

Climate Risk and Spatial Inequality: Institutional Power and Racialized Governance in Contemporary Urban Architecture

Qiyue Ren¹

¹School of Architecture Urban Planning Construction Engineering, Politecnico di Milano, Milan, Milan Province Italy 20133

Email ID : Amelia6yy@outlook.com

ABSTRACT

Urban environments are increasingly exposed to climate risks such as flooding, heatwaves, and sea-level rise, disproportionately affecting marginalized communities. While existing literature often addresses climate risk and spatial inequality separately, the intersection of institutional power, racialized governance, and urban design practices remains underexplored. This study examines how architectural practices, shaped by governance structures, contribute to spatial inequalities exacerbated by climate risks. Using case studies of Miami (USA) and Rotterdam (Netherlands), the research employs qualitative methods, including historical analysis and comparative study, to explore how institutional and racialized power dynamics influence the distribution of climate resilience measures. The findings reveal that institutional power plays a crucial role in perpetuating unequal access to climate adaptation resources, with wealthier, predominantly white communities benefitting from enhanced resilience measures, while marginalized communities remain exposed. This study contributes to the field by integrating urban political ecology, critical race theory, and postcolonial studies, offering new insights into how governance structures shape urban vulnerability. The findings underscore the need for inclusive urban design and governance that prioritize the needs of vulnerable populations in climate adaptation strategies..

Keywords: Climate Risk, Spatial Inequality, Racialized Governance, Urban Architecture, Climate Resilience..

1. INTRODUCTION:

Urban environments around the world are increasingly facing the impacts of climate change, with risks such as flooding, heatwaves, and sea-level rise disproportionately affecting marginalized communities[1]. As cities continue to expand and adapt to these environmental challenges, the question of spatial inequality has become more prominent[2]. The built environment, shaped by architecture and urban planning decisions, plays a crucial role in either mitigating or exacerbating these risks[3]. This paper focuses on the intersection of climate risk and spatial inequality, exploring how institutional power and racialized governance shape contemporary urban architectural practices[4]. Understanding these dynamics is essential for developing inclusive, equitable, and climate-resilient cities, particularly for vulnerable communities that are most at risk from climate impacts.

While there has been growing attention to climate risk in urban settings, much of the existing literature focuses on either environmental or social aspects in isolation. Climate adaptation measures often fail to fully address how institutionalized power structures and racialized governance influence the distribution of resources, including the built environment[5]. Marginalized communities, particularly low-income and racialized populations, frequently find themselves living in areas that are more susceptible to climate risks, due to historical processes of exclusion and land use policies that prioritize affluent neighborhoods[6]. However, few studies have

explored how these intersecting factors contribute to the perpetuation of spatial inequalities in urban contexts at the intersection of climate change and governance[7].

This study aims to fill this gap by analyzing how urban architectural practices, shaped by institutional and racialized power structures, contribute to spatial inequality in the face of climate risk. By employing a qualitative research methodology, this paper examines case studies from cities in both the Global North and South, focusing on how urban spaces are designed, managed, and impacted by institutional decisions. Through a combination of historical research, literature review, and case study analysis, the paper aims to offer new insights into how urban planning and architecture can either challenge or reinforce existing inequalities in the context of climate adaptation. Specifically, this paper looks at how the power dynamics embedded in urban governance frameworks influence the distribution of climate risks and resilience measures across different urban populations.

The significance of this study lies in its potential to contribute to the understanding of how spatial inequality is not just a social issue, but also an environmental and architectural one. By considering the role of architectural practices in shaping urban spaces, the paper argues that climate risks cannot be fully addressed without a critical examination of how institutional power and racialized governance influence the design and development of urban environments. Furthermore, the study offers policy recommendations aimed at creating more inclusive and

resilient cities by rethinking how architectural practices can be reshaped to address both social and environmental challenges. These findings are expected to provide valuable insights for urban planners, architects, and policymakers striving to create equitable cities that are better equipped to withstand the impacts of climate change.

2. LITERATURE REVIEW

The relationship between climate risk and spatial inequality has gained attention in recent academic discussions. However, much of the existing literature addresses these issues separately, focusing on either environmental impacts or social inequalities. Studies on climate risk often highlight physical vulnerabilities of cities to climate change, such as flooding and heatwaves, but rarely explore how these risks are unevenly distributed across socio-economic and racial groups. Similarly, literature on spatial inequality tends to focus on social justice and urban segregation, but overlooks the role of environmental risks in exacerbating these disparities[8][9]. This gap limits understanding of the intersectionality between climate vulnerability and spatial inequality in urban contexts.

One critical gap is the failure to incorporate the role of institutional power in shaping the built environment concerning climate risks. Urban planning and architectural decisions are not only shaped by environmental factors but are also embedded in socio-political power structures[10]. Institutions governing urban development, from city councils to private developers, often prioritize economic growth over the needs of marginalized communities[11]. These decisions reinforce existing social hierarchies, marginalizing vulnerable populations in areas most exposed to climate change. This gap in the literature highlights the need for more attention to institutional governance in understanding spatial inequality.

Moreover, the racialized nature of urban governance remains underexplored in most discussions of climate risk and spatial inequality. Historical processes such as redlining and discriminatory zoning laws have created segregated urban spaces where marginalized communities often live in areas both socially disadvantaged and exposed to climate risks[12]. Despite the recognition of environmental justice, much research on racialized governance does not fully address how these power structures manifest in architectural and urban design decisions. There is a need to examine how racial inequality is reproduced in physical urban spaces.

Additionally, much of the existing literature fails to consider the agency of marginalized communities in shaping their environments. While the focus has largely been on institutional actions, there is little recognition of how communities actively resist and adapt to spatial inequalities. Case studies of community-led initiatives, such as grassroots environmental justice movements, are often sidelined in favor of top-down approaches[13]. A lack of attention to community agency limits understanding of how marginalized groups can influence

their neighborhoods' climate resilience.

Lastly, the literature on climate risk and urban inequality often centers on cities in the Global North, particularly Western metropolises, overlooking the challenges faced by cities in the Global South. In these regions, rapid urbanization, lack of resources, and climate vulnerability intersect in ways that require distinct strategies to address spatial inequality[14]. While recent studies have focused on urbanization in the Global South, they often treat climate risk and spatial inequality as separate issues, failing to explore how governance structures perpetuate racialized spatial inequities[15]. Comparative research is needed to examine the intersections of climate risk and racialized governance across global contexts, considering the unique socio-political and environmental challenges faced by cities in the Global South.

In conclusion, the literature on climate risk and spatial inequality remains fragmented. There is a pressing need for interdisciplinary research that integrates environmental justice, racialized governance, and urban design to address the complex relationship between climate risk and spatial inequality. This study seeks to fill these gaps by analyzing how institutional power and racialized governance shape urban architecture and contribute to the unequal distribution of climate risks. By examining both the environmental and social dimensions of urban inequality, this paper aims to offer a more holistic understanding of how cities can be reimaged to be more resilient, equitable, and just.

3. THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Theoretical Framework

This study examines how institutional power and racialized governance intersect with urban architectural practices to shape spatial inequality in the context of climate risk. It uses theoretical frameworks from urban political ecology, critical race theory, and postcolonial studies to explore how environmental risks and social inequalities are influenced by governance structures.

Urban Political Ecology (UPE) explores how cities are shaped by the interplay of natural and social processes, where power dynamics affect resource allocation and spatial development. UPE helps analyze urban planning decisions, such as infrastructure placement, zoning laws, and access to green spaces, which often favor affluent, predominantly white communities, leaving marginalized groups more vulnerable to climate risks. This study applies UPE to examine how institutional power structures guide urban development in ways that expose marginalized communities to climate risks while enhancing resilience in wealthier areas.

Critical Race Theory (CRT) is crucial for understanding how racialized governance shapes urban spaces. CRT views racism as structural, embedded in policies, institutions, and cultural practices. Urban planning and architecture have historically reinforced racial segregation. This study applies CRT to show how racialized governance perpetuates spatial inequalities,

making racial minorities more vulnerable to climate risks. Postcolonial studies highlights how colonial histories continue to influence urbanization, particularly in the Global South. Colonial legacies, such as unequal land distribution and exclusionary policies, continue to shape cities today. Postcolonial theory is essential for understanding urbanization processes in the Global South, where rapid development often disregards the needs of marginalized communities, increasing climate vulnerability. This study applies postcolonial theory to explore how historical injustices and contemporary governance practices contribute to the uneven distribution of climate risks.

These three frameworks provide a comprehensive approach to understanding how institutional power, racialized governance, and spatial inequality intersect in the context of climate risk. Together, they offer a multi-dimensional lens for examining how historical, political, and social forces shape urban spaces and exacerbate inequalities in the face of environmental challenges.

3.2 Research Methodology

This study employs a qualitative research methodology, best suited to explore the complex interactions between institutional power, racialized governance, and spatial inequality in urban architectural practices. The research methodology comprises case studies, comparative analysis, and historical research. Each method is designed to provide a nuanced understanding of how institutional practices influence the distribution of climate risks across urban spaces and highlight the role of governance structures in perpetuating or mitigating these disparities.

3.2.1 Case Studies

The first method used in this study is case study analysis. Specific urban case studies from both the Global South and North will be examined to show how institutional practices, including urban planning, architecture, and policy decisions, affect marginalized communities in the context of climate risk. The selection of cities from different regions allows for a comparative understanding of how institutional powers and governance frameworks address or exacerbate spatial inequality.

For example, one case study will focus on Miami (USA), where rapid urbanization has led to unequal access to climate-resilient infrastructure. Wealthier communities are often located in areas with climate adaptation measures, such as seawalls and green spaces, while low-income and racial minority communities are excluded from these protections, making them more vulnerable to flooding and heatwaves. In contrast, Rotterdam (Netherlands) presents a case where robust climate resilience measures, driven by decentralized governance and public-private partnerships, aim to address climate risks more equitably. However, the benefits of these measures are not always evenly distributed, and lower-income communities still face higher exposure, particularly on the city's outskirts.

This comparative analysis will underscore the influence of governance structures, institutional power, and urban

planning decisions on the distribution of climate risks. It will reveal how political, social, and economic factors intersect in shaping the vulnerability of marginalized populations. Table 1 summarizes the key characteristics of the case study cities, comparing their demographic profiles, climate risks, and institutional frameworks.

Table 1. Comparison of Key Characteristics of Case Study Cities

City	Region	Historical Urbanization Impact	Urban Governance Approach	Climate Resilience Approach
Miami (USA)	Global North	Rapid urban expansion, segregation due to redlining and zoning laws	Decentralized, fragmented governance, private-sector involvement	Limited green infrastructure, emphasis on private adaptation efforts
Rotterdam (Netherlands)	Global North	Post-war reconstruction, integration of immigrant communities	Progressive urban governance, public-private partnerships	Strong green infrastructure, flood defenses, water-sensitive urban design

While this study focuses on Miami and Rotterdam as paradigmatic cases of racialized and institutional climate governance in the Global North, it acknowledges the importance of Global South urban experiences. In those cities, colonial legacies, informality, and acute vulnerability intersect in distinct ways. The exclusion of Southern cities here is a methodological choice, allowing for a focused analysis of two contrasting governance models. Future research will expand this framework to cities like Jakarta or Lagos to test its applicability across postcolonial contexts.

3.2.2 Comparative Analysis

The second method is comparative analysis, used to examine how varying institutional powers and racialized governance structures in different urban environments address or exacerbate spatial inequalities. This approach will focus on comparing cities like Miami and Rotterdam to understand the differing impacts of governance models on climate resilience.

A comparison of Miami and Rotterdam reveals that, while both cities face significant climate risks such as flooding and heatwaves, the spatial distribution of these risks is

influenced by their governance structures. In Miami, institutional power often favors affluent, predominantly white communities, granting them access to climate resilience measures such as flood defenses and cooling infrastructure. Conversely, marginalized communities, especially low-income and racial minorities, remain vulnerable due to systemic exclusion. In contrast, Rotterdam has implemented more inclusive governance policies prioritizing green infrastructure and climate adaptation, but similar to Miami, lower-income neighborhoods still face higher climate risks due to historical exclusion in early urban development.

This comparative analysis highlights how differing governance models and institutional power impact the distribution of climate resilience measures and spatial inequality, exploring the role of institutional frameworks in either reinforcing or mitigating inequalities exacerbated by climate change.

3.2.3 Historical Research

The third method, historical research, traces the development of urban architectural practices in relation to racialized governance and institutional power. It focuses on key historical events, such as colonial land distributions, segregation laws, urban renewal projects, and zoning regulations, which have shaped urban environments and determined where marginalized communities are situated and how vulnerable they are to climate risks.

For example, a historical analysis of Miami might show that zoning laws and land-use policies, rooted in racialized governance, have excluded low-income, racialized communities from resilient infrastructure. These policies have perpetuated urban segregation, with wealthier, predominantly white neighborhoods benefiting from climate adaptation measures, while poor, racialized neighborhoods are left exposed to climate risks. The practice of redlining, which denied loans and insurance to racial minorities, further entrenched these inequalities, preventing these communities from investing in climate-resilient infrastructure.

Similarly, historical research into Rotterdam might uncover how post-WWII urban renewal projects displaced working-class and immigrant populations to make way for more affluent developments. While these projects improved the city's infrastructure, they left displaced populations more vulnerable to climate risks by relocating them to areas with insufficient resilience measures. By tracing these historical patterns, this study reveals how past institutional decisions continue to shape present-day urban vulnerabilities, especially in marginalized communities.

In conclusion, combining case studies, comparative analysis, and historical research offers a comprehensive framework for understanding how institutional power, racialized governance, and architectural practices shape spatial inequality in the context of climate risk. These methodologies critically examine how governance structures influence climate risk distribution, while also addressing the historical roots of spatial inequalities. This

approach provides a nuanced understanding of how past and present institutional decisions affect marginalized communities' ability to adapt to climate change.

4. FINDINGS AND DISCUSSION

4.1 Key Findings: Spatial Inequality and Climate Risk

The analysis of case studies and literature reveals key findings about the relationship between spatial inequality and climate risk in urban environments. These findings show how institutional power and racialized governance shape urban spaces, leading to uneven exposure to climate risks.

In both Miami and Rotterdam, urban planning and architectural decisions have been influenced by institutional power structures that favor affluent areas while neglecting marginalized communities. In Miami, for example, zoning laws and land-use policies have historically excluded low-income and racialized communities from climate-resilient infrastructure, such as green spaces and flood defenses. These policies have led to a situation where wealthy neighborhoods are better equipped to handle climate risks, while predominantly Black and Latino communities remain vulnerable. The legacy of redlining, which restricted access to housing and insurance in minority neighborhoods, further compounded these vulnerabilities, leaving these communities without resources for climate adaptation.

In contrast, Rotterdam has adopted a more proactive approach to climate adaptation, integrating green infrastructure and flood defenses into its urban planning. However, these benefits are not evenly distributed across the city. Marginalized communities, particularly working-class and immigrant populations, still face greater exposure to climate risks. Mid-20th century urban renewal projects displaced these communities to areas with less climate resilience, exacerbating their vulnerability to flooding and heatwaves. Despite the city's progressive governance and emphasis on sustainability, these efforts have not fully addressed the unequal distribution of climate resilience.

These case studies suggest that spatial inequality in the face of climate risk is not just a product of physical geography but also of historical and ongoing institutional decisions. Institutional power plays a crucial role in determining which communities receive climate resilience investments and which are left exposed. This inequality is further reinforced by racialized governance, ensuring marginalized communities remain on the periphery of urban development and climate adaptation.

Figure 1 illustrates the conceptual framework of institutional power and racialized governance in shaping urban spaces, showing how these factors influence the uneven distribution of climate resilience measures and expose marginalized communities to greater climate risks. The framework highlights the central role of institutional power and racialized governance, which are connected to policy decisions, community participation, and ultimately, spatial inequalities and climate risk exposure.

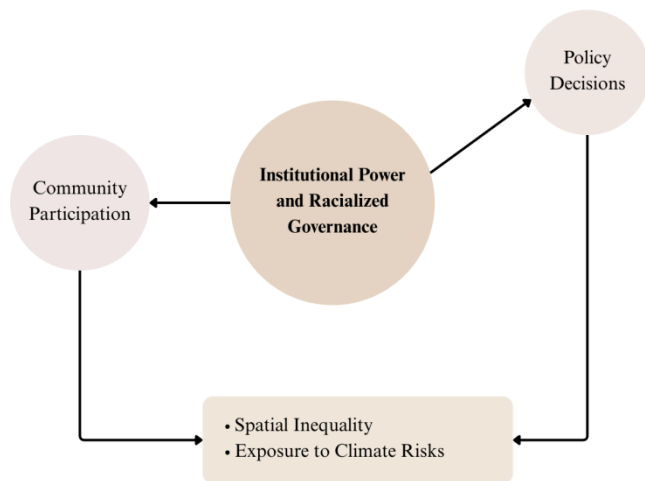


Figure 1. Conceptual Framework of Institutional Power and Racialized Governance in Shaping Urban Spaces

4.2 Comparison with Existing Research

When compared to existing research on climate risk, spatial inequality, and racialized governance, these findings align with and extend the existing literature. Previous studies have shown that marginalized communities often face disproportionate environmental burdens due to historical patterns of urban development, such as segregation, redlining, and urban renewal projects. For instance, scholars have documented how communities of color in the United States, particularly African Americans and Latinos, are more likely to live in areas prone to flooding, heat stress, and other climate hazards. These communities are also less likely to have access to resources that could mitigate these risks, such as green spaces or flood defenses.

This study builds on existing research by highlighting the role of institutional power in shaping urban climate risks. While previous studies have focused on the environmental and social factors that contribute to spatial inequality, this research brings attention to how institutional governance structures, whether centralized or decentralized, affect the distribution of climate resilience resources. The findings in Miami and Rotterdam underscore the ways in which urban planning decisions, guided by institutional power, exacerbate or mitigate spatial inequality in the face of climate change. This extends the existing literature by incorporating both institutional and racialized dimensions of governance into the analysis of climate risk, which has often been treated separately in earlier studies.

Moreover, the Global South and Global North comparison adds a critical dimension to the literature by showing how different governance structures, such as centralized governments in the Global South and more decentralized governance in the Global North, lead to differing outcomes in climate adaptation. In Miami, a relatively decentralized governance system has led to fragmented climate adaptation efforts, whereas Rotterdam's mixed public-private partnerships have resulted in more coordinated but still inequitable climate resilience measures.

Table 2 below compares the key characteristics of Miami and Rotterdam, summarizing their demographic profiles,

climate risks, and institutional frameworks. This comparison provides valuable insights into the role of governance structures in shaping urban resilience.

Table 2. Comparison of Key Characteristics of Case Study Cities

City	Region	Climate Risks	Institutional Governance	Key Vulnerable Communities
Miami (USA)	Global North	Flooding, heatwaves	Decentralized governance, private-public partnerships	Low-income, racial minorities, immigrant communities
Rotterdam (Netherlands)	Global North	Coastal flooding, heatwaves	Decentralized governance, mixed private-public partnerships	Working class, immigrant communities

This comparison highlights the ways in which institutional governance influences the distribution of climate risks and resilience measures, as well as the uneven impacts on vulnerable communities in both cities.

4.3 Innovative Contributions: The Role of Architecture and Governance

One of the innovative contributions of this study lies in its integration of multiple theoretical frameworks, urban political ecology, critical race theory, and postcolonial studies, to explore the role of institutional power and racialized governance in shaping urban environments vulnerable to climate risks. By combining these frameworks, the study provides a comprehensive understanding of how both historical and contemporary governance structures influence the spatial distribution of climate risks.

The study also contributes to the field by examining the role of urban architectural practices in perpetuating or mitigating spatial inequality. While much of the existing research focuses on governance and policy, this study emphasizes how architectural and urban design decisions shape the resilience of different communities. For instance, the prioritization of green infrastructure in wealthier areas of Miami and Rotterdam, alongside the exclusion of marginalized communities from these protections, highlights the direct role that architectural design plays in reinforcing or challenging spatial inequality.

Table 3 provides a summary of institutional power and climate risk distribution in both cities, further clarifying how governance structures influence urban development and resilience measures.

Table 3. Institutional Power and Climate Risk Distribution in Miami and Rotterdam

Institutional Power	Miami	Rotterdam
Urban Planning	Fragmented, favors affluent areas	Coordinated, but unequal distribution
Climate Resilience	Uneven, marginalized communities excluded	Progressive but still unequal
Governance Framework	Decentralized, private sector influence	Decentralized, public-private collaboration

The findings suggest that architectural practices, such as the design of flood defenses, green spaces, and cooling systems, often reflect underlying institutional and racialized power dynamics. In Miami, wealthy neighborhoods benefit from robust climate resilience measures, while poor, racialized communities face greater risks due to the lack of such infrastructure. In Rotterdam, despite progressive urban design policies, the unequal distribution of these measures highlights the need for more inclusive and equitable urban planning that considers the needs of all urban residents.

4.4 Implications for Policy and Urban Design

The findings of this study have significant implications for urban policy and architectural design in the context of climate adaptation. To address the spatial inequalities highlighted in the case studies, policymakers and urban designers must prioritize inclusive urban planning that considers the needs of marginalized communities in the face of climate risks. This includes ensuring that climate resilience measures, such as green infrastructure and flood defenses, are equitably distributed across all urban areas, particularly those that have historically been neglected or excluded.

Furthermore, urban architects and planners must work alongside community members to develop climate

resilience strategies that reflect the needs and priorities of vulnerable populations. The inclusion of marginalized communities in the planning and decision-making processes will help ensure that urban environments are not only sustainable but also equitable, providing protection for all residents against the impacts of climate change.

5. CONCLUSION

This study has contributed to urban studies by examining how architectural practices, influenced by institutional power and racialized governance, contribute to spatial inequalities exacerbated by climate risks. Through case studies of Miami and Rotterdam, it has highlighted the role of institutional frameworks in shaping climate resilience and the distribution of climate risks. By integrating urban political ecology, critical race theory, and postcolonial studies, the research has provided a comprehensive analysis of the intersection between environmental justice, spatial inequality, and urban design.

The study’s findings offer valuable insights for urban planners, architects, and policymakers aiming to foster more inclusive and climate-resilient urban spaces. Policy recommendations include prioritizing equitable climate resilience measures that address the needs of marginalized communities, ensuring that these communities are not left behind in the face of climate risks. By integrating green infrastructure, flood defenses, and other climate adaptation strategies into urban planning, cities can promote resilience for all residents, particularly those in vulnerable areas. The research also emphasizes the importance of community participation in the planning and decision-making process to ensure that climate adaptation efforts are inclusive and responsive to the needs of diverse populations.

Future research could explore further case studies across global cities, particularly in the Global South, where rapid urbanization and climate vulnerability intersect. These studies would provide deeper insights into how urban governance structures in different regions address or fail to address spatial inequality in the face of climate risks. Additionally, exploring the intersection of environmental justice and urban design would be valuable in understanding how design practices can promote or hinder social and environmental equity. Future studies could also investigate community-led urban resilience projects, examining how grassroots movements and local initiatives can contribute to creating more sustainable and just cities.

REFERENCES

1. Sharma, S. E. (2023). Urban climate resilience under racial capitalism: governing pluvial flooding across Amsterdam and Dhaka. *Geoforum*, 145, 103817.

2. Shokry, G., Anguelovski, I., & Connolly, J. J. (2025). (Mis-) belonging to the climate-resilient city: Making place in multi-risk communities of racialized urban America. *Journal of Urban Affairs*, 47(1), 121-141.

3. Méndez-Barrientos, L. E., Fencl, A. L., Workman, C. L., & Shah, S. H. (2023). Race, citizenship, and belonging in the pursuit of water and climate justice in California. *Environment and Planning E: Nature and Space*, 6(3), 1614-1635.

4. Abi Deivanayagam, T., English, S., Hickel, J., Bonifacio, J., Guinto, R. R., Hill, K. X., ... & Devakumar, D. (2023). Envisioning environmental

- equity: climate change, health, and racial justice. *The Lancet*, 402(10395), 64-78.
5. Tilley, L., Ranawana, A. M., Baldwin, A., & Tully, T. M. (2023). Race and climate change: Towards anti-racist ecologies. *Politics*, 43(2), 141-152.
6. Cannon, C. E., McInturff, A., Alagona, P., & Pellow, D. (2024). Wild urban injustice: A critical poet model to advance environmental justice. *Environmental Justice*, 17(2), 120-127.
7. Morello-Frosch, R., & Obasogie, O. K. (2023). The climate gap and the color line—racial health inequities and climate change. *New England Journal of Medicine*, 388(10), 943-949.
8. Norris, D. (2023). Embedding racism: City government credit ratings and the institutionalization of race in markets. *Social Problems*, 70(4), 914-934.
9. Sykes, E. (2025). Power, Control, and Exclusion: The Political Dynamics Behind Urban Spaces. *Sociology Compass*, 19(3), e70043.
10. Heynen, N., & Luke, N. (2023). The case for reparations, urban political ecology, and the Black right to urban life. In *Turning up the heat* (pp. 129-142). Manchester University Press.
11. Prouse, C., & Arefin, M. R. (2024). Feminist urban political ecology. In *Handbook on Gender and Cities* (pp. 206-215). Edward Elgar Publishing.
12. Hassen, N. (2025). Narratives of exclusion: A photovoice study towards racial equity and justice in public urban greenspaces. *Landscape and Urban Planning*, 254, 105233.
13. Zhou, M., & Wang, F. (2024). The driving factors of recreational utilization of ecological space in urban agglomerations: The perspective of urban political ecology. *Ecological Indicators*, 158, 111409.
14. Kwon, J., & Nguyen, M. T. (2024). Four decades of research on racial equity and justice in urban planning. *Journal of Planning Education and Research*, 44(4), 2127-2139.
15. Rusca, M. (2024). Towards a future-oriented political ecology of climate change. *Geoforum*, 153, 103921.