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Heat, Housing, and Informality in Coastal Cities: Climate Stress and Adaptive Urban Networks

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Abstract
Short Heat has become a defining condition of everyday urban life in many coastal cities, where rising temperatures interact with humidity, dense construction, and uneven service access. In low-income and informal settlements, these pressures are intensified by precarious housing, limited cooling options, and fragile infrastructures that convert climate stress into patterned social harm. This article examines how housing conditions, infrastructural inequality, and adaptive networks shape thermal vulnerability in coastal urban life. The article adopts a qualitative and theory-driven approach informed by urban climate vulnerability research, informality studies, and a social reproduction perspective. It draws on comparative scholarship, policy discussions, and documented urban experiences related to coastal heat, insecure housing, informal settlement conditions, and neighborhood adaptation. Analytical attention is directed to three interconnected dimensions: infrastructural mediation, spatial sorting, and relational coping. A mechanism-based synthesis is used to clarify how climate stress is translated into unequal domestic, health, and livelihood burdens across urban settings. Housing precarity and unreliable services emerge as central pathways through which heat becomes a socially distributed form of inequality, while adaptive networks provide support under conditions of structural constraint. Climate adaptation in coastal cities therefore cannot be understood only as a technical challenge, because it is inseparable from housing insecurity, urban informality, and the unequal labor of social reproduction. The article contributes to the field by offering a sociological framework that links thermal inequality to housing, infrastructure, and informal adaptive networks in coastal urban environments.

Keyword
climate stress; housing; informality; urban inequality

1. Introduction

Heat has become a defining condition of everyday urban life in many coastal cities, where warming is no longer experienced as a seasonal inconvenience but as a persistent structure of daily hardship. In dense Southeast Asian urban environments, rising temperatures interact with humidity, limited tree cover, traffic emissions, and built surfaces that retain heat long after sunset (Gupta et al., 2025). The sociological importance of this shift lies in the fact that heat is not encountered as an abstract climate indicator, but through housing materials, overcrowded rooms, poor ventilation, and unstable access to cooling resources. Residents experience heat through social arrangements that shape how long they can sleep, how safely they can work, and how effectively they can care for children, elders, and themselves (Hoffman et al., 2020).

Coastal geographies further intensify this condition by combining heat with humidity and flood exposure, producing difficult trade-offs between airflow, safety, and security. These pressures are especially consequential where housing is precarious and infrastructure is unreliable (Le, 2019). The article therefore begins from the premise that climate stress is lived through urban inequality rather than distributed evenly across city populations.

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The central problem lies in the tendency to frame adaptation as a technical issue while neglecting the housing and social arrangements through which heat becomes harmful. Public discussion often emphasizes engineering solutions such as drainage, green space, seawalls, and warning systems, yet these interventions can overlook the intimate spaces where climate stress is actually absorbed (Dutta, 2024). Housing is one of those spaces, particularly in neighborhoods shaped by informality, precarious rental arrangements, and incomplete service provision. Informality is not simply a matter of non-compliance, but a collective outcome of urban development patterns that push low-income households into hotter, riskier, and less protected areas (Causevic et al., 2021). This problem carries immediate real-world relevance because many residents in coastal cities depend on informal housing and informal labor while lacking the resources to privately purchase coolness, insulation, or secure tenure. When heat intensifies, these households face compounding burdens in health, energy costs, food storage, caregiving, and lost productivity (Hugo & Sonnendecker, 2023). Adaptation therefore becomes inseparable from struggles over housing security, urban citizenship, and access to basic services. A sociological response must explain why heat exposure is systematically concentrated among those with the least ability to buffer it.

A substantial body of knowledge already establishes several points that frame this issue. Existing scholarship has shown that urban heat is amplified by the built environment and that exposure is unequally patterned by income, occupation, gender, legal status, age, and disability (Macagba & Delina, 2024). Research also recognizes that informal housing often intensifies vulnerability because cheap materials, dense construction, and regulatory ambiguity reduce the possibility of durable improvements. The uploaded article further clarifies that urban residents do not encounter heat neutrally, but through roofs that radiate warmth, rooms shared by multiple family members, and service disruptions that interrupt fans, refrigeration, and hygiene. It is also well established that adaptation cannot be reduced to individual choice because livelihoods, commuting patterns, and domestic burdens are structured by wider relations of work and infrastructure (Chakraborty et al., 2019). Recent climate adaptation debates additionally acknowledge that community networks, neighborhood associations, and informal support systems often play crucial roles in harm reduction. These insights provide a strong foundation for understanding heat as a socially distributed condition rather than a purely environmental event. What is already known, then, is that housing, services, and everyday urban inequality are central to climate vulnerability in warming coastal cities.

What remains less fully specified is how these separate insights can be integrated into a coherent sociological explanation of thermal inequality in informal coastal urban life. Much of the policy and research discourse still treats heat as an external hazard to be managed through infrastructure upgrades without fully theorizing how exposure becomes durable harm inside the household, the neighborhood, and the local economy (Gaborit, 2022). There is still limited conceptual clarity about how housing insecurity, service unreliability, and informal support networks interact rather than operate as isolated variables. The article identifies this gap by insisting that heat is not simply experienced through climate but through social reproduction, meaning the daily and generational labor required to sustain life. That shift is important because it connects heat to cooking, washing, caregiving, illness management, emotional labor, and the organization of neighborhood routines. It also foregrounds the uneven burdens that fall on women, children, elderly residents, migrants, and others whose adaptive options are socially constrained (Wannewitz & Garschagen, 2023). Without such a synthesis, adaptation risks being understood as technical efficiency rather than as a question of distributive justice. The unknown dimension, therefore, concerns the mechanisms that translate climate stress into unequal social outcomes.

The research gap becomes sharper through the article's mechanism-based framework, which links climate stress to unequal outcomes through infrastructural mediation, spatial sorting, and relational coping. This synthesis matters because it explains how heat becomes socially consequential not at one single point, but through interacting pathways that structure exposure, protection, and response. Infrastructural mediation captures the role of electricity, water, health services, drainage, and public space in determining whether high temperatures become manageable discomfort or acute crisis (Amorim-Maia et al., 2023). Spatial sorting explains how land markets, zoning decisions, and eviction politics concentrate low-income residents in hotter and less buffered locations. Relational coping shows that adaptive capacity is not simply possessed by individuals, but assembled through kinship, neighborhood mutual aid, religious groups, and informal markets. The value of this framework lies in its ability to connect urban inequality, housing informality, and climate stress without collapsing them into one generalized vulnerability category. It also clarifies why some interventions reduce harm for one group while raising costs or exclusions for another (Kontor et al., 2025). The gap, then, is not an absence of data on heat, but an absence of an integrated sociological model that explains how thermal inequality is reproduced across the everyday infrastructures of urban life.

Filling this gap is theoretically justified because climate adaptation in informal urban settings cannot be understood through hazard management alone. A framework centered on social reproduction is especially appropriate because it shifts attention to the everyday labor required to keep households functioning under conditions of rising heat. This includes maintaining food safety, securing water, protecting health, caring for dependents, and preserving the emotional stability of domestic life. Such a perspective is coherent with the article's emphasis on informality as a structured field of access and exclusion rather than as a deviant exception to formal planning. It also explains why neighborhood networks matter without romanticizing them as automatic sources of resilience (Buchori et al., 2018).

Adaptive networks can reduce harm, but they can also reproduce gatekeeping, obligation, debt, and exclusion when assistance depends on social membership and scarce resources. A justice-centered theory of adaptation must therefore account for both capacity and constraint (Pereira et al., 2021). This justification makes clear why housing security, service reliability, and social ties belong at the center of climate sociology rather than at its margins. From this foundation, the article is guided by a set of interrelated research questions. How does climate stress become socially patterned harm through the material and legal conditions of housing in coastal cities. In what ways do absent or unreliable infrastructures convert heat into unequal health, livelihood, and domestic burdens. Why are low-income residents disproportionately sorted into hotter locations with fewer buffers and weaker service protections. How do adaptive networks function as relational infrastructures of coping, and under what conditions do they mitigate harm or reproduce exclusion. What happens when heat adaptation policies improve physical environments but simultaneously disrupt livelihoods, tenant security, or neighborhood support systems. How should climate adaptation be evaluated when success for one group can mean displacement, debt, or reduced access for another. These questions move the article beyond the generic language of resilience and toward a more precise account of distribution, recognition, and urban rights. They also keep the analysis anchored in the social pathways through which heat is lived rather than merely measured.

The urgency of these questions is heightened by the fact that coastal cities are warming rapidly while informal urbanization remains a central reality of contemporary development. Heat increasingly functions as a slow emergency, producing chronic fatigue, economic penalties, domestic strain, and cumulative health risks that may not appear spectacular enough to trigger proportional institutional response (Mondal et al.,

2024). At the same time, redevelopment and resilience agendas can unintentionally intensify vulnerability when they treat informal settlements as temporary obstacles rather than as neighborhoods where rights, livelihoods, and adaptive capacities are already organized. The article contributes by reframing climate adaptation as social reproduction and by showing that thermal inequality must be analyzed through distribution, not only through exposure. It also contributes by identifying three mechanisms that can guide future empirical research and policy evaluation across different coastal contexts. This framework helps explain why cooling, housing, and services should be understood as social rights rather than optional resilience investments. It offers a portable conceptual language for comparing neighborhoods, cities, and interventions while remaining attentive to justice and informality. The broader significance lies in treating the struggle for a cooler city as a struggle over urban citizenship, dignity, and the conditions required to reproduce life under climate stress (P et al., 2024).

2. Research Method

This article employs a qualitative research design grounded in interpretive urban sociology and mechanism-based analysis to examine how climate stress, housing conditions, and informal adaptive networks interact in coastal urban life. A qualitative approach is appropriate because the central object of inquiry consists of lived experiences, social relations, material conditions, and institutional arrangements that cannot be adequately captured through temperature indicators or aggregate vulnerability scores alone (Esterberg, 2001). The analytical framework combines a social reproduction perspective with the article's three core mechanisms—infrastructural mediation, spatial sorting, and relational coping—in order to explain how heat becomes durable and unequal harm in everyday urban settings.

This framework is suitable because it connects climate exposure to the practical labor of maintaining life, including care, health management, food storage, mobility, and household survival under conditions of precarious housing and unreliable services (Toker, 2022). The design works well for this research because thermal inequality is not produced by environmental variables alone, but through context-specific interactions among built form, tenure insecurity, service provision, and neighborhood sociality. A qualitative strategy makes it possible to trace these interactions as socially embedded processes rather than as isolated technical deficits. It also allows close attention to the meanings and constraints attached to informal adaptation, showing how coping practices are shaped by obligation, exclusion, and unequal access as much as by resilience. Such a design is therefore well suited to a research problem concerned with justice, informality, and the everyday experience of climate stress in coastal cities.

The data consist of academic literature, policy and planning documents, climate adaptation reports, housing and urban informality studies, organizational publications, and publicly available materials concerning coastal heat, service provision, and neighborhood-level coping practices (Lewis, 2015). Data collection was conducted through purposive selection of sources directly relevant to thermal stress, housing precarity, informal urban development, service reliability, and community-based adaptation in coastal city environments. The units of analysis are not individual temperatures or isolated infrastructures, but the social and material arrangements through which heat is lived, including housing conditions, service systems, neighborhood relations, and documented adaptive practices.

A qualitative coding matrix served as the primary instrument for organizing the material according to the main analytical dimensions of infrastructural mediation, spatial sorting, relational coping, social reproduction, service reliability, tenure security, and distributive inequality (Im et al., 2023). These dimensions functioned as the principal

variables for tracing how climate stress is translated into unequal domestic, health, and livelihood burdens. Trustworthiness was strengthened through source triangulation, conceptual consistency in coding, and explicit alignment between the research questions, theoretical framework, and analytical categories, while reliability was supported by maintaining a transparent audit trail of source selection and thematic classification. Validity was enhanced by restricting the analysis to sources directly connected to coastal urban heat, housing, and informality, and by reading policy and scholarly materials in relation to the same mechanism-based framework (Busetto et al., 2020). Because the study relies on publicly accessible documentary materials and does not involve direct human participants, formal informed consent was not required; nevertheless, ethical standards were maintained by avoiding selective misrepresentation, treating vulnerable urban populations with interpretive caution, and preserving confidentiality wherever non-public individual or community-specific information could otherwise be inferred.

3. Result and Discussion

Climate stress in coastal cities is experienced through unequal urban conditions rather than through temperature alone. Heat becomes socially consequential when it is absorbed by precarious housing, unstable service provision, and limited access to cooling resources. In dense coastal neighborhoods, the burden of heat is intensified by humidity, poor ventilation, overcrowding, and building materials that retain warmth long after sunset. These conditions transform climate stress into a daily struggle over sleep, work, care, and bodily endurance. Thermal exposure is therefore not simply an environmental fact. It is mediated by social arrangements that determine who can buffer discomfort and who must endure it directly (Hamstead, 2023). Coastal urban life reveals that adaptation begins not with abstract resilience planning, but with the unequal material conditions of dwelling. The central pattern is one of thermal inequality embedded in the ordinary infrastructures of urban survival.

Housing conditions are the primary site through which this inequality becomes durable harm. Poorly insulated roofs, heat-retaining walls, low-quality materials, and limited airflow make indoor environments physically exhausting during prolonged hot periods. Overcrowding intensifies this pressure because multiple bodies, cooking practices, and constrained spatial arrangements raise indoor temperatures further and reduce opportunities for rest. Insecure tenure compounds the problem by discouraging long-term improvement and making households reluctant to invest in structural adaptation. Renters and informal residents often have little control over the design, repair, or modification of their living spaces. Heat therefore accumulates inside homes that are already shaped by scarcity and instability. What appears as a climate problem at city scale becomes, at household scale, an issue of material inequality and constrained agency (Castro & Delina, 2025). Housing thus functions as a crucial mechanism translating urban heat into patterned social disadvantage.

This domestic exposure cannot be separated from infrastructure. Electricity supply, water access, drainage, waste management, and public space all affect whether high temperatures remain manageable or become disruptive to everyday life. Unreliable electricity limits the use of fans, refrigeration, lighting, and other devices that help households maintain livable conditions. Water disruption increases the difficulty of cooling the body, washing, storing food safely, and caring for children or elderly family members during hot periods. Inadequate drainage and poor environmental maintenance intensify humidity, stagnation, and the broader sensory burden of urban heat. The absence of accessible public cooling spaces also pushes adaptation back into already stressed households. Infrastructure therefore does not merely support adaptation from the outside. It actively structures the threshold between tolerable discomfort and

cumulative domestic crisis. Climate stress becomes more severe where urban systems fail to stabilize ordinary reproduction.

The geography of risk is also socially sorted before any policy response begins. Low-income residents are disproportionately concentrated in neighborhoods with limited green cover, denser building patterns, weaker service access, and greater exposure to combined heat and flood pressures. These spatial arrangements are shaped by land markets, eviction politics, informal settlement histories, and uneven development priorities. Residents do not randomly occupy the hottest parts of the city. They are often pushed there by affordability constraints, exclusion from formal housing markets, and the absence of secure alternatives. Spatial sorting thus produces unequal exposure prior to any discussion of resilience or coping capacity. The city distributes vulnerability through housing location as much as through climate itself. This makes thermal inequality a spatial expression of urban inequality. Adaptation must therefore be understood as inseparable from the politics of land, settlement, and service access.

Against these pressures, households rely heavily on adaptive networks. Kinship ties, neighbors, informal service providers, local vendors, and religious or community associations often provide support when formal systems are inadequate. These networks can supply practical assistance through shared water, temporary shelter, childcare, information exchange, or informal credit during periods of heightened heat stress (Ka et al., 2018).

They also reduce the isolation of households confronting repeated domestic strain. Yet relational coping is not an unlimited or universally available resource. Support depends on social membership, reciprocal obligation, and the uneven distribution of local trust and material capacity. Some residents are better positioned to draw on these networks than others. Informal adaptation therefore reflects both solidarity and social hierarchy. Adaptive networks mitigate harm, but they do not erase the structural inequalities through which heat is distributed. The comparative logic of the discussion can be summarized through four interconnected dimensions: housing precarity, infrastructural mediation, spatial sorting, and relational coping. Each dimension captures a distinct pathway through which climate stress is translated into unequal urban experience. Housing precarity structures the intensity of indoor exposure. Infrastructural mediation shapes the capacity to manage heat in daily life. Spatial sorting determines which neighborhoods face compounded environmental and service burdens. Relational coping reveals how households assemble support under constrained conditions. These dimensions do not operate independently, but reinforce one another in ways that deepen thermal inequality across coastal urban settings.

Table 1. Comparative Dimensions of Climate Stress, Housing, and Adaptive Networks in Coastal Urban Life

Analytical Dimension	*Main Pattern*	*Social Implication*
Housing precarity	Poor materials, density, and insecure tenure intensify indoor heat	Heat becomes a domestic inequality issue
Infrastructural mediation	Electricity, water, drainage, and public services are uneven	Daily adaptation burdens increase
Spatial sorting	Low-income households are concentrated in hotter and riskier areas	Exposure is socially distributed before crisis response
Relational coping	Informal networks provide support but also reproduce obligation and exclusion	Adaptation depends on unequal social ties

Table 1 clarifies that heat in coastal cities is not simply an environmental hazard but a socially organized condition. Housing precarity explains why some households absorb far greater thermal stress than others within the same urban climate. Infrastructural

mediation shows that adaptation capacity is bound to service reliability rather than personal resilience alone. Spatial sorting demonstrates that exposure is structured long before emergency measures or adaptation interventions are introduced. Relational coping adds a further layer by revealing that the ability to survive heat often depends on unequal social ties rather than on universally accessible public protection. The table therefore supports the broader argument that thermal inequality is produced through interacting urban mechanisms rather than through weather alone. It also helps explain why technical adaptation measures often fall short when they fail to address housing and social infrastructure. Climate stress is made durable through the ordinary organization of city life.

This interpretation is consistent with earlier scholarship on urban heat and climate vulnerability, while also extending it through a stronger focus on informality and social reproduction. Existing work has established that heat exposure is unevenly distributed across urban populations and that poorer households face higher risks. Research on informality has likewise shown that precarious housing and weak service provision intensify environmental vulnerability. The present discussion sharpens these insights by connecting them more explicitly to the domestic and relational processes through which households reproduce daily life under thermal pressure. Heat is not only a matter of exposure. It is a matter of maintaining food, care, hygiene, rest, and income under conditions of repeated bodily and infrastructural strain. This emphasis on social reproduction broadens the analytic frame beyond hazard management. It situates climate stress within the ongoing labor required to sustain urban life. The result is a more sociologically grounded account of why adaptation is inseparable from inequality.

The implications for climate justice are substantial. If heat is mediated through housing, services, and social access, then adaptation policy cannot be limited to city-scale technical interventions alone. Cooling, secure housing, and reliable infrastructure become matters of distributive justice rather than optional resilience enhancements. Policies that address heat without addressing tenure insecurity or service instability risk leaving the most exposed households in structurally unchanged conditions. Similarly, adaptation agendas that improve public environments while ignoring low-income housing may shift visibility without reducing domestic burden. A justice-oriented approach must therefore recognize indoor heat, domestic labor, and neighborhood service failure as central adaptation concerns. This shifts the policy question from how cities can become more climate resilient in the abstract to who receives protection, under what conditions, and at whose expense. Climate adaptation is thus a social question about rights, access, and unequal urban citizenship.

The relevance for coastal urban governance extends beyond immediate heat management. City governments often pursue redevelopment, flood control, environmental upgrading, or resilience planning through projects that can unintentionally deepen exclusion. In informal settlements, such interventions may increase rents, reduce tenure security, or weaken neighborhood support systems even while improving selected physical indicators. This creates a tension between environmental improvement and social displacement. Governance that treats informal settlements primarily as technical problems may undermine the very adaptive networks that currently sustain vulnerable households. Coastal adaptation therefore requires a more careful understanding of how housing, livelihood, and social infrastructure interact. Urban governance must address thermal risk without reproducing new forms of dispossession. The broader challenge is to design interventions that cool cities while preserving the social conditions necessary for everyday survival.

Several strengths and limitations emerge from this discussion. Its main strength lies in the mechanism-based explanation of how heat becomes socially patterned through

linked urban processes rather than isolated environmental indicators. The framework also helps connect climate stress to housing precarity, service instability, and neighborhood sociality within a single analytic vocabulary. At the same time, variation across coastal cities means that the relative weight of these mechanisms may differ according to legal regimes, climatic conditions, and political histories. The discussion is also limited by the fact that adaptation practices are dynamic and may change rapidly under economic or policy pressure. An important and somewhat unexpected element is that adaptive networks can be both protective and exclusionary. They offer real support, but they may also depend on obligations and boundaries that leave some residents less protected than others. Informal coping cannot therefore be romanticized as an automatic solution to structural heat inequality.

Future inquiry would benefit from closer comparison across cities, neighborhoods, and housing regimes in order to clarify how thermal inequality is shaped by different forms of informality and governance. More detailed work on gendered care burdens, tenant insecurity, migrant precarity, and elderly vulnerability would deepen understanding of who bears the heaviest costs of domestic heat. Research on neighborhood cooling, informal infrastructure, and everyday service negotiation would also enrich the study of adaptive networks beyond formal policy frameworks. Practical application should focus on integrated interventions linking housing improvement, cooling access, service reliability, and tenure security rather than treating each as a separate domain. Governments, planners, and community organizations need approaches that recognize heat as a condition of unequal urban life rather than as a standalone environmental event. The struggle for adaptation in coastal cities is therefore also a struggle over recognition, material support, and the right to inhabit urban space with dignity.

4. Conclusion

Climate stress in coastal urban life is socially distributed through the unequal material and institutional conditions of housing, infrastructure, and everyday survival. The discussion has emphasized that heat does not become harmful in the abstract, but through precarious dwellings, unreliable services, spatial concentration in high-risk areas, and uneven access to adaptive resources. Housing precarity intensifies indoor exposure, infrastructural instability magnifies domestic burdens, and spatial sorting places low-income residents in hotter and less protected environments before any formal adaptation begins. Informal adaptive networks partially mitigate these pressures, yet they also reveal the limits of coping strategies that depend on unequal social ties and obligations. Thermal inequality therefore appears not as a secondary effect of climate change, but as a central feature of how urban inequality is lived under warming conditions. In coastal cities, adaptation is inseparable from the labor of social reproduction, including care, food storage, rest, mobility, and the maintenance of bodily endurance. The broader implication is that climate stress must be understood as a question of urban justice, not merely as a technical problem of environmental management.

The article contributes to the field by offering a sociological framework that links climate stress to housing informality, infrastructural mediation, spatial sorting, and relational coping within a single analytical model. This contribution is significant because it moves beyond exposure-based accounts of urban heat and demonstrates how thermal risk is produced through the ordinary organization of urban life. By centering social reproduction, the discussion clarifies that the burdens of heat are carried through domestic labor, neighborhood dependency, and unequal access to services rather than through temperature alone. The mechanism-based approach also strengthens scholarship

on informality by showing that informal housing and adaptive networks are not peripheral to climate politics, but integral to the way adaptation is experienced and governed. In doing so, the article broadens climate vulnerability research by integrating distributive inequality, household survival, and urban citizenship into the analysis of coastal heat. Its conceptual value lies in showing that adaptation cannot be adequately understood through infrastructure or resilience discourse alone. The framework thus provides a more grounded basis for examining how climate change is lived, negotiated, and unevenly managed across precarious urban environments.

Future research should extend this framework through more detailed comparative work across coastal cities, neighborhoods, and housing regimes in order to identify how different forms of informality shape thermal inequality under varying political and climatic conditions. Greater attention is also needed to gendered care burdens, tenant insecurity, aging populations, migrant vulnerability, and the differentiated capacities through which households respond to sustained heat stress. Longitudinal research would be especially useful for tracing how repeated exposure to heat interacts with debt, displacement, health deterioration, and the erosion or strengthening of adaptive networks over time. Further inquiry into neighborhood cooling, informal infrastructure, and the relationship between redevelopment and dispossession would help refine the analysis of adaptation beyond formal planning categories. There is also practical value in research that evaluates integrated policies linking housing improvement, cooling access, secure tenure, and service reliability rather than treating them as separate policy domains. Advancing this agenda remains essential for developing climate strategies that reduce thermal inequality without reproducing new forms of exclusion in rapidly warming coastal cities.

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