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Review Article

Socio-Spatial Inequalities and Environmental Injustices: The Distribution of Green Infrastructure and Its Role in Gentrification

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ABSTRACT

Green Infrastructure has become a central strategy in urban sustainability and climate adaptation agendas, yet its benefits are unequally distributed across cities. This review investigates how the unequal distribution of Green Infrastructure contributes to environmental injustice and green gentrification. A systematic literature review was conducted in accordance with the PRISMA framework, with complementary bibliometric support, based on fifteen peer-reviewed articles published between 2019 and 2024 and indexed in the Scopus database. The findings show that unequal access to Green Infrastructure is associated with the displacement of low-income residents, shifts in neighbourhood demographic profiles, and the reproduction of existing socio-spatial inequalities. The review also indicates that interventions not guided by equity-oriented planning may intensify exclusionary urban dynamics. The study synthesises current evidence on the relationship between Green Infrastructure, environmental injustice, and green gentrification, while highlighting the need for inclusive and participatory urban policies capable of protecting vulnerable communities and promoting more equitable access to environmental benefits.

KEYWORDS

Environmental justice, Green infrastructure, Green gentrification, Socio-spatial inequality, Urban planning, Sustainable urban development.

INTRODUCTION

Urban greening initiatives, including the development of parks and the planting of trees, have become prominent strategies for promoting environmental equity in historically underserved communities. These interventions are frequently framed as efforts to mitigate environmental injustices by expanding access to ecological amenities.

Assessing the current condition of urban environments is fundamental to evaluating progress towards sustainability goals, particularly given that cities operate as complex systems characterised by multiple interconnections and dependencies. Within this complexity, neighbourhoods emerge as critical analytical units for examining social, economic, and

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environmental sustainability, as they represent the scale at which the impacts of urban policies are most directly experienced [1].

However, the introduction of green spaces in low-income and racially minoritised neighbourhoods may unintentionally catalyse processes of urban transformation, particularly through environmental or eco-gentrification [2]. This phenomenon involves the influx of higher-income populations into historically marginalised areas following improvements in green infrastructure, thereby altering the social and economic landscape of these neighbourhoods [3].

Green space development is frequently financed through mechanisms such as local taxation. While seemingly straightforward in policy design, such interventions often trigger market-driven responses, including increases in property values, rental prices, and land costs. These dynamics impose additional economic pressures on low-income residents and heighten the risk of displacement, thereby undermining the original equity-oriented objectives of greening initiatives [3]. As a result, urban planners and policymakers are increasingly confronted with a complex dilemma: how to expand access to green spaces in underserved areas without exacerbating socio-spatial inequalities or displacing vulnerable populations [4].

This challenge is particularly visible in dense urban contexts, where constraints related to land availability, vegetation management, and socio-spatial inequality shape uneven access to Green Infrastructure. Guangzhou is analytically relevant in this regard because it exemplifies the structural constraints and distributive inequalities that recur across the literature reviewed in this study. In this city, limited public land availability, restricted planting space, and insufficient financial and institutional capacity for tree maintenance contribute to low Urban Tree Canopy (UTC) coverage and poor vegetation health in low-cost housing areas, including older residential districts, urban villages, and resettlement housing estates [5]. More broadly, since the 1990s, large-scale investments in urban greening have contributed to the gentrification of several historically non-white neighbourhoods [6], reflecting a wider pattern in which Green Infrastructure becomes entangled with speculative urban development and neoliberal market dynamics [7].

Although the academic literature on green gentrification has expanded in recent years, much of the existing research has focused on city-wide analyses, often overlooking the local-scale spatial dynamics that shape these processes. Moreover, relatively few studies have comprehensively assessed both the objective characteristics (e.g. canopy cover and vegetation quality) and the subjective perceptions (e.g. sense of inclusion and aesthetic value) of Urban Green Areas (UGA), revealing significant gaps in the current knowledge base [8]. At the micro scale, individual housing choices—shaped by income, education, and cultural preferences—accumulate to form broader socio-economic and spatial patterns. Simulation models have been developed to examine neighbourhood resilience under varying scenarios of demographic inflows, including higher-income residents, students, tourists, and ethnically diverse populations [9].

However, similarly to broader patterns of urban gentrification, green gentrification may intensify socio-spatial polarisation, restrict access to urban resources, and reinforce existing social hierarchies. These processes may manifest through spatial differentiation, social exclusion, and class-based residential segregation, thereby deepening structural inequalities and reshaping the urban fabric in ways that disadvantage marginalised groups [10]. Although still relatively underexplored in certain urban contexts [11], the phenomenon of green gentrification underscores the need for nuanced, place-based research and the development of inclusive urban policies.

Gentrification refers to the transformation of historically disadvantaged neighbourhoods through the influx of more affluent residents, often accompanied by rising housing costs, socio-spatial restructuring, and the displacement of long-standing populations. In the context of urban greening, this process has been discussed as green gentrification, that is, when environmental improvements associated with Green Infrastructure generate uneven

distributive effects and exclusionary urban outcomes. Although the literature has consistently documented the environmental and public health benefits of GI, its social consequences—particularly those related to environmental injustice, displacement, and housing vulnerability—remain analytically fragmented. This review addresses that gap by examining how the unequal distribution of Green Infrastructure contributes to socio-spatial inequality and green gentrification.

Accordingly, this article engages with this debate by examining the relationship between Green Infrastructure (GI), environmental injustice, and gentrification processes, while emphasising the need for more inclusive and equity-oriented policies. Despite the recent expansion of studies on urban greening, the literature still lacks a sufficiently integrated review connecting GI distribution, environmental injustice, and green gentrification within a single analytical framework. This article addresses that gap by investigating how the unequal distribution of GI is associated with environmental injustice and gentrification processes. Its novelty lies in synthesising recent empirical findings, policy implications, and methodological patterns across the selected studies, thereby clarifying how greening strategies may simultaneously generate environmental benefits and exclusionary socio-spatial outcomes. In doing so, it advances a more integrated understanding of GI as both an environmental asset and a potential driver of distributive inequality when equity safeguards are absent.

To guide the review and strengthen the link between the study motivation, theoretical framing, and analytical synthesis, the following research questions are addressed:

RQ1. How does the distribution of Green Infrastructure affect urban communities in terms of environmental justice and access to resources? How do inequalities in Green Infrastructure distribution influence socio-economic disparities in urban areas? What are the impacts of limited Green Infrastructure provision in marginalised communities, such as low-income areas or ethnic minority groups?

RQ2. What mechanisms enable Green Infrastructure to intensify gentrification processes? How does the implementation of Green Infrastructure in urban areas attract real estate investment and alter the socio-economic profile of resident populations? Is there a causal relationship between increased Green Infrastructure provision and rising property values in cities?

RQ3. How does gentrification interact with environmental injustices in the context of Green Infrastructure? How do communities displaced by gentrification experience unequal access to the benefits of Green Infrastructure? What are the effects of gentrification in terms of excluding vulnerable groups from access to Green Infrastructure and other urban resources?

MATERIALS AND METHODS

This article is a systematic literature review structured in accordance with the PRISMA framework, with an additional bibliometric component used only to support the descriptive mapping of the reviewed corpus. Rather than generating primary empirical evidence, the study synthesises peer-reviewed literature on gentrification processes associated with the implementation of Green Infrastructure (GI). The review is exploratory and analytical in nature, as it aims to identify recurring patterns, conceptual approaches, and reported socio-spatial consequences related to the unequal distribution of GI. This methodological design allows for a more rigorous and coherent synthesis of the available evidence while preserving the distinct role of bibliometric analysis as a complementary, rather than inferential, resource [12].

The qualitative dimension of this review lies in the interpretive synthesis of the arguments, findings, and policy implications reported in the selected studies on Green Infrastructure (GI), environmental injustice, and green gentrification. Rather than directly analysing socio-environmental dynamics in specific urban settings, the review examines how these dynamics are conceptualised, evidenced, and discussed across the literature. This interpretive approach is particularly appropriate for addressing RQ1-RQ3, as it enables the identification of

recurring explanatory patterns, reported distributive effects, and proposed policy responses. When retained, the quantitative dimension is limited to the descriptive mapping of publication characteristics and bibliometric patterns within the reviewed corpus, serving only as a complementary resource to support the overall evidence synthesis [13].

Qualitative analysis was conducted through a systematic literature review structured around three main thematic axes: Green Infrastructure, Environmental Injustice, and Gentrification. Systematic reviews fulfil several essential functions, including providing an overview of the current state of knowledge within a given field, identifying gaps in existing research, supporting theory development or evaluation, and addressing questions that cannot be resolved through isolated studies [14].

The database selected for the literature review was defined according to criteria of topic relevance, source quality, interdisciplinary coverage, and reliability. Accordingly, Scopus was used as the primary platform for journal searches. The review focused on studies published between 2019 and 2024 in order to capture the most recent stage of debate, particularly following earlier foundational work on eco- and green gentrification and the more recent expansion of discussions on Green Infrastructure, climate adaptation, and environmental justice. The final literature search was conducted on 6 April 2025. The review methodology adopted to identify relevant articles was adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (**Figure 1**).

The process began with a preliminary exploration of the research topic and the definition of relevant keywords. The entire PRISMA process was conducted in pairs using a double-blind review approach, strictly adhering to predefined inclusion and exclusion criteria and to the guiding research questions, in order to preserve neutrality and minimise potential influence on article selection. Following the initial database search, 159 articles were identified and subjected to title and abstract screening using the Rayyan software, conducted independently by reviewers.

To examine existing evidence on the relationship between Green Infrastructure (GI), environmental injustice, and gentrification, the literature review followed an adapted PRISMA methodology. This approach was selected due to its methodological rigour and its capacity to support a structured and critical evaluation of the available literature, enabling the identification of patterns and knowledge gaps. In addition, PRISMA provides updated guidelines for conducting systematic reviews, reflecting advances in methods for study identification, selection, appraisal, and synthesis [14].

Search terms were defined through the examination of keywords used in related studies and were subsequently organised into thematic categories. Article searches were conducted in the Scopus database according to the following inclusion criteria: publication between 2019 and 2024; document type restricted to peer-reviewed journal articles, excluding conference papers, books, book chapters, and other formats; and language limited to English. Studies were considered eligible when their full texts were successfully retrieved after standard search and access procedures, allowing complete screening and assessment. In addition, eligibility was determined according to the conceptual scope adopted in this review, which defines Green Infrastructure (GI) as urban green and ecological structures or interventions associated with environmental, climatic, and socio-spatial functions. Therefore, studies were included when they addressed phenomena consistent with this conceptual framing, regardless of whether they provided an explicit standalone definition of GI. After finalising the eligibility criteria, the final search string was defined as follows:

TITLE-ABS-KEY(("green infrastructure" OR "green space" OR "urban space" OR "urban forestry" OR "urban parks" OR "urban green" OR "nature-based solutions") AND ("environmental justice" OR "social vulnerability" OR "environmental injustice" OR "gentrification" OR "inequality") AND ("geographic information systems" OR "satellite imagery" OR "GIS" OR "spatial analysis")) AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (LANGUAGE,"English")).

The research questions introduced at the end of the Introduction guided the eligibility assessment, screening procedure, and qualitative synthesis of the selected studies.

The review followed a structured PRISMA-based sequence comprising database selection, search string definition, eligibility criteria, title and abstract screening, full-text assessment, and final corpus selection. Studies were considered eligible when they addressed Green Infrastructure (GI) in urban contexts, particularly in relation to environmental injustice and gentrification, and were published in English between 2019 and 2024. The review included only original peer-reviewed journal articles with qualitative, quantitative, theoretical, or mixed-method designs, provided that they contributed substantively to the study's research questions. This procedure enabled a transparent and consistent identification of the final sample analysed in the review.

Table 1 presents the frequency with which each exclusion criterion was applied during the eligibility phase. Because these criteria were not mutually exclusive, a single article could meet more than one exclusion criterion. For this reason, the sum of the frequencies reported in **Table 1** does not correspond to the total number of unique articles excluded at this stage. Rather, the table identifies the most recurrent reasons for exclusion and supports the transparency of the selection process. The final numbers of excluded and included studies are reported in the PRISMA flow diagram, which should be considered the reference for the overall sample-selection logic.

Table 1. Frequency of Exclusion Criteria Applied during the Eligibility Phase

Exclusion criteria	Frequency of exclusion criterion
Rural or peri-urban focus outside the review scope	5
Literature review or other non-original publication type	3
Does not fit the conceptual scope of GI adopted in this review	30
Does not substantively address gentrification in relation to GI	128
Does not provide substantive evidence relevant to the review questions	4
Does not address distributive, functional, or socio-spatial dimensions relevant to the review	29

Source: Authors (2025)

Opinion pieces, editorials, non-empirical reports, studies not directly addressing the core themes, research focused on rural areas, publications outside the defined temporal or linguistic scope, and studies employing inadequate methodologies were excluded. The PRISMA selection process involved database searches using Scopus, followed by an initial screening to remove irrelevant publications and subsequent full-text assessments to evaluate relevance. The adapted PRISMA flow diagram (**Figure 1**) was used to illustrate and ensure transparency throughout the review process.

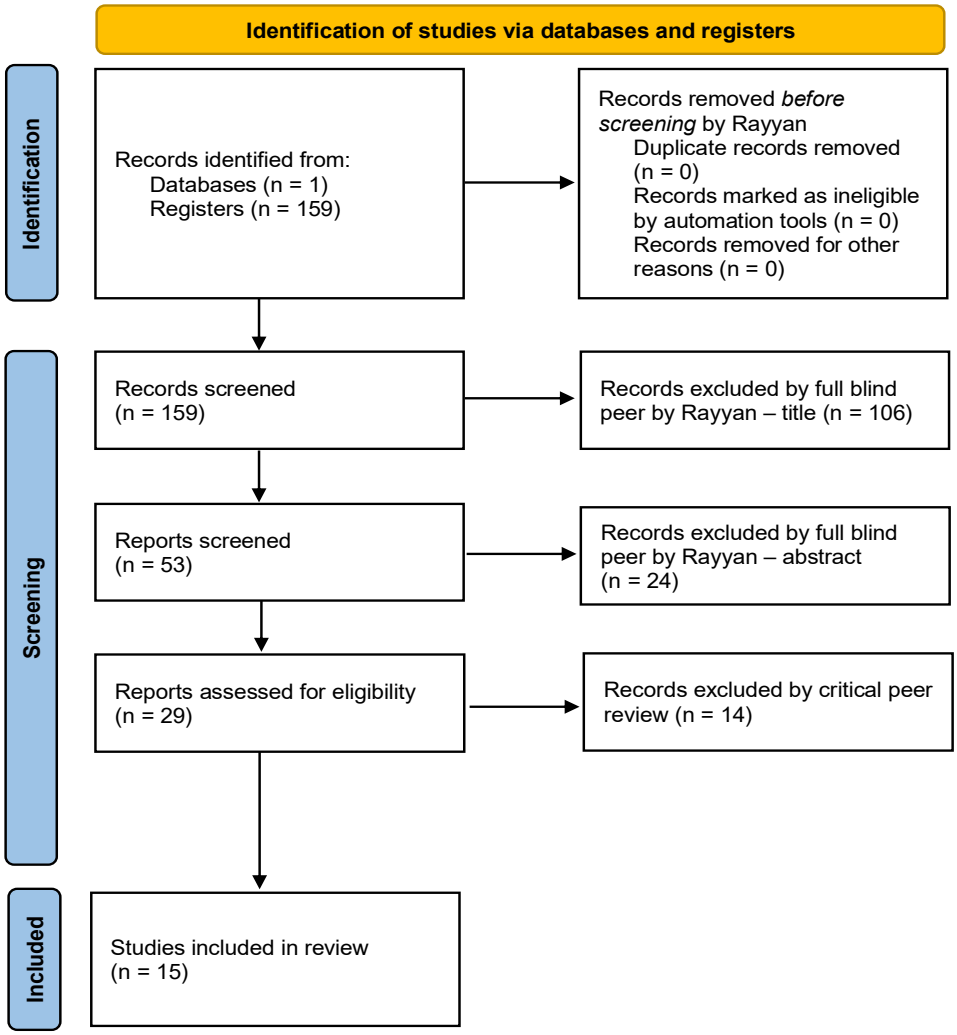

Figure 1. Steps in the application of the adapted PRISMA method [14]

For the quantitative component, as a complement to the systematic literature review (SLR), a bibliometric analysis was conducted using the VOSviewer software. This tool enables the identification and visualisation of relationships among bibliographic elements, such as keywords, authors, institutions, or countries, their evolution over time, and their associations with other attributes, including citation frequency.

Before generating the keyword co-occurrence maps, a thesaurus file was applied in VOSviewer to standardise exact lexical and morphological variants. This procedure was restricted to equivalent spelling variants, singular and plural forms, and unequivocal abbreviations, such as “greenspace”, “green spaces”, and “green space”, as well as “GIS”, “geographic information system”, and “geographic information systems”. Conceptually related but non-equivalent terms, such as “parks” and “green space”, or “urban growth” and “urban development”, were not merged in order to preserve analytical specificity. Country names were excluded from the final visualisation to emphasise the conceptual and methodological structure of the literature rather than the geographical distribution of case studies. To improve the interpretability of the keyword frequency analysis, generic indexing terms, demographic descriptors, and geographical labels were excluded from the conceptual keyword ranking. Terms such as “article”, “human”, “city”, “urban area”, “China”, and “United States” were removed because they refer to publication metadata, broad spatial context, or study location rather than substantive conceptual categories. This filtering was applied only to the conceptual frequency figure and did not alter the systematic review corpus.

RESULTS AND DISCUSSION

The Results and Discussion section is organised in two stages to improve coherence. First, a concise bibliometric overview is presented as a descriptive characterisation of the reviewed corpus. Second, the substantive qualitative synthesis is developed around the research questions, followed by the discussion of public policy implications, the methodological profile of the reviewed studies, research gaps, and broader implications for sustainable development.

Bibliometric Analysis

A concise bibliometric analysis was retained only as a descriptive overview to contextualise the reviewed corpus before the qualitative synthesis. In this study, VOSviewer was used to identify keyword co-occurrence patterns and thematic clustering across the selected articles. This component does not serve as an independent source of inference; rather, it provides a limited visual and descriptive overview of how the main topics are connected in the selected literature.

In the network visualisation, nodes represent the items under analysis, and their size reflects occurrence frequency or relative weight within the dataset. The links between nodes indicate co-occurrence relationships, while link thickness expresses the strength of these associations. Colours identify the clusters generated by the VOSviewer algorithm, grouping terms that are more strongly connected and thus revealing the main thematic structures within the reviewed literature.

The map includes keywords with a minimum occurrence threshold of three. A thesaurus file was applied to standardise exact lexical variants, singular and plural forms, and unequivocal abbreviations. Country names were excluded from the final visualisation in order to emphasise the conceptual and methodological structure of the literature rather than the geographical distribution of case studies.

The network visualisation (**Figure 2**) shows the thematic structure of the reviewed literature through patterns of keyword co-occurrence. Before generating the final map, a thesaurus-based normalisation procedure was applied in VOSviewer to standardise exact lexical variants, singular and plural forms, and unequivocal abbreviations. For example, “greenspace” and “green spaces” were merged into “green space”, while “gis”, “geographic information system”, and “geographic information systems” were standardised as “GIS”. By contrast, conceptually related but non-equivalent terms, such as “parks” and “green space”, were kept separate in order to preserve analytical specificity.

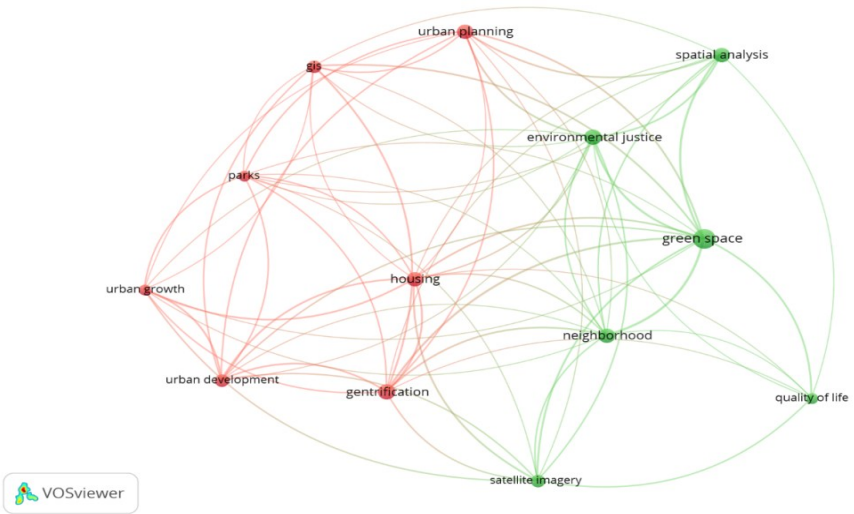

Figure 2. Normalised keyword co-occurrence network of the reviewed literature generated using VOSviewer.

The resulting network is organised around two major thematic clusters. One cluster links terms such as “green space”, “environmental justice”, “spatial analysis”, “neighborhood”, “quality of life”, and “satellite imagery”, indicating a strong focus on the socio-spatial distribution, assessment, and lived implications of urban green spaces. The other cluster connects terms such as “urban planning”, “parks”, “housing”, “gentrification”, “urban growth”, and “urban development”, suggesting that debates on green space are also embedded in broader discussions of planning, urban transformation, and housing dynamics. Taken together, these patterns indicate that the reviewed literature conceptually connects Green Infrastructure (GI) not only to environmental benefits, but also to socio-spatial inequality, urban governance, and potential exclusionary processes.

To complement the network visualisation, **Chart 1** presents the frequency of the most recurrent conceptual keywords identified in the reviewed corpus after thesaurus-based normalisation. This procedure reduced lexical fragmentation by merging exact spelling variants, singular and plural forms, and unequivocal abbreviations, thereby allowing a clearer representation of the dominant conceptual terms in the literature.

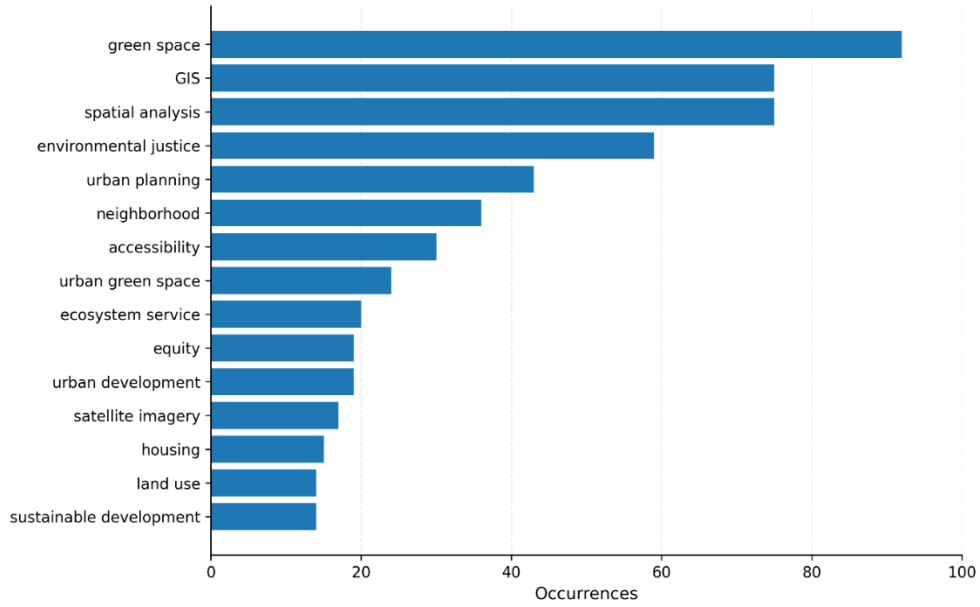

Chart 1. Frequency of the most recurrent normalised keywords in the reviewed corpus.

As shown in **Chart 1**, “green space” is the most frequent keyword in the reviewed corpus, followed by “GIS”, “spatial analysis”, and “environmental justice”. Other recurrent terms include “urban planning”, “neighborhood”, “accessibility”, and “urban green space”. This distribution suggests that the reviewed literature is strongly oriented toward geospatial approaches and socio-spatial concerns, particularly those related to the distribution, accessibility, and justice dimensions of urban green infrastructure. The frequency pattern also reinforces the centrality of spatial methods and planning-related debates in the analysis of Green Infrastructure (GI) and its uneven urban implications.

Systematic Literature Review: Research Questions, Public Policies, Tools Employed, Gaps, and Limitations

Analytical Synthesis of Findings Related to the Research Questions

The relationship between Green Infrastructure (GI) and gentrification has been widely discussed in the literature, but the evidence remains analytically heterogeneous, particularly with regard to the strength of inference, contextual variation, and long-term urban effects [2]. Across the reviewed studies, there is broad convergence that GI interventions are associated

with environmental improvements and enhanced quality of life [9]. At the same time, many studies report that these interventions may coincide with rising property values, reduced housing affordability, and pressures on long-standing and socially vulnerable residents in previously marginalised areas. However, the strength of these conclusions varies across the literature: some studies identify correlations between GI development and exclusionary urban outcomes, whereas others, depending on their design and temporal scope, offer stronger evidence of displacement dynamics and socio-spatial restructuring. The reviewed evidence also suggests that outcomes differ across contexts, particularly according to housing market regulation, the type and scale of GI intervention, and the presence or absence of equity-oriented public policies. This helps explain why cities such as New York and Istanbul are often cited as cases where GI-related improvements have been linked to housing price increases and reduced affordability [3], while other contexts reveal more differentiated or policy-mediated effects.

Although some evidence suggests that gentrification effects may be mitigated over time, the literature offers limited insight into the mechanisms through which such mitigation can occur in an effective and sustainable manner [9]. The stabilisation of property values following green infrastructure interventions is not uniform across contexts [8], with local demographic structures and economic conditions playing a decisive role. In developing cities or in settings characterised by weakly regulated real estate markets, these dynamics tend to be more pronounced and difficult to manage, underscoring the need for robust and adaptive public policy responses.

Community participation emerges as a central strategy for mitigating gentrification impacts [8]. Integrating local residents into the planning and management of green infrastructure may help preserve neighbourhood social character while promoting more inclusive provision. Nevertheless, the effectiveness of participatory approaches depends on factors such as communities' organisational capacity and the willingness of public authorities to support inclusive governance [15]. The literature also cautions that, in the absence of effective participation, green infrastructure may disproportionately benefit higher-income groups, even when framed as a collective good [16]. Constraints including limited resources, political resistance, and insufficient awareness of gentrification dynamics may further undermine these strategies.

The findings also point to the need for more holistic analytical approaches [4]. Combining the creation of new green spaces with the revitalisation and improved management of existing ones may provide a more balanced understanding of gentrification processes [11]. An exclusive focus on new developments, without adequate planning of surrounding areas, risks intensifying socio-spatial inequalities [4], as displacement pressures may extend to adjacent neighbourhoods that remain underserved by high-quality infrastructure. Furthermore, the study highlights the importance of continuous monitoring of gentrification indicators—such as property values, transaction rates, and demographic changes—to capture the evolving dynamics associated with green infrastructure projects [11]. These indicators are essential for assessing both immediate impacts and longer-term structural transformations [17]. The lack of longitudinal analyses remains a significant gap in the literature, particularly given the heterogeneity of gentrification processes across urban contexts.

Within this broader analytical context, several key aspects emerge in relation to each of the three research questions addressed through the systematic literature review. Regarding RQ1, the evidence indicates that the unequal distribution of Green Infrastructure (GI) sustains and reinforces environmental disparities and vulnerabilities among racialised and low-income populations. Areas with lower levels of GI tend to be the most vulnerable, exhibiting reduced quality of life and limited access to environmental resources such as thermal comfort and green spaces [1], [15], [17]. The absence of GI in marginalised communities intensifies environmental injustices, restricts benefits related to thermal regulation and overall quality of life, and exacerbates pre-existing social conditions [5], [15].

Concerning RQ2, the installation and expansion of Green Infrastructure (GI) increase the attractiveness and value of urban areas, leading to real estate appreciation. This process attracts

residents with higher income and educational attainment, thereby altering local socio-economic profiles [4], [7], [10]. Evidence suggests that increases in GI—such as the development of urban green areas and parks—are frequently associated with property value appreciation, particularly in neighbourhoods susceptible to gentrification [7], [10]. Public policies play a significant role in shaping this dynamic, as improvements associated with GI may enhance neighbourhood conditions while simultaneously intensifying real estate competition and price escalation.

With respect to RQ3, the expansion of Green Infrastructure (GI) can act as a catalyst for gentrification processes by increasing property values and triggering the displacement of vulnerable residents, especially in historically marginalised neighbourhoods [1], [8]. Gentrification contributes to social exclusion by reducing social diversity and limiting vulnerable groups' access to the environmental benefits provided by GI [2], [17]. Such exclusion occurs both directly, through displacement, and indirectly, through rising property prices that render access unaffordable for low-income populations [10], [15]. The extent of these effects depends strongly on local context and on the public policies implemented to ensure equitable access; in the absence of adequate regulatory frameworks, vulnerable communities are more likely to remain excluded from GI-related benefits.

To support this analytical discussion, **Table 3** synthesises the main findings of the reviewed studies in relation to RQ1, RQ2, and RQ3. Rather than functioning as a descriptive inventory, the table organises the evidence according to the article's central analytical concerns, allowing comparison across studies and contexts. **Table 4** complements this synthesis by identifying the public policy issues, recommendations, implementation status, and analytical tools referenced in the selected articles, while **Table 5** summarises the methodological limitations, substantive or policy challenges, and research gaps reported in the literature. Taken together, the pattern synthesised in **Table 3** indicates a strong convergence around distributive injustice in access to Green Infrastructure, a frequent association between GI-related interventions and rising property values, and the recurring exposure of vulnerable groups to exclusionary outcomes in the absence of protective housing and equity-oriented public policies.

Table 2. Systematic Literature Review Articles

Authors	Article ID
Elderbrock, E., Russel, K., Ko, Y., Budd, E., Gonen, L., & Enright, C. (2024)	1
Pala, Ö. N., & Acar, S. (2024)	2
Pallathadka, A., Pallathadka, L., Rao, S., Chang, H., & Van Dommelen, D. (2022)	3
Stuhlmacher, M., Kim, Y., & Kim, J. E. (2022)	4
Turk Cerovečki, M., & Stiperski, Z. (2024)	5
Li, Y., Qiu, J., & Gao, Z. (2024)	6
Zhuang, Y., Xie, D., & Yu, X. (2023)	7
Shi, M., Wang, Y., Lv, H., & Jia, W. (2023)	8
Caprioli, C., Bottero, M., & De Angelis, E. (2023)	9
Quinton, J., Nesbitt, L., & Czekajlo, A. (2022)	10
Ling, J., Yip, K. H. A., Wei, S., Sit, K. Y., Sun, L., Meng, Q., Cong, N., Lin, J., & Zhang, H. (2024)	11
Yin, S., Ma, Z., Song, W., & Liu, C. (2019)	12
Sharifi, F., Nygaard, A., Stone, W. M., & Levin, I. (2021)	13
Rigolon, A., & Németh, J. (2021)	14
Black, K. J., & Richards, M. (2020)	15

Source: Authors (2025)

Table 3 presents the main findings related to the three primary research questions guiding the systematic literature review.

Table 3. Key Findings of the Research Questions

RQ1	RQ2	RQ3	Article ID
Unequal distribution of Green Infrastructure (GI) sustains environmental disparities and vulnerabilities among racialised and low-income populations.	The expansion of Green Infrastructure (GI) may catalyse gentrification by increasing property values and displacing vulnerable residents.	Gentrification exacerbates environmental injustices and excludes vulnerable groups from access to environmental benefits.	1
State-led GI development increases land values and restricts access for vulnerable populations, thereby widening socio-spatial disparities.	GI initiatives (e.g. Nation's Gardens) are associated with rising housing prices and the attraction of more highly educated residents, with a causal relationship observed in areas prone to gentrification.	Gentrification excludes vulnerable populations from environmental benefits by displacing them to more distant or peripheral areas.	2
Unequal provision of GI deepens environmental injustices and limits benefits for vulnerable groups, as evidenced during the COVID-19 pandemic.	An indirect relationship is identified, whereby socio-spatial inequality emerges from pre-existing segregation and subsequently leads to real estate valorisation.	Vulnerable communities experience unequal access to environmental amenities, with displacement processes further aggravating these inequalities.	3
Persistent inequalities are observed, with wealthier and predominantly white neighbourhoods exhibiting greater availability of GI.	No direct relationship is identified; observed effects depend on pre-existing urban conditions and the timing of GI interventions.	Gentrification may exclude vulnerable groups, with outcomes varying according to the type of Green Infrastructure (GI) and the local context.	4
GI is predominantly valued and accessed by higher-income groups, reinforcing inequality, while less desirable areas remain occupied by vulnerable populations.	Proximity to highly valued green areas increases property prices and promotes gentrification, particularly in the Jarun surroundings and the city centre.	Property valorisation in areas surrounding GI restricts access for vulnerable populations, reinforcing exclusion and environmental injustice.	5
Larger and higher-quality Urban Green Areas (UGAs) are associated with rising property prices, the attraction of high-income residents, and the intensification of inequalities.	Larger and higher-quality Urban Green Areas (UGAs) are associated with rising property prices and intensified real estate competition, with public policies amplifying these effects.	GI-driven gentrification excludes vulnerable groups from environmental benefits through indirect displacement mechanisms.	6

RQ1	RQ2	RQ3	Article ID
A strong correlation exists between GI—particularly Urban Tree Canopy (UTC)—and property values; vulnerable areas exhibit lower UTC coverage, limited access, and poorer quality of life.	Higher levels of Urban Tree Canopy (UTC) are associated with increased property values and processes of environmental gentrification in already valued neighbourhoods.	Environmental gentrification excludes vulnerable populations from the benefits of Urban Tree Canopy (UTC) through processes of valorisation and displacement.	7
Access to thermal comfort provided by parks is uneven and reinforces existing disparities, with central areas benefiting disproportionately.	Cooling effects associated with parks contribute to higher surrounding property prices, driving processes of climate gentrification.	Climate gentrification reinforces socio-spatial exclusion by excluding peripheral areas from environmental benefits.	8
GI interventions may trigger green gentrification processes, leading to the exclusion of vulnerable households and a reduction in social diversity.	Parks increase nearby property values and facilitate the in-migration of higher-income populations, contributing to neighbourhood socio-economic homogenisation.	Green gentrification reduces social diversity and limits vulnerable groups' access to environmental benefits.	9
Higher income and educational attainment are associated with greater proximity to urban vegetation, perpetuating socio-spatial inequalities.	Greening initiatives may raise property prices and trigger gentrification, underscoring the need for mitigation-oriented public policies.	Gentrification diminishes social diversity and restricts access for vulnerable populations; green equity is contingent upon democratic and inclusive processes.	10
Inequalities in rooftop GI provision concentrate benefits among affluent groups, while low-income populations experience restricted access.	Areas with greater vegetation cover tend to be more highly valued; while public green spaces may mitigate some impacts, exclusionary effects persist in the absence of regulatory frameworks.	Gentrification reinforces exclusionary outcomes when public policies fail to ensure equitable access to green infrastructure.	11
[Not explicitly reported; however, the findings indicate that unequal GI provision reinforces the marginalisation of vulnerable groups.]	[Not explicitly reported; the study addresses urban gentrification more broadly rather than GI-specific mechanisms.]	Gentrification driven by urban policies marginalises vulnerable groups and reproduces socio-spatial inequalities.	12

RQ1	RQ2	RQ3	Article ID
Unequal access to GI intensifies environmental injustices, with low-income populations having fewer opportunities to access green spaces.	The creation of new GI may increase property prices and displace vulnerable populations, exemplifying the so-called *green paradox*.	Green gentrification concentrates green spaces in affluent neighbourhoods, excluding low-income populations.	13
Unequal distribution of GI—particularly urban parks—perpetuates environmental injustices, with minority groups experiencing limited access.	Parks may be employed as tools of urban valorisation and place marketing, increasing property prices and attracting higher-income residents.	Environmental gentrification constrains the ability of vulnerable groups to remain in place, particularly in the absence of equity-oriented public policies.	14
The High Line project led to increased property values and restricted access, privileging high-income groups and excluding vulnerable populations	Strong real estate valorisation effects are observed for properties located in close proximity to green spaces and at similar elevation levels.	Eco-gentrification reinforces the displacement and exclusion of vulnerable populations from the benefits of newly implemented green infrastructure.	15

Source: Authors (2025)

Public Policy Implications

Table 4 synthesises the main public policy issues identified in the reviewed studies, together with the recommendations proposed and the analytical tools employed. To strengthen its interpretive value, the accompanying discussion explicitly examines implementation status and reported evidence of effectiveness. Across the reviewed literature, policy content appears predominantly in the form of recommendations rather than evaluated interventions. Most studies propose measures such as participatory planning, displacement protection, affordable or mixed-income housing, spatial justice frameworks, subsidised housing, and regulatory mechanisms aimed at mitigating exclusionary effects associated with Green Infrastructure (GI). However, direct evidence of implementation is limited, and formal assessments of effectiveness are rare. In a small number of cases, the studies refer to implemented policy contexts—such as state-led urban transformation or land-use regulation—but do not provide direct evaluation of outcomes. Overall, the evidence suggests that the literature offers substantial policy guidance, but still provides only limited insight into whether these measures have been implemented and even less into how effective they are in mitigating green gentrification or environmental injustice.

Furthermore, research on green gentrification in Denver highlights the importance of public policies that integrate participatory planning and the equitable management of green spaces **[18]**. In this perspective, the focus should extend beyond the mere creation of green areas to ensuring that local communities are able to benefit from such improvements without facing economic displacement. Similarly, studies on rooftop greening indicate that patterns of environmental inequality are shaped by socio-economic factors such as income, housing type, dwelling size, and household composition **[19]**. These findings suggest that low-income residents, single

occupants, and individuals living in smaller dwellings may encounter greater barriers to accessing the benefits of such sustainable interventions. Taken together, these studies reinforce the need for public policies and urban planning practices that prioritise social equity across different forms of Green Infrastructure.

Table 4. Findings on Public Policies, Recommendations, and Tools Employed

Public policies mentioned?	Which policies / proposals	Which tool(s)	Article ID
Yes	Recommends participatory planning processes led by and for marginalised communities, alongside the adoption of policies aimed at mitigating gentrification effects.	Spatial statistical analysis using GIS.	1
Yes	Warns of adverse outcomes arising from state-led urban transformation policies implemented without community participation, and highlights the need for future research to inform policy design.	GIS-based spatial analysis and mapping.	2
Not explicit	Proposes the incorporation of socio-economic and climate indicators into future policy frameworks and recommends integrated environmental justice approaches.	GIS spatial analysis using Census Block Groups (CBG), ZIP Code Tabulation Areas (ZCTA), and hotspot analysis.	3
Not explicit	Recommends displacement protection measures and policies that promote equitable access to Green Infrastructure (GI).	GIS-based spatial analysis using NDVI and land-use data.	4
No	Highlights the need for policies ensuring equal access to GI and calls for future research incorporating socio-economic indicators.	GIS applied to geographically weighted regression (GWR) and distance-based calculations.	5
Yes	Emphasises the role of the state and land-use regulation policies, underscoring the importance of housing policies and the mitigation of real estate competition.	GIS with Ordinary Least Squares (OLS), Geographically Weighted Regression (GWR), and Multiscale Geographically Weighted Regression (MGWR).	6
Yes	Recommends policies prioritising improvements in Urban Tree Canopy (UTC) in vulnerable areas and the promotion of spatial equity.	GIS-based image extraction and classification, including Moran's I spatial autocorrelation.	7
Yes	Proposes mixed-income and affordable housing policies, alongside the prioritised allocation of environmental benefits to peripheral areas.	GIS-based spatial analysis combined with remote sensing techniques.	8

Public policies mentioned?	Which policies / proposals	Which tool(s)	Article ID
Yes	Identifies the need for preventive anti-gentrification policies and the inclusion of regulatory mechanisms in analytical models; recommends replicating the approach to inform urban policy.	GIS combined with agent-based modelling, hedonic analysis, and AHP/MCDA.	9
Yes	Draws attention to affordable housing policies, the mitigation of negative greening effects, and the adoption of participatory processes.	GIS-based spatial analysis using Landsat imagery and spatial lag models.	10
Yes	Recommends public policies involving subsidised housing, financial incentives, and regulatory measures to promote equity in vertical green infrastructure.	GIS and Google Earth Engine using Sentinel-2 NDVI.	11
Yes	Suggests the need for affordable rental policies, spatial justice frameworks, and the integration of socio-economic variables into future policy design.	GIS with kriging interpolation and spatial analysis.	12
Yes	Recommends urban policies aimed at promoting equity and mitigating inequality, and calls for measures to prevent the green paradox.	GIS-based accessibility indices, Local Indicators of Spatial Association (LISA), and Moran's I.	13
Yes	Highlights the absence of robust equity-oriented policies in park provision and the need for regulation of new developments.	GIS-based historical–spatial mapping.	14
Not explicit	Warns that greening projects must be carefully designed to avoid reinforcing exclusion, although no specific policy instruments are identified.	GIS-based spatial regression and difference-in-differences analysis.	15

Source: Authors (2025)

The reviewed literature indicates that most studies explicitly address public policy considerations and that all employ Geographic Information Systems (GIS) tools. There is broad convergence around the need for equity-oriented public policies, with particular emphasis on participatory planning and the active involvement of marginalised communities to prevent exclusionary outcomes associated with green infrastructure. Recurrent recommendations include displacement protection and housing policies—such as social housing provision, affordable rental schemes, and mixed-use development—as key instruments for mitigating gentrification. The literature also underscores the active role of the state through land-use regulation, the mitigation of real estate competition, and the prioritisation of investments in vulnerable areas, including enhancements to Urban Tree Canopy. In addition, there is consistent support for incorporating socio-economic and climate indicators into policy frameworks and analytical models within integrated environmental justice approaches. Studies caution that greening initiatives implemented without careful design and adequate regulatory mechanisms may reinforce exclusion, giving rise to the so-called green paradox and highlighting the need for preventive policies and robust governance instruments.

Methodological Profile of the Reviewed Studies

The systematic review further demonstrates the widespread use of GIS as the primary methodological framework across all analysed studies. GIS supports the examination of the spatial distribution of Green Infrastructure, socio-spatial inequalities, and associated processes of gentrification and environmental injustice through cartographic analysis and spatial statistical techniques. Complementary methods—such as vegetation indices (NDVI), spatial regression models (OLS, GWR, MGWR), measures of spatial autocorrelation (Moran's I, LISA), interpolation techniques (kriging), spatial lag models, difference-in-differences analyses, and remote sensing using Landsat, Sentinel-2, and Google Earth Engine—are commonly applied within the GIS environment. Together, these approaches enable the identification of spatial patterns, territorial relationships, and contextual variations related to Green Infrastructure.

From an analytical perspective, the predominance of GIS reflects its capacity to integrate environmental, socio-economic, and spatial data across multiple scales. At the same time, the diversity of associated techniques suggests that no single analytical method predominates beyond GIS itself, with methodological choices largely shaped by research objectives, analytical scale, and the specific questions addressed.

Research Gaps and Future Directions

Table 5 synthesises the main research gaps identified across the reviewed studies while distinguishing between three analytical dimensions: methodological limitations, substantive or policy challenges identified in the analysed contexts, and future research needs. Methodological limitations refer to constraints in the design or evidence base of the studies themselves, such as data limitations, reliance on proxies, lack of longitudinal analysis, or the absence of relevant qualitative variables. By contrast, substantive or policy challenges refer to the urban inequalities and governance problems described in the analysed contexts, such as historical inequality, weak housing regulation, or the absence of equity-oriented public policies. This distinction improves analytical clarity, strengthens comparability across studies, and prevents the conflation of limits of evidence with real-world socio-spatial problems.

Table 5. Gaps, limitations, or critiques identified in the article

Methodological limitations	Substantive or policy challenges identified	Research gap / future need	Article ID
Single-city focus; no longitudinal analysis; transformed-model coefficients difficult to interpret.	Barriers to park use and community participation remain insufficiently examined.	Future studies should examine participation barriers and longer-term dynamics.	1
No neighbourhood-level household income data; difficulty isolating the effect of gardens from other planning factors.	Urban transformation policies without community participation may intensify exclusion.	Longitudinal analyses and assessment of additional green-space attributes are needed.	2
Incomplete data for some cities; limited socio-economic variables; no longitudinal analysis; limited generalisability.	Climatic and contextual determinants of inequity remain unevenly addressed.	Future studies should incorporate broader socio-economic and climatic variables.	3

Methodological limitations	Substantive or policy challenges identified	Research gap / future need	Article ID
Challenges in defining and measuring gentrification; difficulty isolating green-space effects; limited temporal and spatial granularity.	Different non-park green-space types may produce distinct outcomes under uneven urban conditions.	More temporally and spatially detailed studies are needed across contexts.	4
Lack of detailed resident-level socio-economic variables; limited generalisability.	Less desirable areas remain disproportionately occupied by vulnerable populations.	Future studies should incorporate socio-economic indicators and green gentrification processes more directly.	5
Property prices used as proxy for socio-economic status; no longitudinal data; limited generalisability.	Land-use regulation and real estate competition shape unequal outcomes but remain insufficiently evaluated.	Future studies should incorporate more comprehensive social indicators.	6
Property prices used as proxy; cell-based spatial division may fragment neighbourhoods; single-year analysis; no longitudinal data.	Vulnerable areas remain disadvantaged in UTC distribution and associated quality-of-life benefits.	Longer-term analyses with more detailed social variables are needed.	7
Satellite imagery has temporal and spatial resolution constraints; no longitudinal data; limited socio-economic variables in the gentrification analysis.	Peripheral areas may remain excluded from cooling and other environmental benefits.	Future research should combine higher-resolution imagery with richer social data.	8
Restricted socio-economic microdata; ABM depends on expert-assigned weights; no longitudinal validation.	The role of regulatory mechanisms and policy variables remains under-modelled.	Replication in other contexts and stronger empirical validation are needed.	9
Limited generalisability across cities; reliance on proxies; no analysis of green-space quality/function; limited intersectional approach.	Democratic and inclusive processes remain uneven in greening initiatives.	Future studies should analyse quality, function, and intra-group diversity more directly.	10
No longitudinal analysis of building characteristics; ecological benefits across property types not fully assessed.	Equity in vertical Green Infrastructure depends on subsidies and regulation that remain insufficiently assessed.	Further research should examine other vertical-GI forms and differentiated impacts.	11

Methodological limitations	Substantive or policy challenges identified	Research gap / future need	Article ID
No standardised PIR calculation; limited differentiation across income groups; key housing-cost variables excluded.	Housing affordability pressures are shaped by broader urban policy beyond GI alone.	Future research should address rent-income relationships and detailed socio-economic variables.	12
Reliance on 2016 census data; no extensive longitudinal analysis; no qualitative variables on perceptions of green-space quality.	Policies aimed at mitigating inequality remain insufficiently assessed.	Future research should examine drivers of residential mobility and mitigation policies.	13
Methodological evidence is limited by the difficulty of separating historical legacies from current park-distribution outcomes.	Historical inequality, weak equity-oriented regulation, and apparently neutral policies may perpetuate racially stratified impacts.	Future work should assess stronger regulatory instruments in new developments.	14
Limited residents' socio-economic data; no direct displacement data; focus on sales rather than rental markets.	Mitigation policies are not directly examined despite clear exclusionary risks.	Further research should investigate long-term social impacts and rental-market effects.	15

Source: Authors (2025)

Overall, the identified limitations converge around recurrent challenges related to data availability, scale, and analytical scope. Common issues include the absence of longitudinal data, reliance on proxies for socio-economic conditions, limited attention to social diversity and intersectionality, and difficulties in isolating the specific effects of green infrastructure from broader urban dynamics. Several studies also highlight constraints in generalising findings across different urban contexts, alongside insufficient integration of qualitative dimensions, public policy instruments, and equity-oriented indicators. Taken together, these gaps emphasise the need for more comprehensive, longitudinal, and context-sensitive approaches that integrate social, economic, spatial, and policy-related dimensions in future research on green infrastructure and gentrification.

Broader Implications for Sustainable Development

The findings of this study contribute directly to the understanding of how Green Infrastructure (GI) relates to broader sustainable development challenges and community well-being. The evidence demonstrates that, while GI delivers environmental benefits, its uneven distribution and association with gentrification processes may exacerbate socio-spatial inequalities, directly affecting vulnerable populations. These outcomes are closely aligned with the objectives of the United Nations Sustainable Development Goals, particularly SDG 11 (Sustainable Cities and Communities) and SDG 10 (Reduced Inequalities), by highlighting how urban greening strategies can simultaneously promote environmental sustainability and reproduce social exclusion when equity considerations are absent.

Moreover, the results emphasise the relevance of SDG 13 (Climate Action), given the uneven distribution of climate-related benefits such as thermal comfort and urban cooling, and SDG 3 (Good Health and Well-being), as access to high-quality green spaces is unevenly linked to quality of life and environmental health outcomes. By identifying governance gaps, policy failures, and the need for participatory and equity-oriented planning, this study underscores the importance of integrated policy approaches capable of maximising the social co-benefits of green infrastructure while mitigating unintended adverse impacts on community stability and social cohesion.

CONCLUSIONS

In summary, the reviewed literature indicates that Green Infrastructure (GI) operates within a structurally unequal urban landscape in which environmental improvements may coexist with exclusionary socio-spatial effects. Across the selected studies, the main integrated finding is that GI can generate important ecological and quality-of-life benefits while also being associated with rising property values, housing vulnerability, and pressures on long-standing residents when equity safeguards are absent.

The original contribution of this review lies in synthesising this relationship not as an isolated contradiction, but as a recurring pattern linking environmental injustice, urban development, and green gentrification across different contexts. In this sense, the article shows that GI should not be treated solely as an environmental asset, since its distributive and housing-related consequences are central to understanding its urban implications.

This review also has limitations. The corpus was restricted to peer-reviewed journal articles indexed in Scopus, published in English between 2019 and 2024, which narrows the geographical, linguistic, and temporal scope of the evidence considered.

In addition, the relatively small sample limits broader generalisation and reinforces the need for cautious interpretation, particularly regarding bibliometric patterns and contextual comparisons.

Future research should expand the temporal and geographical scope of analysis, incorporate more longitudinal and comparative designs, and examine more directly the conditions under which GI interventions mitigate or intensify displacement pressures. Greater attention is also needed to the interaction between GI, housing regulation, and equity-oriented public policy. Overall, this review highlights that the urban value of GI cannot be assessed only through its environmental benefits, but must also be evaluated in relation to justice, distribution, and the protection of vulnerable communities.

USE OF AI-ASSISTED TOOLS

AI-assisted tools were used solely to support English-language editing and the reorganisation of phrasing during manuscript revision. All substantive interpretations, methodological decisions, and final content were reviewed and approved by the authors.

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NOMENCLATURE

AHP	Analytic Hierarchy Process
CAPES	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
CBG	Census Block Groups

CNPq	National Council for Scientific and Technological Development
GI	Green Infrastructure
GIS	Geographic Information Systems
GWR	Geographically Weighted Regression
LISA	Local Indicators of Spatial Association
LR	Literature Review
MCDA	Multi-Criteria Decision Analysis
MGWR	Multiscale Geographically Weighted Regression
NDVI	Normalized Difference Vegetation Index
OLS	Ordinary Least Squares
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
RQ	Research Question
SLR	Systematic Literature Review
UGA	Urban Green Areas
UTC	Urban Tree Canopy
ZCTA	ZIP Code Tabulation Areas

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