

Balancing Environmental Protection with Social Cohesion and Community Well-being in the City of Monroe, Louisiana, United States of America (USA): Case in Sustainable Urban Greenspace Management.

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Abstract

Urban greenspaces are vital to achieving sustainable, inclusive, and resilient cities. This study evaluates greenspace trends, accessibility, quality, and socio-environmental benefits in Monroe, Louisiana, from 2015 to 2025 using GIS and remote sensing techniques. Results reveal a decline of 8.5% in greenspace, reducing from 43.47 km² to 39.75 km², while developed areas increased by 21%. Notably, 6.83 km² of urban land was reclaimed into greenspaces, but this gain was overshadowed by the loss of 10.74 km² of greenspaces to urban development. A composite Well-Being Index, measured on a scale from 0 to 1, along with Social Cohesion Indicators, revealed significant spatial disparities, particularly in low-income neighborhoods, where greenspace quality and access were lower. These findings underscore the urgency of adopting inclusive and spatially targeted planning approaches that integrate environmental resilience with community well-being.

1. Introduction

Urban greenspaces, including parks, greenways, and community gardens, play an essential role in mitigating climate impacts, supporting biodiversity, and enhancing social well-being, as supported by the works of Kabisch et al. (2015) and Jennings et al. (2019). This recognition aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 on Sustainable Cities and Communities and SDG 13 on Climate Action, both of which emphasize the integration of nature-based solutions into urban development (United Nations, 2023). Despite this global recognition, implementation across cities remains

fragmented, especially in the southern regions of the United States, as highlighted in studies such as Maassen (2025).

The city of Monroe, Louisiana, faces a unique intersection of socio-economic and environmental challenges. With a poverty rate of 36% and a significant African American population comprising over 50%, Monroe is vulnerable to both environmental injustices and climate-related risks such as flooding and heatwaves (U.S. Census Bureau, 2022; Louisiana Watershed Initiative, 2022). Local parks, including Forsythe Park and Charles Johnson Park, serve as important communal assets. However, many of these greenspaces suffer from underinvestment, poor maintenance, and unequal geographic distribution (City of Monroe, 2023).

Although previous studies have explored the ecological and social functions of urban greenspaces, there remains a notable gap in integrating high-resolution geospatial analyses with social indicators to guide equitable greenspace interventions. Scholars such as Reyes-Plata and Villanueva-Vilchis (2021) and Zhang (2021) have emphasized the need for spatially informed and community-responsive approaches. In response to these gaps, this study aims to (1) quantify land use and land cover (LULC) changes from 2015 to 2025, (2) evaluate greenspace accessibility, quality, and social cohesion, and (3) develop a comprehensive Well-Being Index to support inclusive greenspace strategies for Monroe.

2. Literature Review

Urban greenspace management has increasingly been positioned at the intersection of environmental sustainability, public health, and social equity, particularly within mid-sized American cities characterized by uneven development patterns. Contemporary scholarship consistently emphasizes that green infrastructure planning must extend beyond ecological functionality to incorporate social cohesion, environmental justice, and community well-being as interdependent objectives. This integrated perspective is especially pertinent in the context of Monroe, Louisiana, where historical inequities, demographic composition, and environmental vulnerabilities shape both access to and the outcomes of greenspace interventions.

2.1 Urban Greenspace as Multi-Functional Socio-Ecological Infrastructure

The role of urban greenspaces has expanded significantly from recreational and aesthetic amenities to essential components of urban resilience and sustainability strategies. Gill et al. (2007) demonstrate that green infrastructure contributes to climate adaptation through temperature regulation, stormwater management, and air quality improvement, while Alibašić (2022) situates these functions within broader resilience planning frameworks that integrate environmental and institutional systems. The World Bank (2020) reinforces this position by advocating for the integration of green and gray infrastructure to address complex urban challenges through hybrid systems.

However, this infrastructural framing is insufficient when detached from social context. Kabisch et al. (2015) argue that greenspaces must be understood as socio-ecological systems in which ecological performance is mediated by human behavior, governance structures, and cultural interpretations. Similarly, Joynt (n.d.) conceptualizes a well-

functioning urban environment as one that aligns environmental efficiency with human-centered design and experience. When considered together, these perspectives indicate that environmental protection cannot be operationalized independently of social considerations. Instead, the effectiveness of green infrastructure depends on its capacity to simultaneously deliver ecological benefits and support inclusive, meaningful human engagement.

2.2 Health, Well-being, and the Social Function of Greenspaces

Extensive empirical evidence establishes a strong relationship between greenspace exposure and improved health outcomes. Hartig et al. (2014) synthesize findings demonstrating reductions in stress, improvements in cognitive functioning, and increased physical activity associated with contact with natural environments. Mitchell and Popham (2008) further show that access to greenspaces can mitigate health inequalities, particularly among socio-economically disadvantaged populations. Jennings et al. (2019) frame these benefits within a broader understanding of greenspaces as public health infrastructure in the United States.

Recent research advances this discussion by emphasizing the role of greenspaces in fostering social cohesion. Jennings et al. (2024) highlight that greenspaces act as social infrastructures that facilitate interpersonal interaction, trust, and collective identity formation. Nevertheless, Jennings et al. (2017) caution that these outcomes are contingent upon equitable access and inclusive design, particularly for historically marginalized communities. In this regard, the literature suggests that the health benefits of greenspaces are not solely derived from ecological exposure but are significantly shaped by social inclusivity and patterns of use. Consequently, interventions that prioritize environmental enhancements without addressing social accessibility may fail to achieve intended public health outcomes and may even reinforce existing disparities.

2.3 Environmental Justice, Accessibility, and Green Inequality

A critical body of literature interrogates the uneven distribution of greenspaces and their implications for environmental justice. Boone et al. (2009) demonstrate that park provision in U.S. cities reflects entrenched patterns of racial and economic segregation, resulting in disparities in both access and quality. Comber et al. (2008) extend this analysis by showing that accessibility is influenced not only by spatial proximity but also by network connectivity and

socio-cultural barriers, which differentially affect ethnic and religious groups.

Anguelovski et al. (2020) introduce the concept of green gentrification, providing evidence that investments in urban greening can lead to increased property values and the displacement of vulnerable populations. This introduces a fundamental tension between environmental improvement and social stability. When these studies are considered collectively, they reveal that greenspace development operates within broader socio-economic structures that can either promote inclusion or exacerbate inequality. Without deliberate policy interventions, environmental gains may be accompanied by social costs, thereby undermining social cohesion and long-term community well-being.

2.4 Participatory Governance and Community-Centered Approaches

In response to the limitations of top-down planning models, the literature increasingly emphasizes participatory and community-centered approaches to greenspace management. Damptey et al. (2022) demonstrate that citizen science initiatives can enhance biodiversity assessment while fostering local stewardship and environmental awareness. King et al. (2021) similarly show that youth-engaged citizen science contributes to reducing health inequities and advancing environmental justice.

The concept of social appropriation, as articulated by Reyes-Plata and Villanueva-Vilchis (2021), further underscores the importance of community ownership in achieving sustainable outcomes. Russ and Krasny (2017) highlight the role of environmental education in strengthening civic engagement and long-term stewardship of urban greenspaces. Synthesizing these perspectives, participatory governance emerges not merely as an inclusive process but as a critical mechanism for aligning environmental objectives with community needs. By embedding local knowledge and priorities into planning processes, cities can mitigate risks associated with exclusion, enhance legitimacy, and improve both ecological and social outcomes.

2.5 Policy Frameworks and the Monroe, Louisiana Context

Global and national frameworks reinforce the importance of equitable and sustainable greenspace planning. The United Nations (2023) identifies access to safe and inclusive green spaces as a key component of sustainable urban development, while the Trust for Public Land (2023) provides benchmarking tools for evaluating park systems

across U.S. cities. However, these frameworks often lack the specificity required to address localized socio-economic and environmental conditions.

In Monroe, Louisiana, local planning documents provide critical insight into these contextual dynamics. The City of Monroe (2023) Community Engagement and Parks Feedback Report identifies persistent concerns regarding accessibility, maintenance, and safety, indicating a disconnect between greenspace provision and user experience. The Monroe Parks and Recreation Department (2023) further highlights disparities in park quality and distribution across neighborhoods. These local findings are consistent with broader national trends, such as the decline in urban tree cover documented by Nowak and Greenfield (2018), which exacerbates environmental and social vulnerabilities.

The Louisiana Watershed Initiative (2022) situates greenspace within a resilience framework by emphasizing nature-based solutions for flood mitigation and climate adaptation. When considered alongside demographic data from the U.S. Census Bureau (2022), it becomes evident that greenspace planning in Monroe must address intersecting challenges related to environmental risk, socio-economic inequality, and community needs. Integrating insights from global frameworks, national trends, and local evidence, the literature indicates that effective greenspace management in Monroe requires a context-sensitive approach that simultaneously advances environmental protection, promotes social cohesion, and supports community well-being.

2.6 Conclusion of Literature Review

The literature demonstrates that urban greenspaces function as complex socio-ecological systems in which environmental, social, and governance dimensions are deeply interconnected. While their benefits for climate resilience, public health, and community cohesion are well established, persistent inequities in access, quality, and participation highlight the challenges of achieving balanced outcomes. In the context of Monroe, Louisiana, sustainable greenspace management will depend on integrating ecological objectives with inclusive, community-centered strategies that address structural inequalities while enhancing both environmental and social resilience.

3. Methods

3.1 Study Area

The study was conducted in Monroe, a city located in Ouachita Parish in northeastern Louisiana. Geographically, Monroe is positioned at approximately 32.5093°N latitude and 92.1193°W longitude. The area features a humid subtropical climate characterized by hot, humid summers and mild winters. Annual rainfall averages about 1400 mm, and the city sits within the flat Mississippi Alluvial Plain, with elevations ranging from 20 to 30 meters above sea level.

3.2 Data Collection and Processing

Data used in the analysis included classified LULC raster datasets from 2015, 2020, and 2025, with a spatial resolution of 30 meters. Vegetation health was assessed using Sentinel-2 NDVI imagery at 10-meter resolution and long-term MODIS NDVI data from 2015 to 2025. Land surface temperature (LST) data for 2015 and 2020 were extracted from MODIS daytime products. Additional datasets included local GIS layers representing road networks and population density. All spatial data were clipped to Monroe's administrative boundaries, reprojected for consistency, and masked to exclude non-relevant areas. Change detection was conducted through post-classification comparison, and NDVI and LST values were calculated using seasonal median composites to ensure temporal consistency (Figure 1)

3.3 Derived Metrics

Several metrics were derived from the data to support the analysis. Greenspace quality was assessed based on patch size, edge density, and core area measurements. Accessibility was evaluated using 300-meter buffers and 10-minute isochrone maps, alongside the percentage of the population living within walking distance to greenspaces. Social cohesion was analyzed using a composite index based on proximity to parks, patch connectivity, and gathering potential. The Well-Being Index was a weighted composite score incorporating NDVI (20%), greenspace accessibility (20%), greenspace quality (15%), gathering potential (15%), social cohesion (15%), road density (10%), and park access (5%).

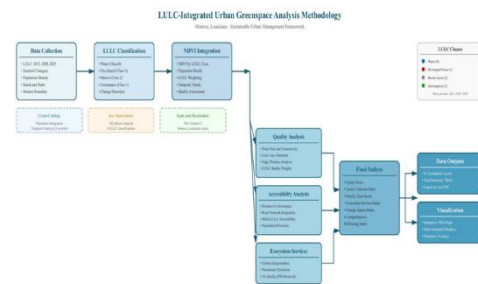


Figure 1: Methodology work flow

4. Results

4.1 LULC Trends (2015–2025)

Between 2015 and 2025, greenspace coverage in Monroe declined from 43.47 km² to 39.75 km², marking a total loss of approximately 8.5%. Concurrently, developed areas increased from 35.19 km² to 42.76 km², reflecting a 21% growth. Notably, 6.83 km² of urbanized land was reclaimed into greenspace, likely due to deliberate city planning interventions. However, 10.74 km² of greenspaces were converted into developed land, presenting a net loss and underscoring the dominance of urban expansion over greenspace preservation.

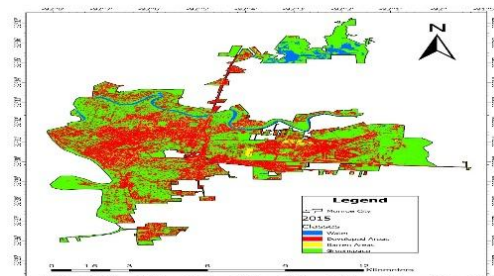


Figure 2: 2015 LULC of Monroe

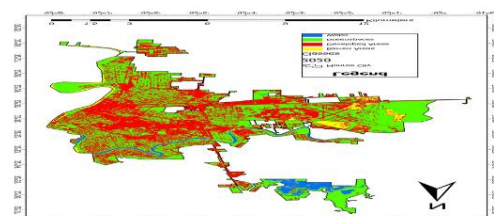


Figure 3: 2020 LULC of Monroe

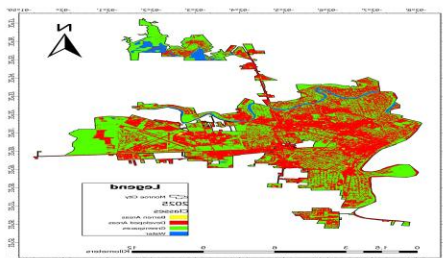


Figure 4: 2025 LULC of Monroe

4.2 Vegetation Health and Climate Resilience

The NDVI analyses from Sentinel-2 and MODIS datasets showed modest improvements in vegetation health within restored greenspaces. However, areas with high land surface temperatures and low NDVI values often coincided with neighborhoods of higher population density and lower income, indicating exposure to urban heat island effects.

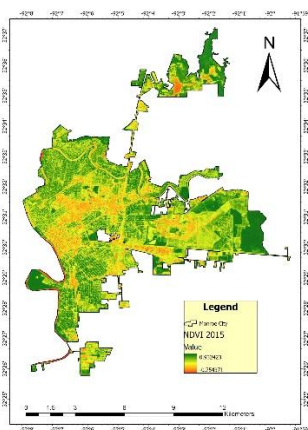


Figure 5: NDVI (2015) for Monroe

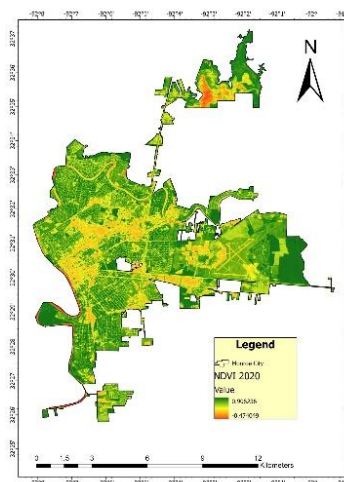


Figure 6: NDVI (2020) for Monroe

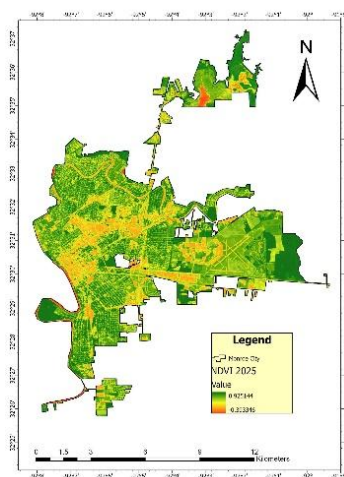


Figure 7: NDVI (2025) for Monroe

4.3 Accessibility and Quality Disparities

Analysis of greenspace accessibility revealed that only about 42% of Monroe's population resides within 300 meters of a greenspace. The lowest accessibility was observed in high-density, low-income neighborhoods. Greenspace quality assessments indicated high fragmentation, with elevated edge density and limited core areas, thereby reducing ecological function and user experience.

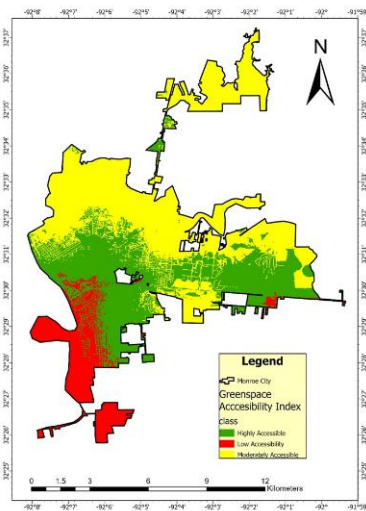


Figure 8: Green space accessibility in Monroe

4.4 Social Cohesion and Community Engagement

Mapping of the Social Cohesion Index revealed that the highest levels of community interaction potential were found in centrally located parks with good infrastructure and connectivity. While 19.9 km² of the city scored high for gathering potential, 27.7 km² had low scores, reflecting missed opportunities for enhancing social infrastructure.

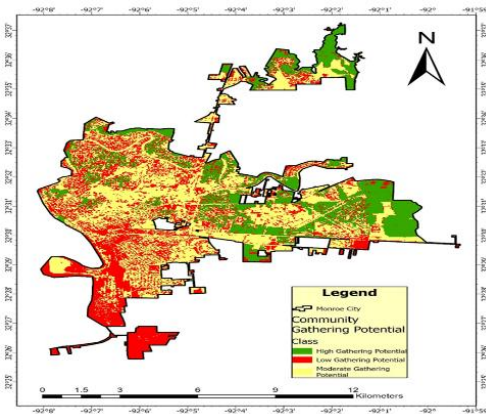


Figure 10: Community Gathering Potential for Monroe

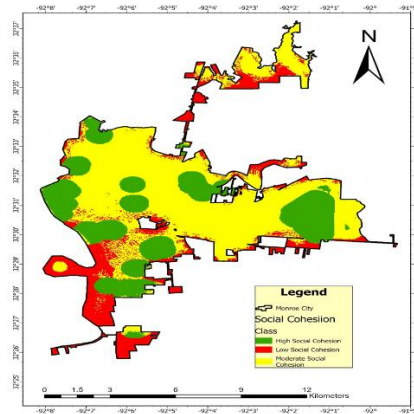


Figure 9: Level of social cohesion for Monroe

4.5 Ecosystem Services and Well-Being

Greenspaces in Monroe were found to provide substantial ecosystem services, including stormwater retention estimated at around 1.2 million cubic meters per year, carbon sequestration at roughly 18,000 tons annually, and air quality improvement through removal of approximately 72,000 kilograms of particulate matter. The Well-Being Index averaged 0.48 across the city, but certain neighborhoods scored below 0.3, aligning with high socio-economic vulnerability and limited greenspace benefits.

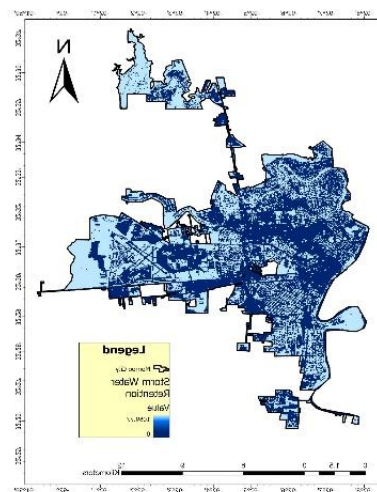


Figure 11: Stormwater retention for Monroe

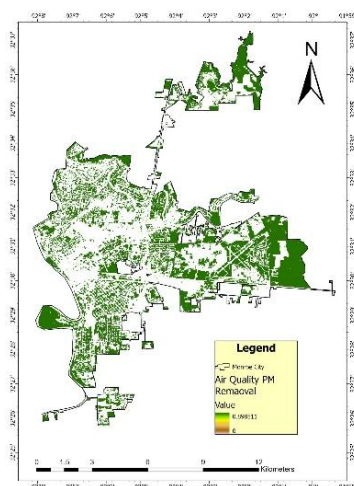


Figure 12: Air quality improvement for Monroe

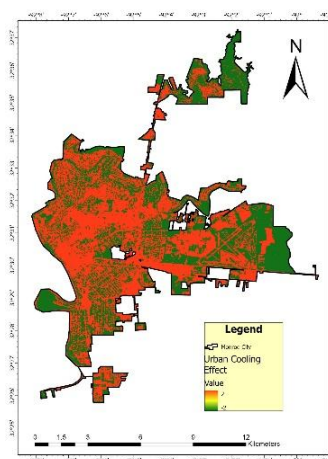


Figure: Urban Cooling Effect for Monroe

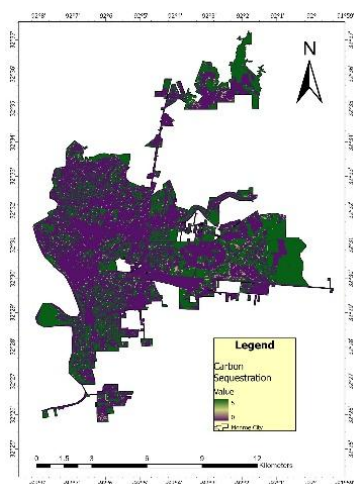


Figure 13: Carbon sequestration for Monroe

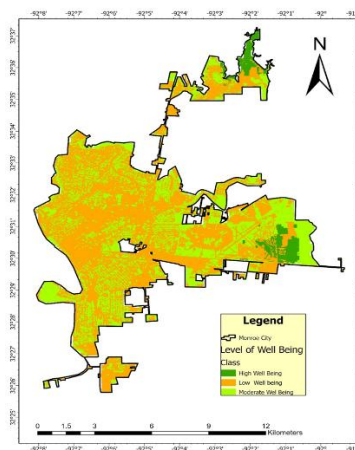


Figure 15: Community well-being for Monroe

5. Discussion

The observed 8.5% decline in greenspaces in Monroe aligns with national trends showing urban tree cover loss in many U.S. cities due to unchecked development and infrastructure expansion (Nowak & Greenfield, 2018). The reclamation of 6.83 km² of urban land into greenspaces offers hope, yet is insufficient to counterbalance the 10.74 km² lost to urban development. This trend resonates with studies by Rigolon et al. (2018) and Wolch et al. (2014), which highlight how development pressures often overshadow environmental and social priorities in city planning.

The spatial disparities in greenspace access and quality confirm findings by Comber et al. (2008), who emphasized how ethnic and socio-economic groups experience unequal

access to urban greenspaces. The fact that only 42% of Monroe's population lives within 300 meters of a greenspace, particularly in low-income zones, echoes prior research linking greenspace access with health inequities (Jennings et al., 2016; Mitchell & Popham, 2008).

The ecological fragmentation and low cohesion metrics observed in Monroe are consistent with studies by Gill et al. (2007) and Van den Berg et al. (2015), which argue that highly fragmented greenspaces provide fewer ecosystem services and less usable community benefits. Our Well-Being Index not only quantifies these disparities but also integrates environmental and social variables into a spatially meaningful framework, addressing calls for more holistic assessment tools as seen in Boone et al. (2009) and Reyes-Plata and Villanueva-Vilchis (2021).

Moreover, the urban heat patterns observed in vegetation-sparse areas support earlier studies indicating that inadequate greenery exacerbates local climate risks, especially in vulnerable communities (Hartig et al., 2014). The findings from the Social Cohesion Index, where gathering potential is limited in over half of Monroe's area, further reinforce literature showing that poorly planned greenspaces inhibit civic participation and collective identity (Kuo et al., 1998; Jennings et al., 2024).

These findings carry significant implications. Without targeted policies to expand and enhance greenspaces in underserved neighborhoods, Monroe may face worsening health disparities, diminished climate resilience, and reduced social cohesion. Future strategies should draw from inclusive, community-led models such as those presented by King et al. (2021) and Dampthey et al. (2022), where residents are directly involved in assessing, designing, and maintaining urban greenspaces.

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