Mitigating Urban Heat Island Effects via Spatial Planning Integration and Optimization of Urban Green Spaces and Built-up Density in Southeast Sulawesi

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Abstract

Rising surface temperatures due to the Urban Heat Island (UHI) phenomenon have become a critical environmental challenge in Kendari and Baubau Cities, Southeast Sulawesi, driven by rapid urbanization, reduced Green Open Space (GOS), and unregulated building density. This study aimed to analyse the dominant factors influencing UHI, evaluate the gaps in spatial planning policies, and develop context-specific mitigation strategies. Using a mixed-method approach combining spatial analysis (NDVI, NDBI, LST), policy document review, and SWOT analysis, the research revealed distinct determinants: in Kendari, vegetation density played a key role in cooling, whereas in Baubau, built-up density was the dominant warming factor. Existing spatial policies were found to be normative and ineffective, with GOS coverage reaching only 11.81% in Kendari and 12.3% in Baubau, poorly distributed, and with weak enforcement of building density regulations. The study concludes that evidence-based, differentiated strategies are essential; Kendari requires the redistribution of GOS and the expansion of functional green space, while Baubau needs strict control of Floor Area Ratio (FAR) and building density. Recommendations include integrating spatial indicators into policy, strengthening legal instruments, and fostering multi-stakeholder collaboration to achieve sustainable, climate-resilient urban development.

Keywords: Building Density, Green Open Space, Spatial Policy, Sustainable Urban Development, Urban Heat Island

1. Introduction

Urban Heat Island (UHI) is a phenomenon of increasing air temperature in urban areas compared to their surroundings, primarily due to anthropogenic activities and land cover change [1][2][3] and [4] In Southeast Sulawesi Province, population growth and urbanisation, which have reached 4.2% annually since 2015, have resulted in the conversion of green land into impervious surfaces by up to 28% in Kendari City [5]. Landsat 8 satellite imagery data show an average land surface temperature (LST) increase of 2.8°C during 2015–2023 in major urban areas such as Baubau [6]. This condition is exacerbated by the deficit of Green Open Space (GOS), which only accounts for 12.3% of the total city area in Baubau [7]. In comparison, Kendari City has only 11.81% GOS coverage [8][9] and [10], far below the 30% standard mandated by Law No. 26/2007. The impact of UHI is not only reflected in higher energy consumption for cooling (15–20%), but also in worsening health risks, such as heatstroke and respiratory disorders[11].

Previous studies have mostly emphasised UHI in major Indonesian cities such as Jakarta, Surabaya, and Bandung [12]. However, the lack of comparable research in eastern Indonesia, particularly in Southeast Sulawesi, has led to local spatial planning policies that do not adequately incorporate microclimate mitigation. UHI phenomena in Southeast Sulawesi, especially in Kendari and Baubau, have been identified [6][13] and [14]. Findings suggest that the expansion of built-up land contributes significantly to temperature rise, leading to broader areas exposed to UHI.

The potential occurrence of UHI in this region is supported by empirical evidence from other studies that identify relevant driving factors. One study [15] found that energy consumption and CO_2 emissions in Baubau City continue to increase, contradicting the goal of achieving a green city. This condition may further aggravate UHI, underscoring the need for effective UHI-based environmental mitigation policies. In Kendari City, UHI is influenced by land degradation, declining environmental quality, and the limited capacity of the existing GOS to significantly reduce emissions [16] and [17]. Supporting this, both Kendari and Baubau, as medium-sized and growing cities, face significant challenges in adopting sustainable city concepts [18] and [19]. Nevertheless, solutions to these environmental phenomena lie environmental governance and policy, land use and building management, waste management, and environmental control [16]. These factors are key to reducing the impacts of UHI.

Furthermore, the hilly topography and humid tropical climate of Southeast Sulawesi also contribute to unique patterns of heat distribution [20]. In terms of policy, the disparity between spatial planning (RTRW) and its implementation, particularly regarding building density control, has accelerated environmental quality degradation [21]. Previous analyses [6][13] and [14] require further exploration and updates to earlier findings [1][2] and [3] by integrating spatial and ecological data-based policies in examining UHI. Both theoretically and practically, integrating spatial planning policies with spatial ecological data offers a critical solution for effectively mitigating UHI, particularly in this region.

Recent studies on UHI, as found in ScienceDirect, SpringerLink, and Google Scholar, have primarily focused on cool pavement technologies [22] or green roofs [23], with limited attention to integrating spatial planning policies. This study offers novelty through a multidisciplinary integration approach that combines urban ecology, public policy, and data science into a comprehensive UHI mitigation model. The key distinction from the three prior studies [6][13] and [14] lies in the integration of technical aspects (such as remote sensing) with spatial planning policies, thereby providing a more holistic solution for UHI mitigation in urban areas. Based on the above background, this study addresses three main research questions: (1) How is the relationship between green open space distribution, building density, and UHI intensity in the urban areas of Southeast Sulawesi Province? (2) What are the weaknesses of existing spatial planning policies in integrating UHI mitigation?

2. Study Area

The study was conducted in two coastal cities of Southeast Sulawesi, Indonesia. Kendari and Baubau. (Figure 1). Both cities are strategically located along the coastline and serve as important regional hubs with distinct geographic and socio-economic characteristics. Kendari, the provincial capital, lies at approximately 3°58′20″ S and 122°30′54″ E (−3.9722°, 122.5149°). The city covers about 270 km² and is situated on the eastern coast of Sulawesi Island, bordering Kendari Bay. Its coastal morphology is characterized by lowland plains, mangrove wetlands, and gently sloping hills that rise to 450 meters. Baubau, positioned at around 5°28′37″ S and 122°36′60″ E (−5.4770°, 122.6166°), lies on the southwestern coast of Buton Island. The city extends over 295 km², including approximately 30 km² of marine territory, and is bordered by the Buton Strait. Its landscape combines coastal plains with hilly and mountainous zones that rise modestly from sea level. Today, Baubau plays an important role as the economic nucleus of Buton Island and is envisioned as a growing maritime hub, supported by expanding port facilities and strategic sea connections within eastern Indonesia.

3. Material and Methods

3.1 Land Surface Temperature (LST)

Land Surface Temperature (LST) is a fundamental parameter for understanding surface atmosphere interactions and plays a crucial role in Urban Heat Island (UHI) analysis. LST retrieval from Landsat imagery primarily relies on thermal infrared (TIR) bands, specifically 10.40–12.50 µm for Landsat 7 and 10.60–11.19 µm for Landsat 8/9. To achieve accurate LST estimates, raw thermal data must undergo a series of conversions, including the transformation of digital number (DN) values into spectral radiance, followed by conversion to at-satellite brightness temperature (BT)[24]. The conversion from DN to spectral radiance is expressed in Equation 1:

$$L_\lambda = M_L Q_{cal} + A_L$$

Equation 1

Where L_λ is spectral radiance ($W \cdot m^{-2} \cdot sr^{-1} \cdot \mu m^{-1}$), M_L and A_L are multiplicative and additive rescaling factors and Q_{cal} is the calibrated *DN*.

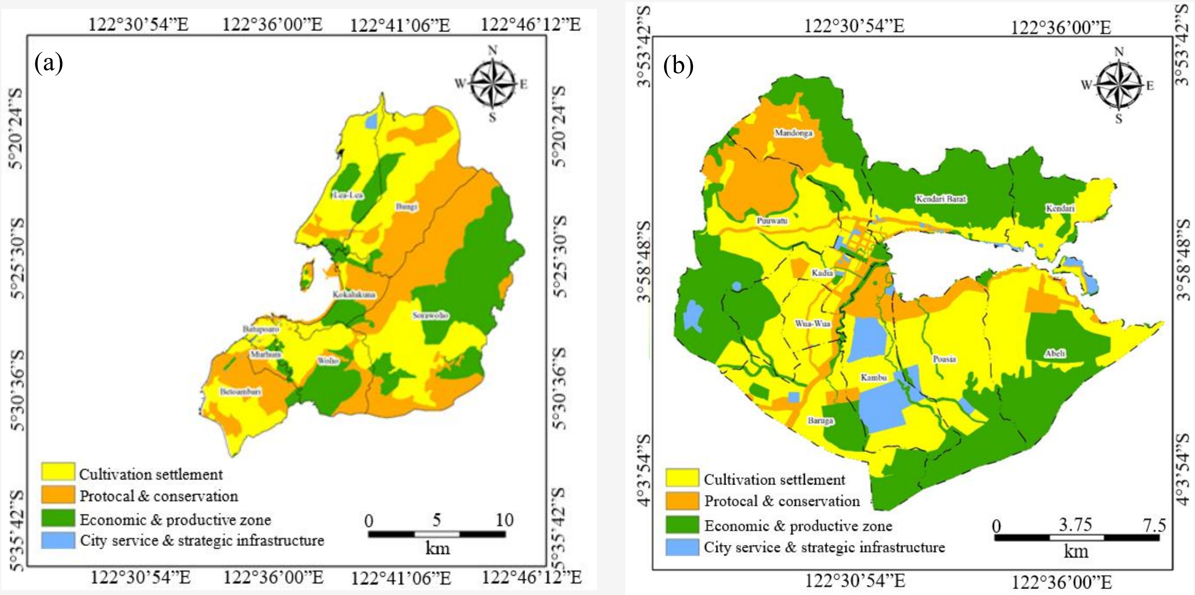

Figure 1: Space pattern (a) BauBau city, and (b) Kendari city

The spectral radiance is then converted into brightness temperature (T_b) using the thermal calibration constants are calculated in Equation 2 [25]:

$$T_b = \frac{K_2}{\ln\left(\frac{K_1}{L_\lambda + 1}\right)}$$

Equation 2

Where K_1 and K_2 are band-specific thermal constants.

Since brightness temperature corresponds to blackbody radiation, further correction is needed to account for Land Surface Emissivity (LSE), which varies with land cover. The corrected LST can be calculated in Equation 3 [26]:

$$LST = \frac{T_b}{1 + \frac{XT_b}{\rho}\ln\varepsilon}$$

Equation 3

Where λ is the effective wavelength of TIRS Band 10 (10.8 µm), $\rho = 1.438\times10^{-2}$ mK is a constant derived from Planck's law, and ε is land surface emissivity.

Emissivity (ε) is typically estimated from vegetation fraction, using the NDVI-based approach proposed by [27]. It is modeled in Equation 4:

$$\varepsilon = m.\, P_v + n$$

Equation 4

Where m = 0.004 (soil emissivity), n = 0.986 (vegetation emissivity), and P_v is the proportion of vegetation cover [28], given in Equation 5:

$$P_v = \left(\frac{NDVI - NDVI_{\min}}{NDVI_{\max} - NDVI_{\min}}\right)^2$$

Equation 5

NDVI (Normalized Difference Vegetation Index) is calculated in Equation 6 from Landsat OLI bands [29]:

$$NDVI = \frac{\rho_{NIR} - \rho_{RED}}{\rho_{NIR} + \rho_{RED}}$$

Equation 6

Where ρ_{NIR} and ρ_{red} correspond to surface reflectance in the near-infrared (Band 5) and red (Band 4) bands, respectively.

In summary, the LST retrieval process involves the following steps: Thermal DN → Spectral Radiance → Brightness Temperature → Emissivity Correction → LST (°C). This NDVI-based emissivity approach has been widely applied in urban thermal studies. It has been shown to improve retrieval accuracy compared to traditional mono-window and single-channel methods [30] and [31].

3.2 Normalized Difference Built-up Index (NDBI)

NDBI is designed to highlight built-up and impervious surfaces by exploiting the spectral difference between shortwave infrared (SWIR) and near-infrared (NIR) reflectance. It is computed in Equation 7:

$$NDBI = \frac{\rho_{SWIR} - \rho_{NIR}}{\rho_{SWIR} + \rho_{NIR}}$$

Equation 7

Where:

ρ_{SWIR} = reflectance in the shortwave infrared band (Band 6, Landsat 8/9 OLI),

ρ_{NIR} = reflectance in the near-infrared band (Band 5, Landsat 8/9 OLI).

Positive NDBI values generally correspond to impervious or built-up areas, while negative values are associated with vegetated or water-covered surfaces [32].

3.3 Multivariate Regression Modeling to Examine the Relationship of NDVI and NDBI with LST

To quantitatively assess the relationship between vegetation density, built-up density, and surface thermal patterns, a multiple linear regression (MLR) model was employed. The approach allows evaluation of how NDVI and NDBI act as explanatory variables influencing LST as the dependent variable. This method has been widely applied in urban climate studies to model the contribution of land cover indicators to surface temperature variations [33] and [34]. The regression model is formulated in Equation 8:

$$LST = \beta_0 + \beta_1 NDVI + \beta_2 NDBI$$

Equation 8

Where:

LST = Land Surface Temperature (°C),

β_0 = intercept term,

β_1, β_2 = regression coefficients for NDVI and NDBI, respectively,

4. Results and Discussion

4.1 Multivariate Regression Modeling to Examine the Relationship of NDVI and NDBI with LST

The regression analysis presented in Table 1 demonstrates that the Urban Heat Island (UHI) phenomenon in Baubau and Kendari results from complex interactions between land cover characteristics and local urban features. While the relatively low R² values (0.14 for Baubau and 0.29 for Kendari) indicate that NDVI and NDBI alone cannot fully account for land surface temperature (LST) variability, the models nonetheless offer valuable insights into the relative influence of these spatial factors on UHI patterns.

Table 1: Regression statistic BauBau City and Kendari City

Regression Statistics	BauBau city	Kendari city
Multiple R	0.377	0.536
R Square	0.142	0.287
Adjusted R Square	0.124	0.272
Standard Error	1.939	1.363
Observations	100	100

These moderate R² values are consistent with findings [35], which emphasized that comprehensive UHI modeling requires approaches that extend beyond fundamental land cover indicators. Additionally, our spatial patterns align with [36], who documented significant landscape composition effects on LST in Southeast Asian megacities. The results further corroborate previous studies [37] and [38], highlighting how the thermal regulation capacity of vegetation and built-up areas depends critically on local contextual factors, including urban morphology, surface materials, and anthropogenic activities. Consequently, while these findings provide preliminary evidence for differentiated policy approaches in each city, they also underscore the need to incorporate site-specific variables and develop more comprehensive modeling frameworks to represent urban thermal dynamics in future research accurately.

Nevertheless, despite the relatively low R² values (Table 1), the regression coefficients of NDVI and NDBI still demonstrate theoretically consistent directions of influence. Specifically, NDVI shows a negative association with LST, indicating that increased vegetation cover reduces surface temperature. At the same time, NDBI exhibits a positive association with LST, suggesting that higher built-up density is associated with surface temperature increases [39][40] and [41]. Statistical analysis (Table 2) further reveals that in Baubau, a one-unit increase in NDBI is estimated to raise LST by 9.513 °C, the regression model is $LST = 36.16 - 2.061NDVI + 9.513NDBI$. In contrast, in Kendari, the statistical model (Table 3) suggests that a one-unit increase in NDVI is expected to reduce LST by 4.751 °C. The regression model is $LST = 28.4 – 4.751NDVI + 0.564NDBI$, while the NDBI coefficient shows no statistical significance ($p=0.717$). This clear statistical evidence confirms that vegetation density, rather than built-up areas, is the primary factor influencing thermal conditions in Kendari. The statistical insignificance of NDBI ($p=0.717$) underscores that building density regulations would a have limited impact on UHI mitigation in Kendari without concurrent vegetation enhancement. These findings highlight the critical role of vegetation and built-up density in shaping urban thermal environments. They are highly relevant for UHI mitigation frameworks, particularly through the optimization of urban green spaces and the regulation of building density within urban spatial planning policies. The divergence in both R^2 values and statistical significance between the two cities reflects their distinct phases of urban development. This contrast in variable significance, where NDVI is insignificant in Baubau but highly significant in Kendari, validates the need for context-specific UHI mitigation strategies that account for different urban development trajectories. As shown in Table 2 in Baubau, although the overall regression model is significant (*p*-value Regression = 0.000595). LST is more strongly influenced by NDBI (*p*-value = 0.003). At the same time, the effect of NDVI is statistically insignificant (*p*-value = 0.338). Indicating that vegetation is not a primary determinant of UHI in this city. This statistical insignificance contrasts sharply with Kendari where NDVI showed a strongly significant influence underscoring the fundamental differences in UHI drivers between the two urban contexts. This indicates that Baubau has entered a phase of urban consolidation. Characterized by a compact city center where dense building materials dominate and contribute substantially to heat retention. Baubau's urban core is relatively narrow with a high concentration of built-up areas, thus, even small changes in building density have a pronounced impact on surface temperature. Conversely, NDVI is not significant due to the presence of extensive vegetated areas (secondary forests, plantations, and vacant lands) surrounding the city, which reduces the contrast in vegetation cover across the study area. This finding is consistent with previous studies reporting that in historically dense urban centers, building materials tend to be the primary drivers of the UHI effect [36].

In contrast, in Kendari, which is undergoing rapid urban expansion. LST sensitivity is more strongly associated with NDVI. indicating that vegetation loss is the primary driver of rising temperatures (*p*-value Regression = 3.10^{-5}). As the provincial capital of Southeast Sulawesi. Kendari has experienced rapid land-use conversion, with urban forests, paddy fields, and plantations being replaced by residential and commercial areas. This process creates a sharp contrast between high-vegetation and low-vegetation zones, intensifying surface temperature variations. Such dynamics are in line with findings that in fast-growing cities, the conversion of green cover into built-up land is a significant determinant of UHI formation [42].

Table 2: Output regression BauBau City

	df	**SS**	**MS**	**F**	**Significance (p)**
Regression	2	60.372	30.186	8.026	0.001*
Residual	97	364.835	3.761		
Total	99	425.207			

Parameter	**Coefficients**	**SE**	**t Stat**	**p-value**	**Lower 95%**	**Upper 95%**
Intercept/constant	36.160	0.975	37.105	0.000**	34.226	38.094
NDVI	-2.061	2.140	-0.964	0.338*	-6.308	2.185
NDBI	9.513	3.107	3.062	0.003**	3.348	15.679

*Not Significant
**Significant

Table 3: Output regression Kendari City

	df	***SS***	***MS***	***F***	***Significance (p)***
Regression	2	72.456	36.228	19.509	0.000*
Residual	97	180.128	1.857		
Total	99	252.584			

Parameter	**Coefficients**	**SE**	**t Stat**	**p-value**	**Lower 95%**	**Upper 95%**
Intercept/constant	28.044	0.499	56.197	0.000	27.053	29.034
NDVI	-4.751	0.793	-5.989	0.000**	-6.325	-3.177
NDBI	0.564	1.549	0.364	0.717*	-2.511	3.639

*Not Significant
**Significant

Despite these differences in variable sensitivity, both NDVI and NDBI simultaneously influence LST in Baubau and Kendari, as indicated by the significance of the overall regression model (*F*-test significance < 0.005). The spatial analysis reveals distinct urban patterns between the two cities, as evidenced in Figures 2-4. In Baubau City (Figure 2), concentrated built-up areas indicated by high NDBI values (red - brown) are primarily located in Murhum, Batupoaro, and Betombari, while extensive vegetation coverage (dark green NDVI) dominates the eastern and northern regions. Conversely, Kendari City (Figure 3) exhibits widespread urban sprawl with high NDBI values across multiple districts and fragmented NDVI patterns showing vegetation loss in urban centers with preservation in peripheral areas.

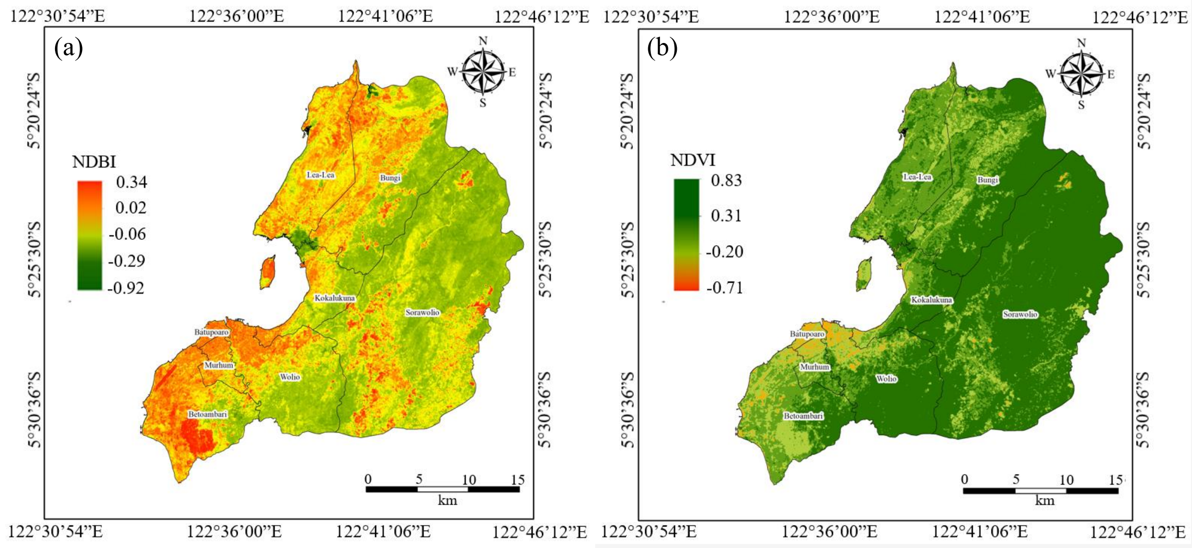

Figure 2: Spectral indices in BauBau city (a) NDBI, and (b) NDVI

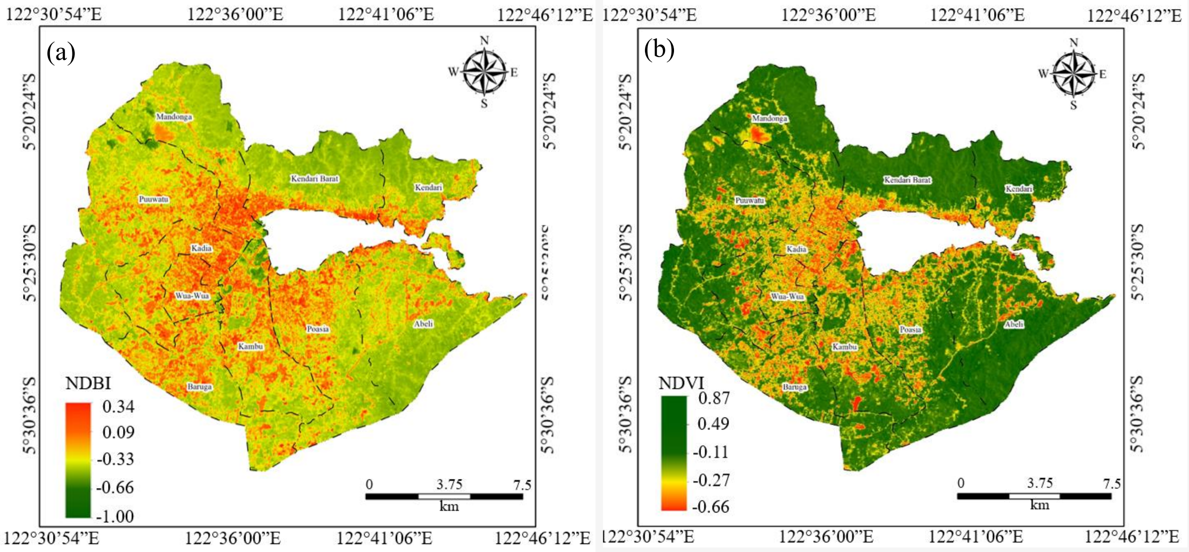

Figure 3: Spectral indices in Kendari city (a) NDBI, and (b) NDVI

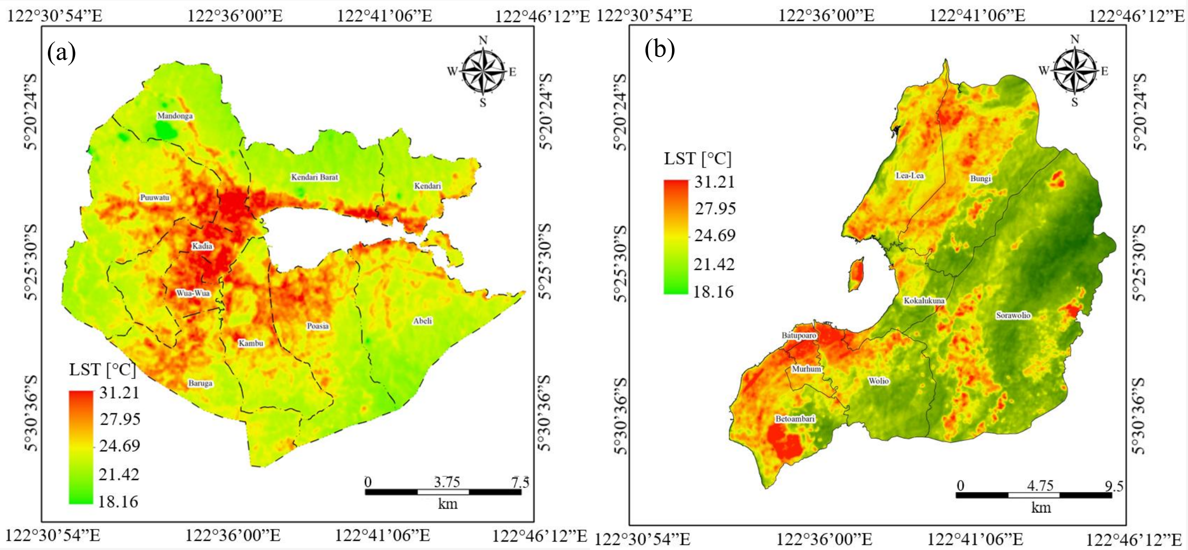

Figure 4: LST (a) Kendari city, and (b) BauBau city

The Land Surface Temperature patterns (Figure 4) demonstrate that high-temperature zones (red) strongly correlate with built-up areas and vegetation deficit in both cities, with Kendari showing extensive UHI coverage while Baubau exhibits localized thermal hotspots corresponding to its urban clusters, reflecting their different urban development characteristics and thermal vulnerability patterns.

The policy implications of these findings underscore the importance of adopting context-specific approaches in mitigating the Urban Heat Island (UHI) effect. For cities such as Baubau, policy interventions should prioritize the regulation of building materials and the optimization of green open spaces (GOS) within densely built areas [43] and [44]. This is consistent with studies highlighting the effectiveness of high-albedo materials in reducing surface temperatures [42][44] and [45]. In contrast, for rapidly expanding cities like Kendari, policies should focus on protecting existing green areas and promoting urban reforestation, in line with recommendations emphasizing large-scale vegetation planting strategies as a key mitigation pathway in fast-growing urban regions [46]. These contrasting approaches suggest that there is no "one-size-fits-all" solution to UHI mitigation. as strategies must be tailored to the developmental stage and spatial configuration of each city.

For future research, a more comprehensive modelling framework is required by incorporating additional variables such as urban morphology, surface albedo, and anthropogenic activities. As previously suggested, accurate UHI modelling necessitates multi-variable integration, encompassing both physical and socio-economic dimensions [35]. Furthermore, the integration of high-resolution remote sensing data with in-situ field measurements could significantly enhance model accuracy, as demonstrated in studies that combine satellite observations with ground-based measurements for more precise UHI modelling [47].

4.2 Spatial Planning Regulation Analysis

Analysis of spatial planning documents (RTRW) and local regulations on Green Open Space in Kendari and Baubau (Table 4) reveals a significant gap between normative policies and on-the-ground implementation. Although regulations mandate a minimum of 30% Green Open Space (GOS) in accordance with Law No. 26 of 2007, actual achievement remains low. Only 11.81% in Kendari and 12.3% in Baubau, with uneven distribution mainly largely in peripheral areas. Urban cores, characterized by high population density and economic activity, suffer from severe vegetation deficit (<5%), despite clear evidence that green spaces play a critical role in mitigating urban heat distribution (44).

In addition to GOS deficit and spatial imbalance. Building density regulations are weakly enforced in both cities. In Kendari. The Building Coverage Ratio (BCR) in central zones frequently exceeds 70%, while Baubau experiences uncontrolled over-building. Regulations tend to prioritize economic interests over microclimate mitigation. These findings are further reinforced by spatial regression modeling.

Table 4: Comparison of Local Policies vs. UN-Habitat Standards

Policy Aspect	Kendari City	Baubau City	UN-Habitat Standards	Empirical Gaps
Proportion of Green Open Space (GOS)	Realization: 11.81%; target: 30%	Realization: 12.3%; target: 30%	Minimum 45% open space; 15–20% public green space	Both cities fail to meet national and international targets.
Distribution & Accessibility	GOS concentrated on the outskirts; <5% vegetation in the city center	City parks are symbolic, not inclusive; highly uneven distribution	Access to green space within 400 m of residence	Residents' access to green space is severely limited and falls short of global standards
Building Density (BCR)	Several core zones exceed 70% BCR; vegetation is lost	Overbuilding in the urban core; uncontrolled high density	Density control and integration of green infrastructure	Local policies fail to regulate land-use intensity
Evidence-Based Policy	GOS targets are normative; NDVI significantly reduces LST (–4.751°C)	Normative targets; NDBI significantly increases LST (+9.513°C)	Policies informed by spatial data and environmental indicators (NDVI. LST)	Spatial planning regulations do not incorporate available scientific evidence.

Current spatial planning policies remain normative and administrative in nature, lacking technical instruments and thus failing to effectively address Urban Heat Island (UHI) challenges [48][49] and [50]. Policy reform is urgently needed: Kendari requires GOS redistribution to urban cores through vertical gardens, green corridors, and optimized private yards, while Baubau must enforce strict building density controls including closer oversight of KDB/KLB, restrictions on construction permits in central zones. and enhanced socio-ecological functionality of urban parks.

4.3 SWOT Analysis

The SWOT factors were evaluated through expert weighting and scored based on their impact on UHI mitigation and policy feasibility. Scores were assigned on a scale of 1–4, aggregated, and plotted on a SWOT matrix. The resulting quadrant positions (WO and ST) guided the formulation of context-specific strategies. Based on the SWOT scoring results; internal strengths such as regulations and institutional support are still balanced against structural weaknesses. including the low achievement of green open space (GOS) targets and the weak implementation of density control. On the other hand, the external factors reveal those threats. in the form of development pressures and the Urban Heat Island phenomenon. are more dominant than opportunities offered by international standards or urban innovations. Accordingly, a visual representation of the SWOT quadrant will provide a clearer illustration of the strategic positioning of Kendari and Baubau, while also serving as the foundation for formulating relevant and applicable policy strategies. Based on Figure 5, the visualization of the SWOT quadrant derived from the scoring results shows that the strategic position of Kendari and Baubau lies between the WO (turnaround) and ST (defensive) quadrants.

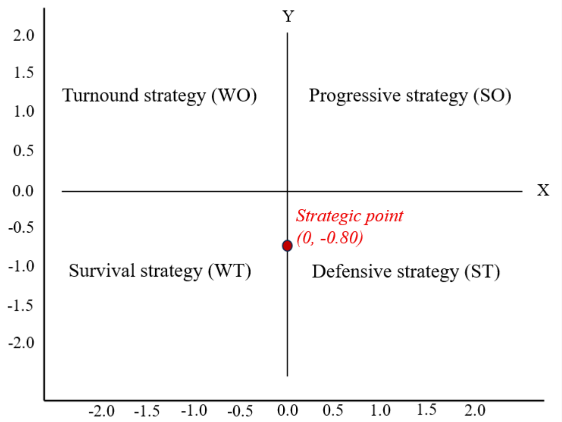

Figure 5: SWOT quadrant analysis

On the horizontal axis (internal factors), the difference between strengths (2.00) and weaknesses (2.00) yields a value of zero, indicating that internal strengths and weaknesses are in balance. This suggests that although both cities possess regulatory frameworks and institutional support, weaknesses such as the low achievement of green open space

(GOS) targets and the weak implementation of building density control effectively offset their internal strengths. On the vertical axis (external factors). the difference between opportunities (1.40) and threats (2.20) results in a negative value (–0.80), highlighting that external threats outweigh available opportunities. Development pressures, land-use conversion, and the intensifying Urban Heat Island phenomenon make both cities increasingly vulnerable, despite the opportunities offered by international UN-Habitat standards and sustainable urban innovations. Given this position, the most relevant strategies for Kendari and Baubau are not purely offensive (SO) strategies focused on expansion, but rather a combination of progressive and defensive strategies. Progressive strategies (WO) are necessary to address internal weaknesses by leveraging opportunities for instance, employing spatial data and urban greening technologies to improve the quality of GOS. Meanwhile, defensive strategies (ST) are essential to safeguard existing strengths against external threats. such as strengthening spatial planning controls to prevent further land-use conversion that threatens urban green space.

This visual interpretation underscores that the strategic position of Kendari and Baubau is inherently complex: on the one hand, there is room for improvement through data-driven innovation, while on the other, strong external threats necessitate protective and defensive measures. Therefore, the direction of spatial planning policies must balance progressive strategies for transformation with defensive strategies for protection. ensuring that efforts to mitigate the Urban Heat Island phenomenon can be pursued in a sustainably.

5. Conclusion

Based on the findings, it can be concluded that different dominant factors significantly influence the Urban Heat Island (UHI) phenomenon in Kendari and Baubau. The contrasting statistical significance of NDVI and NDBI between the two cities where vegetation significantly cools Kendari but shows no significant effect in Baubau validates the need for fundamentally different mitigation approaches. While the regression models explained moderate variance (R^2: 0.14-0.29). They successfully identified these critical contextual differences that should inform spatial planning policy.

However, the existing spatial planning policies in both cities remain essentially normative and administrative, with green open space (GOS) coverage far below the standard 11.81% in Kendari and 12.3% in Baubau and unevenly distributed, as core urban areas contain less than 5% vegetation. The implementation of building density control is also weak. with many core zones having a Building Coverage Ratio (BCR) above 70%. Moreover, the regulations lack both operational technical instruments and effective enforcement mechanisms. Therefore, this study recommends adopting contextual and evidence-based policy approaches: Kendari should focus on redistributing and expanding functional GOS, while Baubau needs to prioritize controlling building density through Floor Area Ratio (FAR) restrictions. The integration of spatial data (NDVI. NDBI. LST) into policy evaluation, consistent law enforcement, and multi-stakeholder collaboration is crucial to achieving sustainable and climate-resilient urban development in Southeast Sulawesi.

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