

INTISARI

PEMANTAUAN DINAMIKA SPASIAL CAHAYA MALAM BERBASIS *BIN-SPECIFIC ANALYSIS DATA VIIRS-DNB PADA TIPOLOGI BEBERAPA WILAYAH PEMBANGUNAN DI INDONESIA (2018-2024)*

Penginderaan jauh cahaya malam (*Nighttime Lights*) menggunakan sensor satelit VIIRS-DNB telah banyak dimanfaatkan sebagai proksi aktivitas sosial-ekonomi, urbanisasi, dan dinamika pencahayaan malam pada berbagai skala spasial. Namun, transisi massal ke teknologi lampu modern memicu bias spektral serta menyamarkan perubahan distribusi spasial radiansi apabila hanya dievaluasi menggunakan indikator agregat. Oleh karena itu, penelitian ini menerapkan pendekatan *bin-specific analysis* secara temporal melalui platform Google Earth Engine (GEE) menggunakan citra VIIRS-DNB periode 2018–2024 untuk menganalisis dinamika pergeseran distribusi kelas radiansi pada lima provinsi dengan tipologi pembangunan berbeda di Indonesia. Hasil komputasi menunjukkan bahwa mayoritas wilayah Indonesia didominasi oleh perluasan kawasan berintensitas rendah (mengikuti Hukum Pareto) yang mengalami anomali peredupan meluas (*widespread dimming*) akibat bias spektral lampu LED. Berbeda dengan pola nasional, dengan DKI Jakarta yang telah mencapai saturasi tata ruang kota (distribusi unimodal) serta Sulawesi Tengah yang menunjukkan pemisahan ekstrem (*enclave economy*) akibat hilirisasi industri ekstraktif. Temuan penelitian ini menunjukkan bahwa pendekatan *bin-specific analysis* berpotensi menjadi dasar yang lebih objektif dalam evaluasi kebijakan tata ruang berbasis pencahayaan malam, sekaligus mendorong pemanfaatan sensor satelit malam multispektral untuk meningkatkan akurasi analisis ekonometrika geospasial di masa mendatang.

Kata kunci: Cahaya malam, Dinamika Spasial, Penginderaan Jauh, Polusi Cahaya, *Rebound Effect*, VIIRS-DNB

ABSTRACT

MONITORING SPATIAL DYNAMICS OF NIGHT-TIME LIGHT BASED ON BIN-SPECIFIC ANALYSIS OF VIIRS-DNB DATA IN VARIOUS TYPES OF DEVELOPMENT AREAS IN INDONESIA (2018–2024)

Remote sensing of night-time lights (NTL) using the VIIRS-DNB satellite sensor has been widely utilised as a proxy for socio-economic activity, urbanisation and night-time lighting dynamics at various spatial scales. However, the widespread transition to modern lighting technology introduces spectral bias and obscures changes in the spatial distribution of radiance when assessed solely using aggregate indicators. Therefore, this study employs a temporal bin-specific analysis approach via the Google Earth Engine (GEE) platform, using VIIRS-DNB imagery from 2018–2024 to analyse the dynamics of shifts in the distribution of radiance classes across five provinces with different development typologies in Indonesia. Computational results indicate that the majority of Indonesia's territory is dominated by the expansion of low-intensity areas (following Pareto's Law), which exhibit widespread dimming anomalies due to the spectral bias of LED lighting. In contrast to the national pattern, DKI Jakarta has reached urban spatial saturation (unimodal distribution), whilst Central Sulawesi exhibits extreme (enclave economy) due to the downstream processing of extractive industries. The findings of this study suggest that the bin-specific analysis approach has the potential to serve as a more objective basis for evaluating spatial planning policies based on night-time lighting, whilst also encouraging the use of multispectral night-time satellite sensors to improve the accuracy of geospatial econometric analyses in the future.

Keywords: Night-time Light, Spatial Dynamics, Remote Sensing, Light Pollution, Rebound Effect, VIIRS-DNB