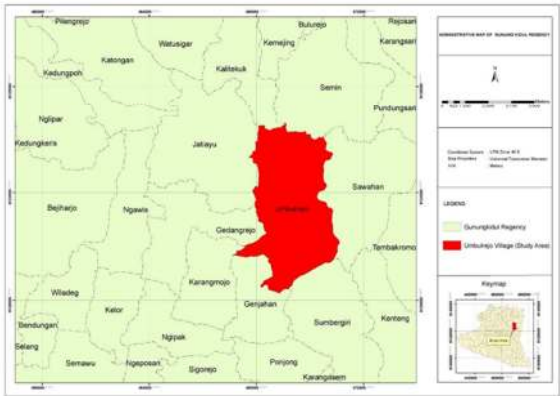
No.	Planting Age	Water Supply			
		Morning		Afternoon	
		UIR	Watering	UIR	Watering
		(mm/day/hectar)	period, every	(mm/day/hectar)	period, every
1	1 - 15 DAP	3.89	2 days	3.86	2 days
2	15 - 45 DAP	2.86	2 days	2.86	2 days

energy, reduce crop losses, and increase economic sustainability, and reduce greenhouse gas emissions (4,7). This research aims to examine the effectiveness of low-carbon development in reducing GHG emissions by cultivating watermelon in Umbulrejo Village, Ponjong District, Gunungkidul Regency. This development model can be expanded by evaluating the effectiveness of SPP pump irrigation in reducing GHG emissions.

Materials and Methods

Research Sites

The research was conducted in Sladi Hamlet, Umbulrejo Village, Ponjong District, Gunungkidul Regency, Special Region of Yogyakarta (Figure 1). The research object is a SPP pump irrigation system designed to irrigate watermelon plants, developed by INSTIPER in collaboration with State-Owned Enterprises (SOE) company PT Virama Karya.



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