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EVALUASI PENERAPAN IRIGASI SPRINKLER MELALUI ANALISIS HIDRAULIK DAN KESERAGAMAN DI LAHAN PERTANIAN PESISIR PANTAI GLAGAH KULON PROGO
Devi Ramdani, Dr. Ir. Murtiningrum, S.T.P., M.Eng., IPM., ASEAN Eng.; Ir. Andri Prima Nugroho, S.T.P., M.Sc., Ph.D
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EVALUASI PENERAPAN IRIGASI *SPRINKLER* MELALUI ANALISIS HIDRAULIK DAN KESERAGAMAN DI LAHAN PERTANIAN PESISIR PANTAI GLAGAH KULON PROGO

INTISARI

Oleh:
Devi Ramdani
22/494865/TP/13443

Peningkatan kebutuhan efisiensi penggunaan air pada lahan pertanian pesisir mendorong pengembangan sistem irigasi yang mampu mendistribusikan air secara merata pada kondisi lingkungan dengan kemampuan menahan air yang rendah. Namun, implementasi sistem irigasi *Sprinkler* seringkali menunjukkan performa yang belum optimal. Penelitian ini bertujuan mengevaluasi karakteristik hidraulik serta keseragaman distribusi air pada sistem irigasi *Sprinkler* di lahan pertanian pesisir. Metode penelitian meliputi pengujian laboratorium, simulasi hidraulik jaringan menggunakan QGISRed, analisis keseragaman berdasarkan *Christiansen Uniformity* (CU), serta pengembangan rekomendasi jaringan optimal. Hasil penelitian menunjukkan bahwa peningkatan tekanan operasi dari 2,11 m menjadi 3,52 m meningkatkan nilai CU dari 77,93% menjadi 92,81%. Simulasi jaringan menunjukkan masih terdapat beberapa node *Sprinkler* pada bagian hilir yang berada di bawah tekanan minimum akibat meningkatnya kehilangan energi (*head loss*) sepanjang lateral sehingga distribusi air menjadi kurang merata. Analisis *heatmap* menunjukkan variasi distribusi aplikasi air berkisar antara 1×10^{-3} mm hingga lebih dari $4{,}9 \times 10^{-3}$ mm selama waktu operasi 8 menit. Hasil simulasi rekomendasi jaringan menunjukkan bahwa konfigurasi 14 *Sprinkler* dan 15 *Sprinkler* dengan penempatan sumber air di bagian tengah lateral mampu menghasilkan distribusi tekanan yang lebih stabil dan merata dibandingkan konfigurasi lainnya, sehingga faktor hidraulik menjadi aspek penting dalam perancangan sistem irigasi *Sprinkler* di lahan pertanian pesisir.

Kata kunci: *Christiansen Uniformity*, irigasi *Sprinkler*, karakteristik hidraulik, keseragaman distribusi, lahan pesisir

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EVALUATION OF SPRINKLER IRRIGATION PERFORMANCE BASED ON HYDRAULIC ANALYSIS AND DISTRIBUTION UNIFORMITY IN COASTAL AGRICULTURAL LAND OF GLAGAH BEACH, KULON PROGO

ABSTRACT

By:
Devi Ramdani
22/494865/TP/13443

The increasing need for efficient water use in coastal agricultural land has encouraged the development of irrigation systems capable of distributing water uniformly under soil conditions with low water-holding capacity. However, the implementation of sprinkler irrigation systems often demonstrates suboptimal performance. This study aimed to evaluate the hydraulic characteristics and water distribution Christiansen Uniformity of sprinkler irrigation system in coastal agricultural land. The research methods included laboratory testing, hydraulic network simulation using QGISRed, water distribution analysis based on Christiansen Uniformity (CU), and the development of optimal network recommendations. The results showed that increasing the operating pressure from 2.11 m to 3.52 m improved the CU value from 77.93% to 92.81%. Network simulations indicated that several downstream sprinkler nodes remained below the minimum required pressure due to increasing head loss along the lateral pipes, resulting in less uniform water distribution. Heatmap analysis revealed variations in water application distribution ranging from 1 x 10^{-3} mm to more than 4,9 x 10^{-3} mm during an 8 minute operating period. The recommended network simulation results demonstrated that configurations with 14 and 15 sprinklers, with the water source positioned at the center of the lateral pipe, produced a more stable and uniform pressure distribution compared to other configurations. Therefore, hydraulic factors play a crucial role in the design of sprinkler irrigation systems for coastal agricultural land.

Keywords: Christiansen Uniformity, coastal land, hydraulic characteristics, Sprinkler irrigation, water distribution