ABSTRAK

Ruang terbuka publik memiliki peran strategis bagi aktivitas sosial dan ekologis, namun performanya sangat dipengaruhi oleh kondisi mikroklimat. Penelitian ini menganalisis kenyamanan termal kawasan Simpang Lima Pendopo, Kabupaten PALI, yang menunjukkan tekanan panas tinggi akibat dominasi perkerasan keras, minimnya vegetasi peneduh, dan terbatasnya ventilasi mikro. Melalui simulasi ENVI-MET, penelitian ini mengevaluasi kondisi eksisting dan membandingkan tiga skenario optimasi desain (20%, 40%, dan 60%) berbasis vegetasi, material permukaan, dan elemen air. Simulasi dilakukan pada pukul 13.00, 15.00, dan 17.00 untuk mewakili dinamika panas harian, dengan analisis empat parameter mikroklimat: suhu udara, kelembapan relatif, kecepatan angin, dan Predicted Mean Vote (PMV). Validasi model dilakukan melalui kalibrasi data iklim BMKG serta pattern matching dengan literatur kawasan tropis lembap.

Hasil penelitian menunjukkan bahwa kondisi eksisting berada pada kategori “panas–sangat panas”, dengan suhu 29.5–31°C dan PMV mencapai 5.3 pada puncak panas. Skenario optimasi 20% hanya memberikan dampak lokal dan belum mengubah pola termal kawasan. Skenario 40% mulai memberikan perbaikan melalui vegetasi berlapis dan material reflektif yang menurunkan suhu 1.2–1.8°C. Skenario 60% merupakan intervensi paling efektif, menghasilkan penurunan suhu hingga 3–4°C, stabilisasi RH (76–80%), peningkatan ventilasi mikro, serta penurunan PMV menjadi 0.4–2.6. Kombinasi vegetasi tiga lapis, material permeabel–reflektif, dan kolam reflektif menghasilkan distribusi termal paling merata dan menghilangkan hotspot perkerasan. Berdasarkan temuan empiris ini, skenario 60% direkomendasikan sebagai dasar desain optimal untuk peningkatan kenyamanan termal ruang publik di kawasan tropis lembap.

Kata kunci: kenyamanan termal, mikroklimat, ENVI-MET, vegetasi berlapis, ruang terbuka publik, PALI.

ABSTRACT

Public open spaces play a strategic role in supporting social and ecological activities, yet their performance is highly dependent on microclimatic conditions. This study analyzes the thermal comfort of the Simpang Lima Pendopo area in PALI Regency, which experiences high heat stress due to the dominance of hard pavements, the lack of shading vegetation, and limited micro-ventilation. Using ENVI-MET simulations, this research evaluates existing conditions and compares three design optimization scenarios (20%, 40%, and 60%) based on vegetation enhancement, surface material modification, and the addition of water elements. Simulations were conducted at 13:00, 15:00, and 17:00 to represent daily thermal dynamics, analyzing four key microclimate parameters: air temperature, relative humidity, wind speed, and Predicted Mean Vote (PMV). Model validation was performed through calibration using BMKG climatic data and pattern matching with empirical studies in humid tropical environments.

The results show that existing conditions fall within the “hot–very hot” category, with temperatures of 29.5–31°C and PMV values reaching 5.3 during peak heat hours. The 20% optimization scenario produced only localized effects and did not alter the overall thermal pattern of the area. The 40% scenario began to demonstrate improvements through layered vegetation and reflective materials, reducing air temperature by 1.2–1.8°C. The 60% scenario was the most effective intervention, producing temperature reductions of up to 3–4°C, stabilizing RH at 76–80%, enhancing micro-ventilation, and lowering PMV to 0.4–2.6. The combination of three-layer vegetation, permeable–reflective materials, and reflective water features provided the most uniform thermal distribution and successfully eliminated pavement hotspots. Based on these empirical findings, the 60% scenario is recommended as the optimal design framework for improving thermal comfort in public spaces within humid tropical regions.

Keywords: thermal comfort, microclimate, ENVI-MET, multilayer vegetation, public open space, PALI.