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Beyond technocracy: why local knowledge is the cornerstone of climate adaptation in conflict-affected cities

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Climate adaptation scholarship and practice are often shaped by technocratic approaches that prioritize engineered solutions, quantitative risk modeling, and centralized planning. While such approaches can be effective in stable institutional contexts, they are frequently ill-suited to conflict-affected cities, where fragmented governance, infrastructural damage, and contested authority shape how climate risks are experienced and managed. This Perspective argues that the marginalization of local knowledge in these settings is not merely a technical limitation but a political challenge that can reproduce vulnerability and reinforce existing power asymmetries. Drawing on interdisciplinary literature from climate adaptation, urban studies, and conflict research, the paper conceptualizes conflict-affected cities as spaces of compound risk, where climate hazards and violence interact in ways that strain conventional adaptation logics. It advances the view that local knowledge should be understood not as supplementary input to technocratic planning, but as a core adaptive resource embedded in everyday practices, informal governance arrangements, and social networks. By reframing climate adaptation around legitimacy, trust, and lived experience, this Perspective calls for more context-sensitive and politically aware approaches to adaptation in fragile urban environments. In doing so, it contributes to ongoing debates on climate adaptation by foregrounding the epistemic and governance challenges of adapting to climate change under conditions of conflict and instability.

KEYWORDS
climate adaptation, conflict-affected cities, fragile contexts, governance, lived experience, local knowledge, urban resilience

1 Introduction

Climate change poses a significant and growing threat to urban systems worldwide. As climatic hazards increase in both frequency and intensity, risks to human security, critical infrastructure, and social stability also rise. Cities in fragile and conflict-affected contexts face especially high risks. For this paper, we define "conflict-affected cities" as places where formal governance is weak or contested, social cohesion is fractured, and physical infrastructure is damaged. These conditions are due to ongoing or recent armed conflict, political violence, or prolonged crisis. In these complex environments, the dominant technocratic approach to climate adaptation often fails. Top-down planning, standardized engineering solutions, and comprehensive data do not produce effective or fair resilience. This paper argues that climate planning in such areas must change direction. Local knowledge, residents' practical often

unspoken understanding, should be the foundation for any adaptation strategy, not a marginal concern. Despite growing recognition of these challenges, much of the climate adaptation literature continues to prioritize technocratic planning models that assume stable governance, reliable data, and institutional coherence conditions that rarely exist in conflict-affected cities. This creates a conceptual gap in how adaptation is theorized and operationalized in fragile urban contexts.

In conflict-affected cities, climate change impacts are not just added to existing vulnerabilities. Instead, they are multiplied by fragility, creating a crisis of compound risks (Sitati et al., 2021). Critical infrastructure already damaged by violence becomes more likely to fail during floods or heatwaves. Governance systems, fractured by conflict, often lack the capacity to organize large technical responses (Rosvold, 2023). Social capital and trust, which are necessary for collective action, are frequently eroded. Population displacement increases pressure on urban services and ecological buffers that are already strained (Lasater et al., 2025). For example, in cities like Mogadishu and Khartoum, recurrent flooding devastates informal settlements where many displaced people live. Drainage systems are damaged, and no authority is clearly responsible for response (Osman and Das, 2023; Tambal et al., 2024; Minko, 2025). As a result, residents in these urban areas face threats to safety, livelihoods, and well-being. They are caught in a cycle of overlapping shocks (Buhaug and von Uexkull, 2025). These dynamics highlight a disconnect between how climate risk is experienced on the ground and how adaptation is commonly designed and evaluated in policy and research.

Given this reality of compound risk, effective climate adaptation is not just essential but existential for conflict-affected cities. Climate adaptation here must be understood as the process of adjusting socio-ecological-technical systems to actual or expected climatic stimuli, with the explicit goal of reducing harm amidst ongoing instability (Grover and Kahn, 2024). It encompasses actions ranging from immediate community-organized responses to floods, heatwaves, and water shortages to the long-term, politically complex task of rebuilding resilient water governance. While international frameworks and national policies provide crucial mandates and resources, the operational scale of adaptation is inescapably local. This is because the manifestation of compound risks, where a flood intersects with a land dispute, or a heatwave with a disrupted health clinic, is highly context-specific. The local scale is where threats are directly lived, where residual capacities reside, and where any intervention, to be legitimate and not provoke conflict, must be negotiated (Vij et al., 2018). However, prevailing adaptation frameworks often under-theorize the role of local knowledge in navigating these negotiations, particularly in settings marked by violence and institutional fragmentation.

This Perspective contributes to ongoing critiques of technocratic climate adaptation by advancing a conflict-sensitive, urban-focused argument that local knowledge should be treated as a foundational element of adaptation in cities affected by violence and fragility. Although existing scholarship increasingly acknowledges the value of community-based and participatory approaches, local knowledge is often framed as a supplementary input to externally designed interventions. In contrast, this paper argues that in conflict-affected cities characterized by fragmented governance and contested infrastructure, local knowledge frequently represents a primary source of adaptive capacity. Drawing on insights from climate adaptation, conflict studies, and urban resilience literature, the paper reframes local knowledge not as an informal substitute for technical expertise, but as a form of situated intelligence essential for navigating compound climate–conflict risks. The objective of this Perspective is threefold: (1) to examine the limitations of technocratic adaptation approaches in conflict-affected urban contexts; (2) to conceptualize local knowledge as a core adaptive resource rather than a supplementary input; and (3) to propose an analytically grounded reframing of climate adaptation that better reflects the realities of fragile cities.

As a perspective article, this study does not employ a formal systematic review methodology. Instead, it is based on a targeted, interdisciplinary synthesis of existing literature. Relevant studies were identified through iterative searches of academic databases, including Scopus, Web of Science, and Google Scholar, using keywords such as "climate adaptation," "conflict-affected cities," "local knowledge," and "urban resilience." Priority was given to peer-reviewed research and policy-oriented studies addressing adaptation in fragile and conflict-affected contexts. The selected literature was analyzed conceptually to identify recurring themes, theoretical debates, and empirical insights that inform the comparative framework and arguments advanced in this paper. The resulting comparative framework derived from this synthesis is illustrated in Figure 1.

The comparative framework presented in Figure 1 is grounded in established critiques of technocratic planning and scholarship emphasizing the role of local knowledge, legitimacy, and informal institutions in fragile and conflict-affected contexts. Research has shown that centralized, data-driven adaptation approaches often fail where governance is fragmented and institutions are unstable (Pelling, 2011; Eriksen et al., 2021). Conversely, locally embedded knowledge systems and informal governance arrangements have been shown to enhance legitimacy, flexibility, and adaptive capacity, particularly in contexts of conflict and urban fragility (Barakat and Zyck, 2009).

2 Why technocratic solutions fail in conflict zones

The prevailing technocratic approach to climate adaptation relies on pillars of centralized data, complex infrastructure, and formal governance partnerships, each of which is systematically undermined in conflict-affected urban environments. In these contexts, the very systems designed to build resilience often become new sources of vulnerability.

Efforts to apply data-driven models and engineered solutions in cities like Sana'a and Mogadishu illustrates both ambition and fundamental mismatch. For instance, the UN's Flash Environmental Assessment Tool (FEAT) is designed for rapid post-disaster environmental impact assessment, yet its application in active conflict zones like Syria has proven limited due to inaccessible data, security constraints, and the inability of static models to account for the dynamic hazards of warfare (Trombetta, 2008). Similarly, urban climate risk assessments often depend on satellite-based remote sensing, but, as Ahmed et al. (2024) demonstrate in their analysis of Somalia, these methods frequently fail to capture critical, ground-truthed socio-political realities, such as how territorial control by armed groups alters vulnerability and access to resources. The resulting plans, while technically sophisticated, can be dangerously misaligned with on-the-ground survival priorities.

These initiatives reflect a growing recognition of compound climate-conflict risks. Yet adaptation in these fragile urban settings remains nascent and fragmented. Quevedo et al. (2023) note that adaptation in fragile states is largely project-based and externally driven. Such interventions are rarely informed by robust conflict analysis, leading to unsustainable outcomes. Similarly, Kazemi et al. (2024) found that less than 10% of adaptation funding in the Lake

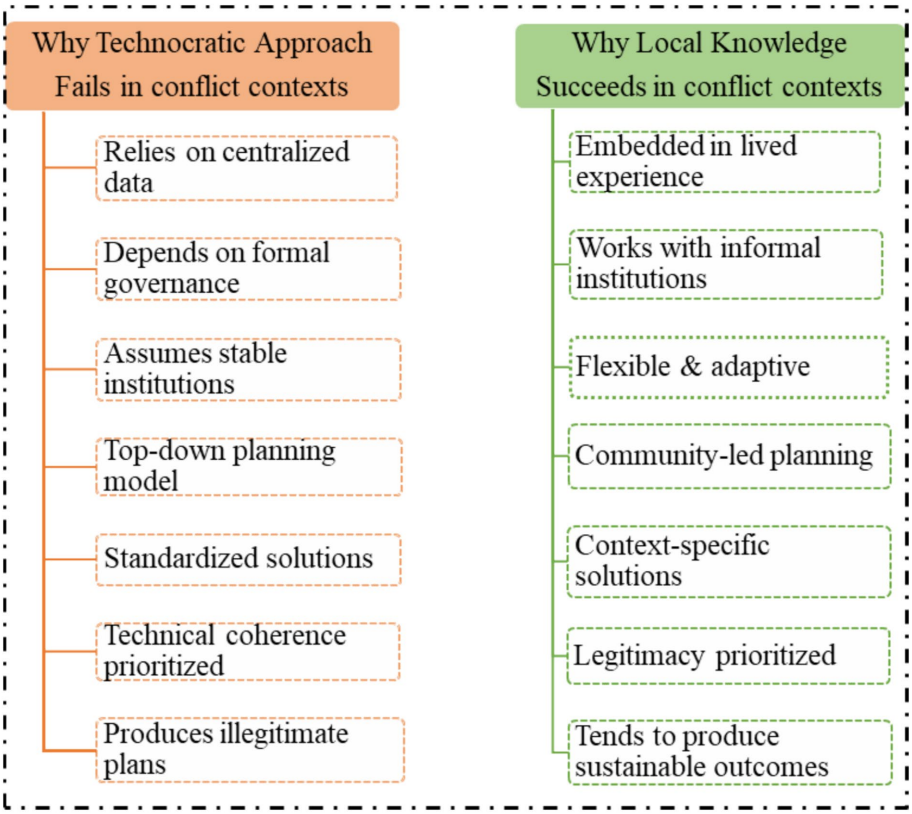

FIGURE 1
Conceptual framework comparing technocratic planning approaches with locally embedded knowledge systems in fragile and conflict-affected contexts.

Chad region was channeled through local institutions, despite their acknowledged importance. This persistent disconnect between international planning frameworks and local actors' capacities underscores the urgent need for more integrated, locally informed adaptation approaches.

The challenges constraining effective action are profound and structural. Conflict-affected cities typically operate with shattered municipal finances, destroyed infrastructure, and a fragmented civil service, severely limiting the fiscal and institutional capacity to manage complex engineering projects (Barakat and Milton, 2020). Political will is also diverted; as Ben Hassen and Hageer (2024) note, municipal authorities in such cities are overwhelmingly focused on immediate humanitarian survival and securing basic service provision, pushing long-term, climate-informed planning to the periphery. Furthermore, the unique, hyper-localized nature of risks, where a single checkpoint or a shift in front lines can determine access to water or safety from flooding, is poorly captured by standard vulnerability indices. Scholarly reviews of urban resilience frameworks have highlighted significant gaps in how existing approaches address contexts characterized by political instability and conflict. Mainstream resilience tools and models, developed primarily for natural hazards, climate adaptation, and stable development settings, are often generalized and lack the flexibility needed to account for the granular, fluid, and highly politicized realities of conflict-affected urban environments (Sun et al., 2025). These analyses suggest that without adaptation, such tools may offer limited actionable guidance for local and international actors operating in volatile conflict settings. Taken together, this evidence indicates that technocratic climate adaptation is not simply constrained by conflict, but structurally mismatched to it. Approaches premised on centralized authority, stable institutions, and comprehensive data misdiagnose the nature of risk in conflict-affected cities, where uncertainty, informality, and contested power are defining conditions rather than temporary obstacles. In such contexts, technocratic interventions risk producing plans that are technically coherent but socially illegitimate, politically infeasible, or operationally irrelevant. This mismatch helps explain why adaptation initiatives in fragile urban settings frequently fail to endure beyond short project cycles.

3 The vitality of local knowledge as an alternative foundation

If technocratic adaptation fails because it cannot navigate uncertainty, contested authority, and fragmented infrastructure, then local knowledge emerges not as an optional complement but as the most reliable foundation for climate adaptation in conflict-affected sittings. In conflict-affected urban settings, local knowledge can be understood as comprising three interrelated dimensions. First, experiential knowledge refers to residents' embodied understanding of environmental patterns, infrastructure weaknesses, and hazard histories derived from daily exposure. Second, social-network knowledge encompasses awareness of trust relations, informal institutions, and reciprocal support systems that shape collective action under insecurity. Third, political-territorial knowledge involves an acute understanding of

power relations, contested authority, and shifting control over space, which determines what adaptation actions are feasible or dangerous. Together, these forms of knowledge constitute a situated intelligence that cannot be captured by standardized datasets or externally defined risk assessments. In climate adaptation scholarship, social navigation has emerged as a useful lens for understanding this dynamic. It frames adaptation as actors' continual re-positioning within shifting landscapes, emphasizing agency, flexibility, and tacit local knowledge (Stacey et al., 2025). Research in East African drylands shows that pastoralist communities adjust livelihoods and social strategies in response to climate variability. They rely on knowledge of social networks, resource access, and shifting power dynamics to make decisions under uncertainty, and many adaptations remain invisible to technocratic plans. For example, in Turkana and Marsabit counties in Kenya, regions affected by drought, conflict, and displacement, pastoralists use mobility patterns, social networks, and traditional grazing practices as adaptive strategies. These practices enable them to manage scarce water and pasture, coordinate herd movements, share resources, and mitigate conflicts over land, demonstrating how local knowledge transforms uncertainty into practical resilience despite intense climatic and social stresses (Mohamed, 2025).

Beyond strategic positioning, local knowledge often enables improvised material adaptation in the absence of formal infrastructure. In many developing contexts, community members draw on generations of experience to modify built and natural environments cost-effectively, from traditional water harvesting and soil conservation to locally tailored cropping calendars. Studies on indigenous and local climate adaptation strategies highlight how community-derived practices, which integrate long-term ecological observation with everyday resource management, are central to building resilience where formal systems are weak or absent (Smith et al., 2023). In flood-prone communities in south Sudan's Akuak swamps, a context affected by both climate shocks and prolonged state fragility, residents rely on locally developed island-building techniques with papyrus and mud rather than engineered levees to keep homes habitable despite high seasonal floods, a practice rooted in long-standing local knowledge rather than centralized planning (Benansio et al., 2025). Moreover, locally developed adaptation practices can serve as the basis for hybrid strategies that blend empirical knowledge with scientific inputs, ensuring relevance and community uptake rather than imposition from the outside (Hermans et al., 2022).

A third dimension of local knowledge's vitality is its role in trust-based systems of early warning and communication. Centralized technology-driven early warning mechanisms may fail in settings with fragile infrastructure or conflict. In contrast, community-based systems rooted in local observation and social networks often perform critical functions. Reviews of early warning systems show that community-driven risk knowledge, monitoring, and communication enhance responsiveness to hazards. This includes the use of indigenous weather signs and peer networks (Macherera and Chimbari, 2016). Post-conflict urban settings, such as informal settlements in Accra, Ghana, show how residents' lived experience and shared flood risk observations shape localized adaptation. This is evident where municipal infrastructure is weak and formal channels are distrusted or slow (Adams et al., 2022). In conflict-affected settings marked by displacement, infrastructure breakdown, and distrust of formal authorities, trust-based systems support adaptation by using existing social bonds and embedded practices. These locally sustained processes demonstrate that adaptation emerges from lived experience and social relations, not just from technical solutions imposed onto complex human terrain.

4 A practical framework for enabling local adaptation

In conflict-affected cities, enabling locally led climate adaptation requires approaches that are not only participatory, but explicitly sensitive to political fragmentation, insecurity, and contested authority. They should genuinely empower communities. Studies on community-based adaptation (CBA) show that participatory approaches, in which local actors lead planning and decision-making, yield more relevant and lasting outcomes than top-down interventions (Selje et al., 2024; Parsons et al., 2025). Research also highlights the importance of flexible funding, which lets local organizations adjust resources as priorities change. This flexibility is key to building adaptive capacity in unstable, uncertain contexts (Kaijser and Kronsell, 2014). Local knowledge is also essential for understanding complex social and ecological issues in conflict-affected areas. Communities often know local vulnerabilities, governance structures, and coping strategies in detail (Ayers and Forsyth, 2009).

Beyond finance, enabling local adaptation relies on appropriate technologies and knowledge co-production. Co-production integrating scientific and local knowledge in planning and implementation enhances adaptive capacity, improves legitimacy, and fosters social learning (Lavorel et al., 2020). Research indicates that tools should be robust, low-barrier, and contextually appropriate, supporting local systems rather than replacing them (Moser and Ekstrom, 2010). Additionally, partnerships must be grounded in institutional listening and reflexivity, with external actors first understanding local power structures, socio-cultural norms, and political sensitivities before intervention (Taylor et al., 2025). When combined with flexible funding, co-produced knowledge, and humble partnerships, these strategies enable communities to lead adaptation efforts that are both resilient and sustainable in conflict-affected urban settings. Crucially, locally led adaptation in conflict-affected cities must be risk-sensitive to political and security dynamics. Interventions that are technically sound may still exacerbate tensions if they alter access to resources, confer legitimacy on particular actors, or are perceived as aligning with one side of a conflict. Local knowledge is therefore essential not only for identifying environmental risks, but for navigating questions of neutrality, legitimacy, and safety. Adaptation frameworks that ignore these dimensions risk unintentionally reproducing conflict dynamics, whereas those grounded in local political-territorial awareness are more likely to achieve durable and equitable outcomes.

5 Conclusion

In conflict-affected cities, technocratic approaches to climate adaptation are often misaligned with the realities of risk, fragmented governance, and social insecurity. Local knowledge, rooted in residents' everyday experience, social networks, and political awareness is not merely supplementary but a primary foundation of adaptive capacity. Recognizing its centrality highlights critical questions about whose knowledge shapes adaptation agendas and who controls decision-making, emphasizing the politics of knowledge in fragile urban contexts.

Forward-looking adaptation requires flexible funding, co-produced knowledge, and partnerships that empower local institutions and communities. By centering local knowledge, climate adaptation can become more legitimate, context-responsive, and capable of addressing the intertwined challenges of environmental change and urban fragility.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

SS: Conceptualization, Investigation, Project administration, Writing – original draft, Writing – review & editing. ZM: Writing – review & editing.

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