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Research article

Urban fire resilience and the right to the city: Structural pathways in Ghanaian markets and settlements

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Abstract: Fire outbreaks have become a recurrent urban disaster undermining the Right to the City—understood here as the collective right to safe, inclusive, and participatory urban spaces—in Ghana's rapidly urbanising centres. Despite policy commitments to inclusive and sustainable cities, repeated fires in markets and informal settlements revealed persistent structural vulnerabilities and governance breakdowns. This study examined the structural vulnerabilities through which spatial configurations, socio-economic inequalities, and institutional practices perpetuate urban fire risk in Accra and Kumasi. Using a mixed-methods approach combining geospatial analysis, household surveys, key informant interviews, and policy review, the study identified market-level fire risk patterns and traced how inadequate infrastructure, weak regulatory enforcement, and fragmented governance systems translated into heightened exposure and unequal losses. Results demonstrated clear pathways linking poor spatial planning and limited fire safety provision to recurrent fire incidents, particularly among informal traders and low-income households. It further showed that urban fire governance remained largely reactive, with minimal integration of preventive, community-led resilience practices. Grounded in the Right to the City and urban resilience frameworks, the study advanced a context-specific Fire Resilience Framework that integrated spatial planning reform, participatory governance, and low-cost technological support. It concluded that strengthening these structural pathways is critical not only for reducing fire risk, but also for advancing equitable, inclusive, and sustainable urban development in Ghana and comparable Sub-Saharan African contexts.

Keywords: fire resilience; informal settlements; right to the city; structural pathways; urban governance

1. Introduction

Urban fire disasters represent a persistent yet comparatively under-examined hazard in rapidly urbanising cities of the Global South, despite their recurring socio-economic consequences [1,2]. Although scholarship on urban resilience and disaster risk reduction has expanded significantly, dominant attention continues to focus on floods, heatwaves, and storms [3,4]. Fire risk—particularly within densely built markets and informal settlements—remains marginal in both empirical research and policy discourse, even though such fires frequently result in extensive livelihood losses, displacement, and prolonged economic disruption [5–10]. This imbalance reveals a critical disconnect between lived urban risks and the hazards prioritised within planning and resilience agendas.

Across African cities, urban fires are neither isolated nor rare events, but recurrent incidents that vary in scale from frequent small outbreaks to episodic catastrophic market fires [11,12]. Available evidence shows that fire incidents are spatially concentrated in informal trading hubs and high-density settlements, where combustible materials, unsafe electrical connections, narrow access routes, and inadequate emergency infrastructure intersect [13–16]. However, much of the existing literature does not clearly distinguish between the frequency, scale, and spatial concentration of these events, leaving ambiguity over whether urban fire risk is driven primarily by numerous small incidents, fewer large disasters, or a combination of both. This lack of clarity weakens problem framing and limits the effectiveness of urban policy and planning responses.

Ghana exemplifies this dual fire-risk pattern. Between 2020 and 2025, major cities such as Accra and Kumasi recorded repeated fire incidents, with markets emerging as critical hotspots [17]. High-profile fires at Kantamanto, Makola, Kejetia, and other commercial centres resulted in the destruction of stalls, goods, and informal livelihoods, often affecting thousands of traders in single events [18–20]. Alongside these catastrophic incidents, numerous smaller fires occur annually within informal settlements and neighbourhood markets, cumulatively generating substantial economic losses and social vulnerability [17]. Empirical evidence attributes these fires to a convergence of structural and governance failures, including poor spatial planning, overcrowded market layouts, obsolete or illegal electrical wiring, limited fire-hydrant coverage, and weak enforcement of building and safety regulations [18,20]. Although institutions such as the Ghana National Fire Service (GNFS) and the National Disaster Management Organisation (NADMO) are mandated to manage fire risk, preventive capacity remains constrained by fragmented governance, limited resources, delayed response times, and insufficient integration of fire risk considerations into urban planning, resulting in largely reactive responses [21–23].

Urban fire risk in Ghana is further complicated by socio-political dynamics surrounding market governance. Fire incidents are frequently politicised, with narratives of sabotage or arson obscuring structural explanations linked to infrastructure deficits and spatial design [24,25]. This politicisation diverts attention from persistent vulnerabilities such as congested alleys, the absence of firebreaks, limited water access, and minimal trader participation in fire-safety education. Post-fire reconstruction often reproduces unsafe layouts and materials, indicating weak institutional learning and reinforcing cycles of vulnerability [23]. At the city scale, Accra and Kumasi illustrate how informality intensifies

fire exposure, as traders operate within highly congested environments characterised by temporary structures, unregulated electrical connections, waste accumulation, and restricted emergency access [13,15,26,27]. These spatial vulnerabilities intersect with socio-economic marginalisation, as most traders lack insurance, savings, or secure tenure, constraining recovery and deepening post-fire precarity. Consequently, fire disasters disproportionately affect already vulnerable populations, raising normative concerns about equity, justice, and the Right to the City [28,29].

Despite the persistence and severity of urban fires, Ghanaian urban resilience research remains dominated by studies on flooding, sanitation, housing deficits, and climate adaptation, with fire risk receiving comparatively limited analytical attention [27]. More critically, few studies explicitly link urban fire risk to rights-based frameworks such as the Right to the City or empirically ground global development agendas such as Sustainable Development Goal (SDG) 11.5, which seeks to substantially reduce disaster-related losses among the poor and vulnerable [9,10]. Where SDG 11.5 is referenced, it is often treated normatively rather than analytically, without spatially specific evidence demonstrating how recurring fire disasters undermine progress towards this target.

This reveals a clear and authentic knowledge gap. While it is well established that urban fires occur frequently in Ghanaian cities and that informality and governance weaknesses exacerbate risk, what remains insufficiently understood is how fire vulnerability is structurally produced through the interaction of spatial form, institutional fragmentation, and lived urban inequality, and how this process shapes residents' Right to the City. In particular, there is limited spatially grounded evidence from Ghanaian markets that integrates fire-incidence patterns, governance arrangements, and community experiences within a unified analytical framework. This study addresses this gap by evaluating urban fire resilience through a combined lens of structural pathways and the Right to the City, using empirical evidence from Ghanaian markets and settlements. By integrating fire-incident data, spatial analysis, institutional assessment, and community perspectives, the research conceptualises urban fire disasters not as isolated accidents, but as systemic outcomes of planning practices, regulatory enforcement, and socio-economic marginalisation.

In summary, this orienting background establishes that Ghana's urban fire problem is characterised by both frequent small-scale incidents and episodic catastrophic market fires, spatially concentrated in informal trading environments and shaped by structural vulnerabilities. By clearly identifying the empirical and conceptual gaps in existing literature, the study positions itself to contribute original knowledge on urban fire resilience, rights-based vulnerability, and inclusive urban governance. The research therefore proceeds with five sections: (1) Introduction, situating urban fire risk within resilience and the Right to the City, (2) Methods, outlining the mixed-methods approach, (3) Results, presenting empirical findings, (4) Discussion, interpreting these findings in relation to governance and spatial dynamics, and (5) Conclusion, proposing integrated policy and planning interventions to strengthen urban fire resilience in Ghana.

2. Methodology

This study employs a mixed-methods approach to examine how recurrent urban market fires undermine disaster resilience and the Right to the City in Accra and Kumasi. The methodological design prioritises analytical clarity, reproducibility, and direct alignment between research questions, data sources, analytical techniques, and outputs. Quantitative and qualitative data were systematically combined to capture the spatial, socio-economic, and institutional dimensions of urban fire

vulnerability, enabling triangulation across datasets and ensuring that empirical findings are grounded in both lived experience and governance practice.

2.1. Study area overview

The research focuses on Accra and Kumasi, Ghana's two largest metropolitan and commercial centres, both of which experience recurrent market fire outbreaks. Accra, the national capital, is located along the Gulf of Guinea between latitude 5°33′N and 5°84′N and longitude 0°05′W and 0°25′W, covering approximately 173 km^2. It is characterised by a coastal savannah climate, with dry and windy conditions that influence fire ignition and spread, particularly within densely built market environments such as Makola, Kantamanto, Agbogbloshie, Kaneshie, and Dome Market. Kumasi, situated in south-central Ghana between latitude 6°35′N and 6°40′N and longitude 1°30′W and 1°35′W, covers approximately 254 km^2 and functions as a major trade corridor linking southern and northern Ghana as well as neighbouring countries. The city hosts extensive traditional and informal markets, including Kejetia Central Market, Asafo Market, Bantama Market, and Race Course, which are characterised by high trading densities and extensive informal commercial activity.

Across both cities, market environments are dominated by tightly packed timber stalls, metal containers, temporary structures, informal electrical extensions, limited access routes, and intense pedestrian congestion [30,31]. These spatial and infrastructural characteristics heighten fire ignition risk, accelerate fire spread, and constrain emergency response, making Accra and Kumasi suitable contexts for analysing market fire vulnerability, institutional response capacity, and governance practices in relation to SDG Target 11.5 and the Right to the City framework [9,10,24,32]. The spatial locations of the study areas are presented in Figure 1.

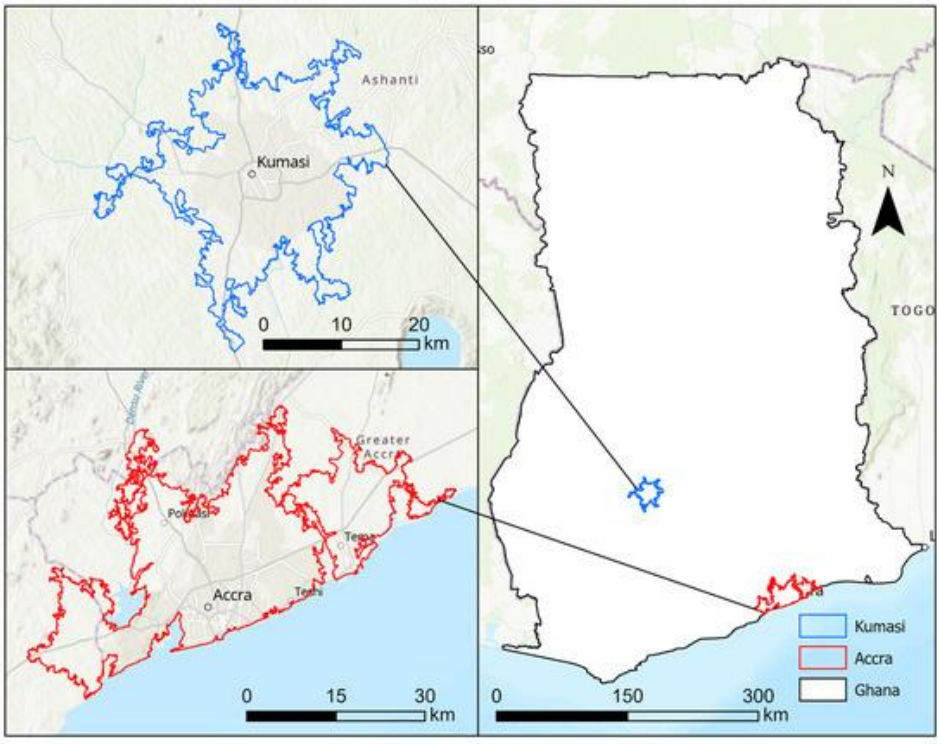

Figure 1. Boundary map of Ghana showing the study regions and areas that are an economic hub.

2.2. Research methods

A pragmatic mixed-methods research design was adopted to generate policy-relevant evidence on urban fire risk governance in Ghanaian market environments. Pragmatism was applied specifically to justify the integration of geospatial analysis, structured surveys, and institutional interviews in examining spatial exposure, socio-economic vulnerability, and governance processes associated with recurrent market fires. A cross-sectional explanatory sequential design was employed, whereby quantitative data were first used to identify patterns of fire exposure, preparedness, and vulnerability, followed by qualitative interviews to explain the institutional, regulatory, and governance factors shaping these patterns [33–35]. This design enabled a clear analytical progression from empirical observation to institutional interpretation.

Data collection was explicitly structured to address the study's research questions. Structured surveys captured traders' preparedness practices, asset exposure, insurance coverage, and perceptions of fire risk; institutional interviews examined governance coordination, enforcement challenges, political interference, and emergency response capacity; geospatial datasets were used to assess the spatial concentration of fire risk and response constraints within market environments; and secondary documents were analysed to validate fire occurrence trends, regulatory frameworks, and response records. This structure ensured a transparent linkage between data inputs, analytical procedures, and outputs presented in the Results section.

Table 1. Breakdown of study participants.

Participant category	City (Accra)	City (Kumasi)	Total sample size	Sampling technique	Rationale
Market traders and adjacent residents	150	150	300	Stratified Random	Measures perceptions, practices, preparedness, insurance and vulnerability
Market management committee members	5	5	10	Purposive	Insights into local governance and safety decisions
GNFS officers	4	4	8	Purposive	Assessment of response capacity and enforcement
NADMO officials	2	2	4	Purposive	Disaster risk management and recovery
AMA and KMA planning engineers	2	2	4	Purposive	Planning enforcement and infrastructure approval
Insurance agents/Underwriters	2	2	4	Purposive	Evidence on insurance uptake and compensation
Total	165	165	330	–	–

The study population comprised stakeholders directly affected by, or responsible for, urban fire risk management, including market traders, adjacent residents, market management committees, officers of the GNFS, officials of the NADMO, metropolitan planning and building control departments within the Accra and Kumasi Metropolitan Assemblies (AMA and KMA), and insurance providers. A hybrid sampling strategy was adopted. Stratified random sampling was used to select traders and residents across markets classified as high, moderate, and low-risk zones based on GNFS

fire incidence reports and infrastructure density, while purposive sampling targeted institutional actors with direct responsibility for fire prevention, response, planning enforcement, and post-fire recovery [36,37]. In total, 330 participants were engaged, comprising 240 traders, 60 adjacent residents, and 30 institutional respondents (Table 1).

Three complementary data collection methods were employed to enable triangulation [38,39]. Structured face-to-face surveys were administered to traders during peak trading hours to capture socio-economic characteristics, preparedness practices, asset exposure, insurance uptake, and fire experience histories. Semi-structured interviews were conducted with GNFS officers, NADMO officials, metropolitan planning officers, market managers, and insurance agents to document institutional coordination challenges, enforcement gaps, political influences, and response constraints; interviews were audio-recorded with consent and transcribed verbatim. Geospatial data collection included a digital elevation model (DEM) derived from shuttle radar topography mission (SRTM) data at 30 m resolution to assess terrain influences on access and response time, GPS coordinates of markets, hydrants, access routes, and stall clusters, and systematic market layout observations capturing stall density, congestion, and proximity to electrical wiring. Secondary sources comprised GNFS fire incident records, metropolitan development control regulations, market redevelopment reports, and insurance claim documentation, all of which informed both spatial and institutional analyses.

Geospatial analysis was conducted in ArcGIS Pro at market-level resolution to ensure spatial relevance. Four indicators were selected based on their direct influence on fire ignition, spread, and emergency response: stall density (proxy for fuel load and fire spread potential), distance to fire hydrants (response accessibility), proximity to electrical wiring clusters (ignition risk), and route accessibility and congestion (fire service response delay). A weighted overlay technique was applied, with indicator weights assigned through expert consultation with GNFS officers and metropolitan engineers and supported by fire incident frequency patterns derived from GNFS records. Indicators with stronger influence on ignition and suppression delay, particularly stall density and hydrant distance, were assigned higher weights. Aggregated fire occurrence density from GNFS incident records served as the dependent variable for validation, producing localised fire vulnerability maps that identify high-risk zones within market environments rather than predictive city-wide models.

Survey data were analysed using SPSS version 27.0, employing descriptive statistics (frequencies, percentages, and means) and inferential tests (Chi-square and Cramer's V) to examine relationships between socio-economic characteristics and fire preparedness. Interview transcripts were analysed using NVivo through thematic coding to identify governance failures, enforcement gaps, institutional coordination challenges, and community resilience practices. Analytical integration occurred at the interpretation stage, where institutional narratives were used to contextualise spatial and survey-based vulnerability patterns [36].

Data quality and ethical integrity were ensured through pilot testing of survey instruments in smaller markets prior to full deployment, triangulation across spatial, survey, interview, and documentary data, and member checking with GNFS officers, metropolitan officials, and market leaders to validate interpretations. NVivo coding was peer-reviewed to ensure thematic consistency [37,39]. Ethical approval was obtained from the University Institutional Review Board. Participation was voluntary, with oral consent obtained from traders due to literacy considerations and written consent from institutional respondents. All data were anonymised, securely stored, and used solely for academic and policy purposes [33].

3. Results

Following the methodological framework outlined in the preceding section, this section presents the empirical results derived from market-scale spatial analysis, structured assessments, and quantitative modelling of recurrent urban fire outbreaks in Ghanaian cities. The results are organised in line with the study objectives and corresponding research questions to ensure coherence and analytical consistency. Spatial data are analysed strictly at the market scale, while regional patterns are referenced only where necessary to contextualise findings. Tables and figures are introduced with explicit reference to measured variables, temporal coverage, and analytical relevance. In keeping with standard reporting conventions, this section is descriptive and does not engage in interpretative discussion, which is addressed subsequently.

3.1. Spatial vulnerability

This subsection addresses Objective 1, which examines the spatial patterns and drivers of recurrent urban fire outbreaks in selected Ghanaian cities, guided by Research Question 1: *How do spatial configurations, infrastructural conditions, and urban planning practices contribute to recurrent fire outbreaks in selected urban markets and settlements in Ghana?* The analysis focuses on four major markets—Makola and Kantamanto in Accra, and Kejetia and Asafo in Kumasi—using market-level spatial indicators derived from field mapping, geospatial datasets, and officially recorded fire incident data covering the period 2020–2025.

Spatial vulnerability was assessed using five indicators that directly influence fire ignition, spread, and emergency response effectiveness: stall density, proximity to functional fire hydrants, internal access route width, prevalence of informal electrical connections, and proximity to combustible materials. These indicators were selected based on established fire-risk assessment criteria and their relevance to dense market environments. Descriptive statistics for each indicator across the four markets are presented in Table 2, allowing for systematic comparison.

Table 2. Market-scale spatial indicators of fire vulnerability in selected markets of Accra and Kumasi (2020–2025).

	Accra		Kumasi	
Spatial Indicator	Makola	Kantamanto	Kejetia	Asafo
Mean stall density (stalls/m^2)	0.83	0.79	0.91	0.88
Stalls within 200 m of hydrant (%)	35.4	30.2	29.8	27.4
Narrow access routes (<2.5 m) (%)	62.5	67.3	69.1	65.4
Informal electrical connections (%)	53.8	49.5	58.4	52.6
Mean distance to combustibles (m)	14.2	12.6	11.8	13.3

The results indicate consistently high stall densities across all study sites, with Kejetia recording the highest mean density at 0.91 stalls per square metre, followed by Asafo (0.88), Makola (0.83), and Kantamanto (0.79). Accessibility to functional fire hydrants within a 200-metre service buffer—reflecting operational firefighting standards in high-density urban areas—was limited across all markets, ranging from 27.4% in Asafo to 35.4% in Makola. Analysis of internal circulation further shows that between 62.5% and 69.1% of access routes were narrower than 2.5 metres, rendering them

inaccessible to GNFS appliances. Informal electrical connections were widespread, exceeding 49% in all markets, while the mean distance to combustible materials remained below 15 metres across sites, indicating a high potential for rapid fire escalation once ignition occurs.

To quantitatively examine the relationship between these spatial characteristics and observed fire occurrences, a multiple linear regression model was applied using market-level fire incidence frequency (total recorded fire events per market between 2020 and 2025) as the dependent variable. The independent variables comprised stall density, hydrant proximity, route obstruction, informal electrical connections, and proximity to combustible materials. The model was specified to assess the relative contribution of each spatial factor to observed fire incidence rather than to predict individual fire events.

As shown in Table 3, the regression model is statistically significant ($R^2 = 0.78$, $p < 0.05$), indicating that the selected spatial variables explain a substantial proportion of variation in market-level fire incidence. Stall density emerged as the strongest predictor ($\beta = 0.573$, $p < 0.01$), accounting for over half of the explained variance. Route obstruction also demonstrated a significant positive association with fire incidence ($\beta = 0.334$, $p < 0.01$), while hydrant proximity showed a significant negative relationship ($\beta = -0.241$, $p < 0.01$), suggesting lower incidence where access to firefighting infrastructure is relatively improved. Informal electrical connections ($\beta = 0.291$, $p < 0.01$) and proximity to combustible materials ($\beta = 0.187$, $p < 0.05$) were likewise significant contributors, reinforcing their role as spatially embedded fire-risk factors within market environments.

Table 3. Regression model output predicting fire incidence from spatial and infrastructure drivers.

Predictor variable	β coefficient	t-statistics	p-value
Stall density	0.573	6.823	0.000*
Hydrant proximity	−0.241	−3.714	0.002*
Route obstruction	0.334	4.580	0.000*
Informal electrical connections	0.291	4.198	0.001*
Proximity to combustibles	0.187	2.642	0.014**

*Note: Significant at $p < 0.01$; **Note: Significant at $p < 0.05$.

Figure 2 presents a market-scale spatial hotspot map illustrating the concentration of fire incidents and associated fatality records in Accra and Kumasi for the period 2020–2025. Fire frequency is visualised as aggregated counts per market block, ensuring scale consistency with the indicators reported in Tables 2 and 3. High-intensity clusters are concentrated within the inner cores of Makola, Kantamanto, Kejetia, and Asafo, where stall density is highest and internal access routes are most constrained. Areas with limited hydrant coverage spatially overlap with these clusters, reinforcing the observed association between infrastructural deficits and fire occurrence.

Overall, the results demonstrate that recurrent urban fire outbreaks in the selected Ghanaian markets are closely associated with market-scale spatial configurations characterised by congestion, limited firefighting access, and infrastructural informality. These findings provide empirical evidence that urban fire risk is not randomly distributed but is spatially embedded within specific physical and planning conditions observable at the local market level.

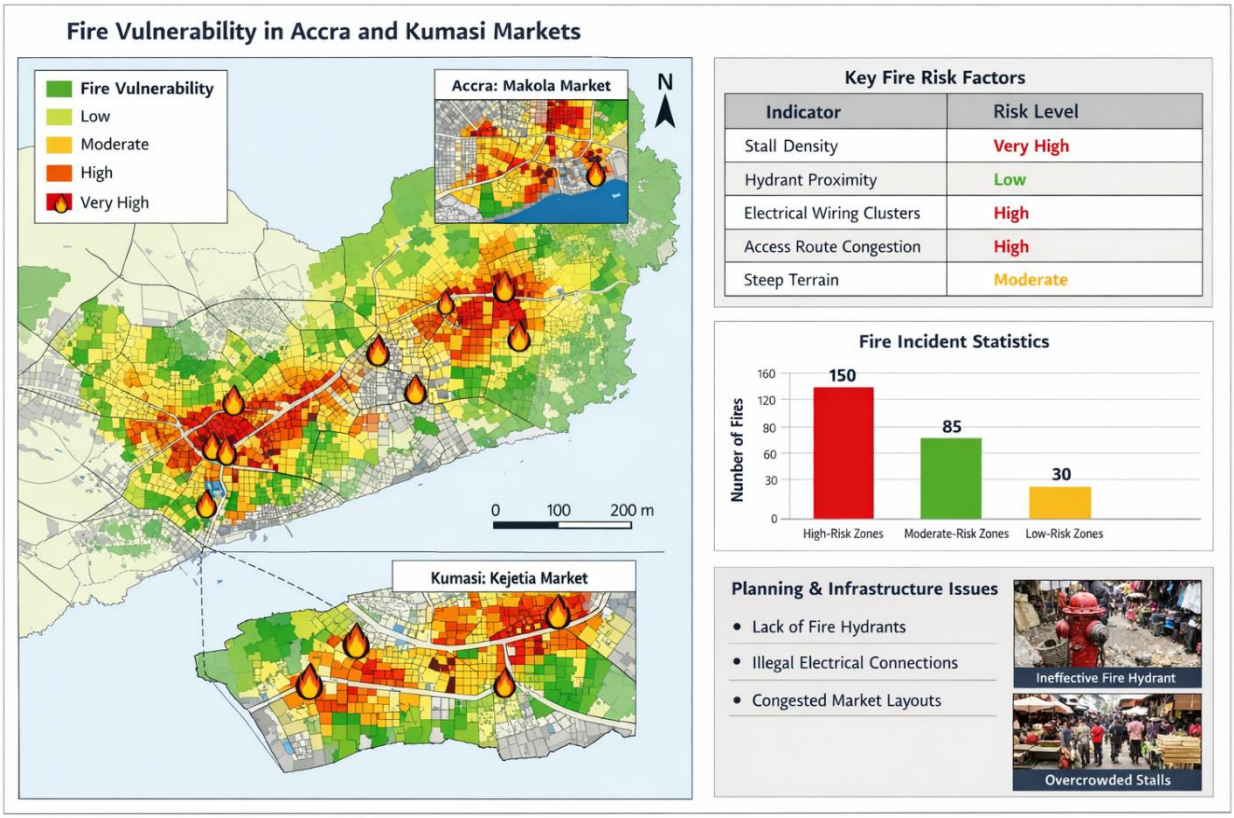

Figure 2. Market-scale hotspot map showing spatial concentration of fire incidence and fatalities in selected markets of Accra and Kumasi (2020–2025).

3.2. Governance constraints

This section presents empirical results addressing Research Question 2: *What institutional and governance factors hinder effective prevention, preparedness, and response to urban fire disasters in Ghana, and how do they influence disaster resilience?* The analysis draws on market-level trader surveys (n = 300), key informant interviews (n = 30), and documentary review conducted in Accra and Kumasi between 2020 and 2025. Data were analysed at consistent spatial (market and metropolitan) and temporal scales. Quantitative findings are reported using descriptive statistics and inferential tests, while qualitative evidence is used to corroborate observed institutional patterns without interpretive extrapolation beyond the empirical scope.

Survey results indicate widespread uncertainty regarding institutional mandates in urban fire governance. As shown in Figure 3a, which aggregates market- and city-level perceptions, 67.8% of respondents agreed that roles among the GNFS, the NADMO, and metropolitan assemblies (AMA and KMA) are unclear, while 22.2% moderately agreed and only 10.0% disagreed. Key informant interviews further clarify that although GNFS is formally responsible for fire prevention and enforcement, market fire audits and infrastructural interventions require approval from metropolitan assemblies, frequently introducing procedural delays. NADMO was consistently perceived as predominantly reactive, a view reflected quantitatively by 83.1% of respondents, indicating that NADMO engagement occurs mainly after fire incidents rather than during prevention or preparedness

phases. Documentary analysis (Table 4) confirms that fire risk reduction is not systematically mainstreamed within statutory city development plans or market redevelopment frameworks.

Table 4. Institutional barriers to effective fire resilience in Ghana.

Governance issue	Key findings	Impact on resilience
Enforcement gaps	Limited inspections, weak code enforcement	Persistent safety violations
Coordination failures	Poor inter-agency communication, overlapping mandates	Delayed emergency response
Political interference	Interference by local politicians, funding delays	Resource allocation delays
Resource constraints	Insufficient equipment, inadequate training	Limited firefighting capacity
Accountability deficits	Weak oversight, unclear accountability	Weak disaster response

To quantify coordination challenges, a coordination index was constructed using seven variables: Frequency of inter-agency communication, data-sharing mechanisms, joint inspections, collaborative planning exercises, shared emergency protocols, integrated budgeting, and response synchronisation. Each variable was measured on a five-point Likert scale and aggregated at the metropolitan level. The resulting mean coordination score was 2.41 out of 5 ($\sigma = 0.83$), indicating weak institutional coordination. Disaggregated results show that 71.6% of GNFS personnel and 64.2% of metropolitan planners reported the absence of shared fire hazard databases or interoperable data platforms. Consistent with these findings, Figure 3b shows that only 18% of reviewed metropolitan development plans formally incorporated GNFS fire safety recommendations. All results are derived exclusively from planning documents and interviews conducted in Accra and Kumasi, ensuring internal scale consistency.

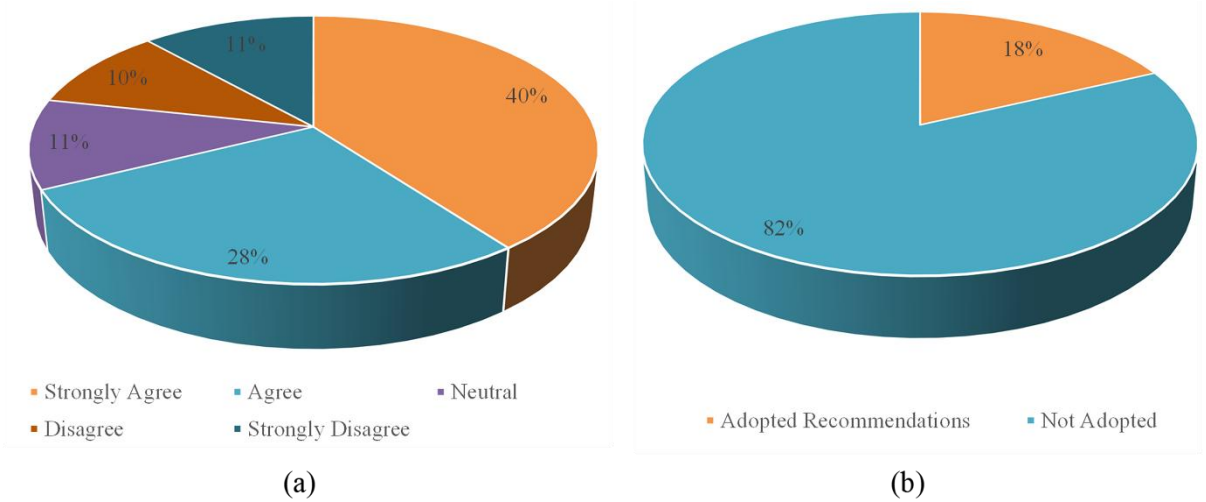

Figure 3. (a) Perceived clarity of institutional roles in urban fire governance (market-level survey data, Accra and Kumasi, 2020–2025); (b) Proportion of metropolitan development plans incorporating GNFS fire safety recommendations (city-level policy review).

Trader survey results further reveal weak enforcement of fire safety regulations at the market level. Overall, 74.4% of traders reported that inspections are rarely conducted, while only 26.6% indicated possession of mandatory fire safety certification. Among certified premises, inspections were reported as irregular and predominantly conducted following fire incidents rather than as part of

routine preventive audits. Fire extinguisher availability was recorded at 41.3% of surveyed stalls, yet functional assessments showed that 59.0% of available extinguishers were expired or non-functional at the time of survey. A chi-square test examining the relationship between regulatory compliance and market association membership revealed a statistically significant association ($\chi^2 = 12.74$, $p < 0.05$), indicating higher compliance levels within more organised market environments. All compliance data are reported at the individual stall and market scale.

Analysis of GNFS financial records and metropolitan budget statements indicates that less than 9.5% of the annual national fire budget between 2020 and 2025 was allocated to market-level fire prevention activities, including inspections, hydrant installation, and public education. In contrast, over 71.0% of total allocations were directed towards post-fire response operations and compensation. Interviews with metropolitan officials further indicate that market-generated revenues are primarily earmarked for administrative expenditures rather than infrastructural investments such as emergency access routes, hydrant networks, or electrical system upgrades. These findings are reported descriptively without causal inference while visualised in Figures 4 and 5 respectively.

Survey-based perception indices were used to examine the influence of political interference on fire safety enforcement. Figure 4 shows a statistically significant positive correlation between perceived political interference and reduced enforcement effectiveness at the city level ($r = 0.64$, $p < 0.01$). More than half of metropolitan officials (57.0%) acknowledged reluctance to enforce regulations against politically connected traders, while traders reported that inspections are often suspended during election periods. Synthesising these results, Figure 5 illustrates that governance constraints affecting urban fire resilience in Accra and Kumasi are characterised by unclear institutional mandates, weak inter-agency coordination, limited integration of fire risk into spatial planning, inconsistent regulatory enforcement, constrained preventive budgeting, and politically mediated enforcement practices. These findings provide a scale-consistent empirical foundation for interpretation in the subsequent discussion section.

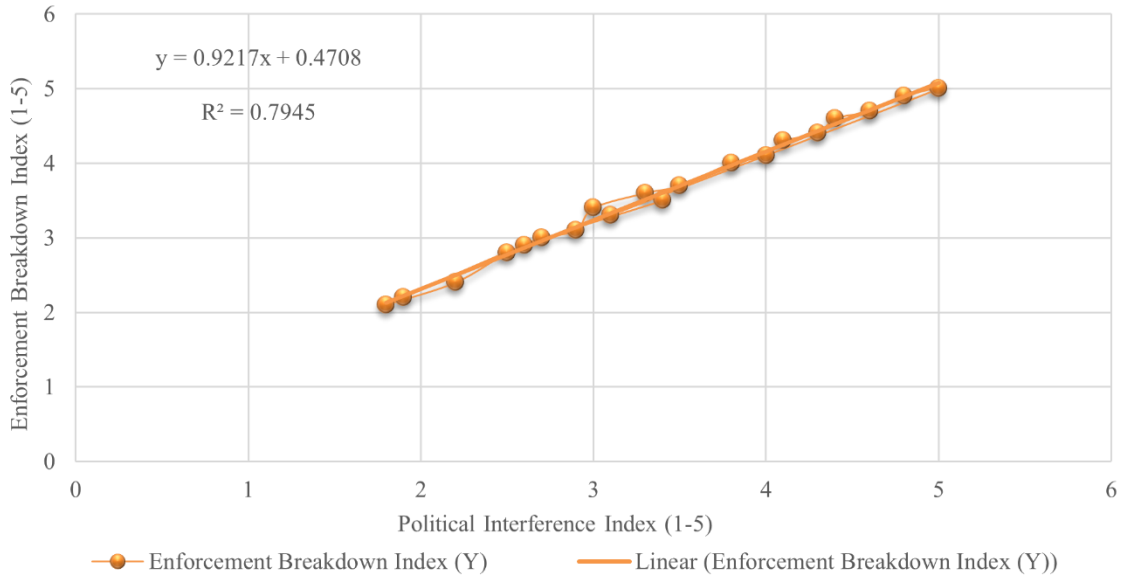

Figure 4. Relationship between perceived political interference and effectiveness of fire safety enforcement in Accra and Kumasi (survey-based perception index, 2020–2025).

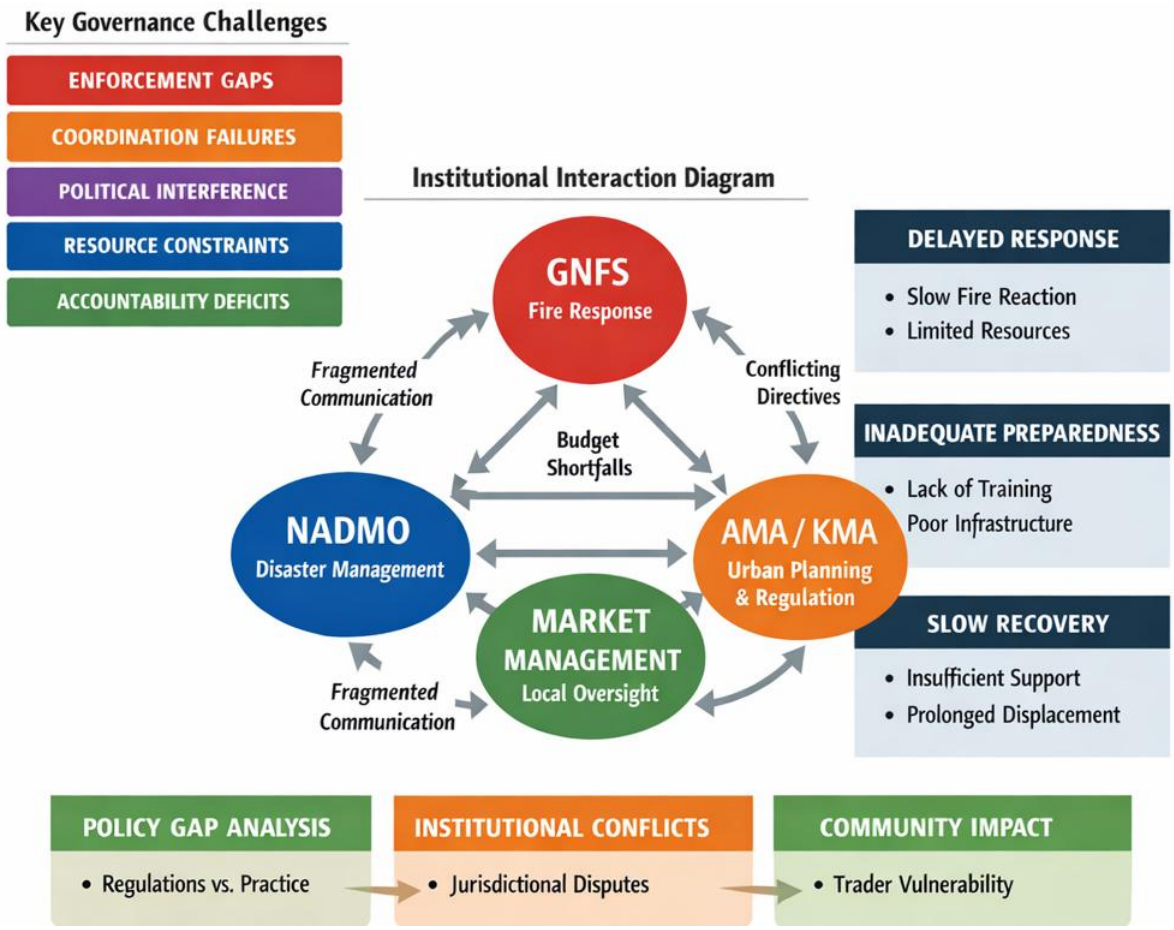

Figure 5. Governance constraints shaping urban fire resilience in Accra and Kumasi.

3.3. Spatial injustice

This subsection addresses Research Question 3: *In what ways do urban fire outbreaks disproportionately impact informal traders and low-income households, and how does this threaten their Right to the City?* It presents results on the spatial and distributional impacts of recurrent urban fire disasters on informal traders and low-income households in selected markets and adjacent settlements in Accra and Kumasi. The analysis focuses on how fire impacts are patterned across space and social groups, linking market-level spatial characteristics with livelihood loss, displacement, and unequal access to secure urban space. All results are derived from market surveys, household surveys, institutional records, and spatial observations analysed consistently at the local market and settlement scale.

Survey data from traders operating in Makola, Kantamanto, and CMB markets in Accra, and Kejetia, Race Course, and Bantama markets in Kumasi show a pronounced concentration of livelihood loss within densely congested market clusters. Across all surveyed markets, 82.4% of traders affected by fire incidents between 2020 and 2025 reported complete loss of merchandise, while 11.3% reported partial recovery, mainly through informal savings, family support, or limited institutional assistance. Loss severity was spatially concentrated in zones characterised by stall separations of less than 1.5–2 metres, extensive use of combustible materials, and non-compliant electrical connections, as identified through market-level spatial audits. These high-loss zones overlapped directly with fire-incident points

recorded by metropolitan fire services over the same period, indicating a strong spatial correspondence between congestion intensity and fire impact concentration.

Financial loss estimates further demonstrate uneven economic exposure across trader groups. Survey results indicate that 58.2% of low-income traders experienced an average loss of GH₵ 18,700 per fire incidence (approximately USD 1,558 at November 2025 exchange rates), while a smaller proportion of better-capitalised traders (10.4%) reported higher absolute losses averaging GH₵ 28,900 (approximately USD 2,408). However, when assessed relative to monthly income, traders earning below GH₵ 500 per month experienced substantially higher livelihood vulnerability, as losses exceeded several months of average earnings (Figure 6). This relative-loss assessment shows that economic exposure is disproportionately borne by poorer traders, despite their lower absolute asset values.

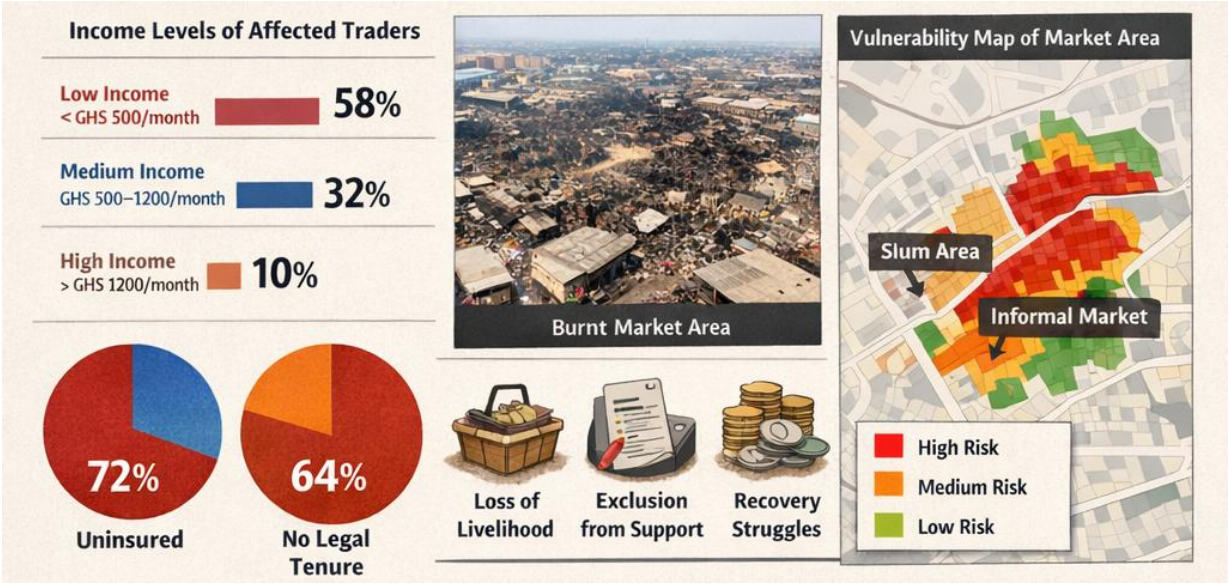

Figure 6. Impacts of urban fires on informal traders and low-income households in Ghana, threatening the Right to the City.

Institutional records and trader association data indicate that 72.1% of surveyed traders lacked fire insurance coverage at the time of fire incidents. Follow-up interviews confirmed that this was largely due to exclusionary insurance conditions, including unaffordable premiums and the non-recognition of wooden or temporary stalls within formal insurance schemes. Post-fire reconstruction records further reveal that 73.3% of rebuilt stalls in informal market sections were reconstructed using combustible materials, primarily through self-financed efforts. In contrast, metropolitan-supported reconstruction prioritised central commercial frontages, creating spatial differentiation between formal and informal market zones. These patterns were consistently observed in both Kejetia and Makola markets, where peripheral and informal sections experienced delayed or absent infrastructural upgrades following fire events.

Household survey results from Old Fadama (Accra) and Aboabo (Kumasi) demonstrate that market fires also generate spill-over impacts on adjacent informal settlements. Among 60 households directly affected by market-linked fire events, 64.0% reported temporary displacement lasting between two and four weeks due to smoke damage, heat exposure, and emergency evacuations during firefighting operations, while 36.0% reported permanent relocation following post-fire demolition or

clearance exercises implemented as risk-control measures. A chi-square test examining the relationship between settlement status and post-fire displacement produced a statistically significant association ($\chi^2 = 17.42$, $p = 0.024$), confirming that residents of informal settlements were significantly more likely to experience displacement following fire incidents.

Post-disaster market redevelopment outcomes reveal further inequalities in access to safer trading spaces. Reviews of market layouts following major fire incidents in 2013, 2017, 2020, and 2025 indicate an increasing reliance on containerised and concrete "premium stalls", typically priced between GH₵ 15,000 and GH₵ 30,000. Survey data show that traders displaced by fires were largely unable to access these upgraded spaces due to affordability constraints. A logistic regression model assessing determinants of access to rebuilt stalls identified monthly trader income ($p < 0.01$), possession of formal municipal certification ($p < 0.05$), and pre-fire capital investment levels ($p < 0.01$) as statistically significant predictors, confirming that post-fire spatial security is shaped by economic and administrative status rather than prior exposure or vulnerability.

Social and psychological impacts were measured using a standardised stress indicator scale ranging from 1 (low stress) to 5 (high stress). Fire-affected traders reported a mean stress score of 4.61, indicating widespread psychological strain linked to livelihood insecurity and uncertainty regarding future displacement. Qualitative survey responses show that 62.7% of traders reported sleeping overnight in their stalls as informal fire-watch measures, reflecting limited confidence in metropolitan fire-response capacity. In addition, 67.0% of respondents expressed distrust towards city authorities, citing perceptions that post-fire restructuring processes tend to marginalise informal traders rather than restore their livelihoods.

Gender-disaggregated analysis shows that 74.8% of fire-affected traders were women, particularly those engaged in food vending, textiles, cosmetics, and small-scale retail. Women traders reported lower access to insurance (8.3%), reduced likelihood of benefiting from post-fire stall reallocation, and higher exposure to loan repayment pressures following fire losses. Chi-square testing confirms a statistically significant association between gender and vulnerability outcomes ($\chi^2 = 21.33$, $p < 0.01$), indicating uneven exposure and recovery capacity across trader groups. These intersecting forms of economic exclusion, insecure tenure, marginalisation from risk governance, and livelihood erosion collectively undermine the ability of informal traders—particularly women—to maintain secure access to urban space and economic opportunity, thereby threatening their Right to the City.

Table 5. Socio-economic impacts of urban fires on informal traders and low-income households.

Indicator	Low-income/Informal group (%)	Higher-income/Formal group (%)	Chi-Square (χ^2)/Cramer's V
Lack of insurance	85	43	45.6**/0.52
Severe asset loss	67	28	38.2**/0.47
Difficulty recovering	74	31	41.8**/0.50
Insecure tenure	59	18	33.5**/0.42

**Note: $p < 0.01$ (highly significant).

Taken together, the results summarised in Table 5 show that urban fire disasters generate patterned and measurable inequalities across market spaces and adjacent settlements. Fire impacts are neither random nor evenly distributed, but are spatially and socially concentrated among informal traders and

low-income households, resulting in disproportionate livelihood loss, displacement, and unequal access to post-fire urban space. These outcomes directly constrain the capacity of affected groups to sustain stable livelihoods and secure urban presence within Ghanaian cities.

3.4. Community mechanisms

This section presents empirical results on community-level fire prevention, preparedness, and recovery mechanisms across selected urban markets in Accra and Kumasi, addressing the research question: *What roles do community-led initiatives and indigenous practices play in fire risk reduction and recovery, and how can they be integrated into formal urban resilience strategies?* The analysis draws on trader and household survey data (n = 300), supported by structured interviews with market leaders and committee representatives. All results are reported at the market scale and aligned with observed fire incident records for the period 2021–2025. Findings are organised around three analytical dimensions: Preventive practices, preparedness capacity, and post-fire recovery mechanisms.

Survey results indicate a high level of perceived exposure to fire risk within the studied markets, with 87.5% of respondents identifying fire outbreaks as a recurrent hazard affecting trading or residential activities. Reported exposure was marginally higher in Kumasi (90.2%) than in Accra (84.9%). The principal drivers of perceived fire risk were overloaded or informal electrical connections (73.1%), congested stall layouts restricting emergency access (61.2%), and the proximity of combustible goods to heat sources (40.3%). These indicators were derived from self-reported exposure measures and direct observational checklists applied consistently across all markets, ensuring comparability of results.

Community-based preventive practices were widely reported, although their form and intensity varied spatially. Overall, 58.2% of respondents indicated that routine inspection of electrical wiring occurs within markets, typically conducted by locally recognised artisans rather than certified electricians. This practice was more prevalent in Kumasi (64.5%) than in Accra (51.3%). In addition, 42.6% of respondents reported the availability of locally improvised fire-quenching materials, mainly sand buckets and wet sacks, at stall or cluster levels. These measures were primarily intended to contain minor fire outbreaks before escalation and were spatially concentrated in high-density trading zones, reflecting targeted community responses to perceived localised risk.

Preparedness capacity was assessed through participation in formal training, ownership of fire safety equipment, and engagement in organised collective actions. Only 31.8% of respondents reported participation in structured fire safety training or drills within the previous three years, with no significant inter-city variation. By contrast, informal preparedness mechanisms were more prevalent: 55.4% of respondents reported acquiring fire safety knowledge through peer learning within market associations, mentorship from senior traders, or experience gained during previous fire incidents. A chi-square test examining the relationship between market association membership and adoption of basic preparedness measures revealed a statistically significant association ($\chi^2 = 27.41$; df = 3; $p = 0.001$), indicating that association members were significantly more likely to possess improvised extinguishing materials. The calculated odds ratio (OR = 2.73; 95% CI) suggests that organised collective structures substantially enhance preparedness capacity at the market level. Despite this, ownership of certified fire extinguishers remained low, with only 12.7% of respondents reporting possession of a functional unit. Cost constraints, lack of training, and uncertainty regarding maintenance were identified as key limiting factors, highlighting a pronounced disparity between informal preparedness practices and access to formal fire safety equipment.

Post-fire recovery mechanisms were predominantly community-driven and informal. A large majority of respondents (84.1%) reported reliance on trader-to-trader support systems following fire incidents, including rotational credit arrangements, collective fundraising, and asset-sharing schemes commonly referred to as susu support. These mechanisms were more prevalent in Kumasi (89.0%) than in Accra (79.2%). Recovery-related decisions, particularly those concerning space reallocation and rebuilding after fire events, were primarily coordinated by market executives, queen mothers, and customary authorities rather than metropolitan officials. Overall, 66.7% of respondents identified informal leadership structures as the principal coordinators of post-fire recovery processes. Formal insurance coverage was notably limited, with only 5.2% of respondents reporting any insured protection for goods or stalls. In this context, informal recovery systems function as substitute risk-sharing mechanisms in the absence of formal financial protection, a pattern corroborated through interviews with market leaders across all study sites.

Emerging collective initiatives aimed at supplementing public fire services were also identified. Survey and interview data revealed the presence of voluntary market-based patrol groups—locally termed market fire watchers—in selected high-risk markets such as Kejetia and Kaneshie. These groups conduct routine after-hours surveillance, monitor electrical connections, and respond to minor fire outbreaks. A descriptive comparison of fire incident records for the period 2020–2025 indicates that markets with active patrol groups experienced between 25% and 37% fewer reported minor fire incidents than markets without such initiatives. These findings are summarised in Table 6 and further visualised in Figure 7, which presents community-led fire resilience practices, their functional roles, associated evidence, key limitations, formal institutional counterparts, and potential integration pathways.

Table 6. Community-led fire resilience practices and institutional integration pathways.

Theme	Variable category description
Community practice	Informal fire watch groups; communal fire alerts; mutual aid firefighting; informal evacuation leadership; post-fire solidarity support; and indigenous risk norms
Local function	Night patrols for early fault detection; whistles, bells, calls for warnings; buckets, sand, basic extinguishers; leaders guide exits during fires; shared funds, space, goods; and rules on cooking, wiring, storage
Evidence	Reduced minor incidents; rapid early mobilisation; contained small ignitions; reduced panic and injuries; faster livelihood recovery; and reduced ignition sources
Key limitation	No mandate, limited tools; uncoordinated alerts; unsafe methods; blocked/unplanned routes; no insurance linkage; and weak enforcement
Formal counterpart	GNFS prevention units; GNFS emergency systems; GNFS first response; NADMO evacuation plans; NADMO relief, insurers; and Metropolitan enforcement
Integration pathways	Bylaw recognition, basic training and equipment; dedicated community–GNFS contact protocols; safety training, low-cost extinguishers; integrate local routes into official maps; hybrid micro-insurance models; and co-produced safety regulations

Overall, respondents expressed strong support for integrating community mechanisms into formal urban fire governance structures. A substantial majority (88.4%) favoured a hybrid fire resilience approach combining community-led initiatives with metropolitan fire services and planning authorities, while 91.2% supported formal recognition and training of voluntary patrol groups. These preferences were consistent across both Accra and Kumasi, indicating broad-based acceptance of collaborative fire

resilience strategies grounded in existing community practices. Figure 7 synthesises these findings by illustrating the types of community mechanisms identified, their adoption rates, primary functions, and potential pathways for formal institutional integration at the market scale.

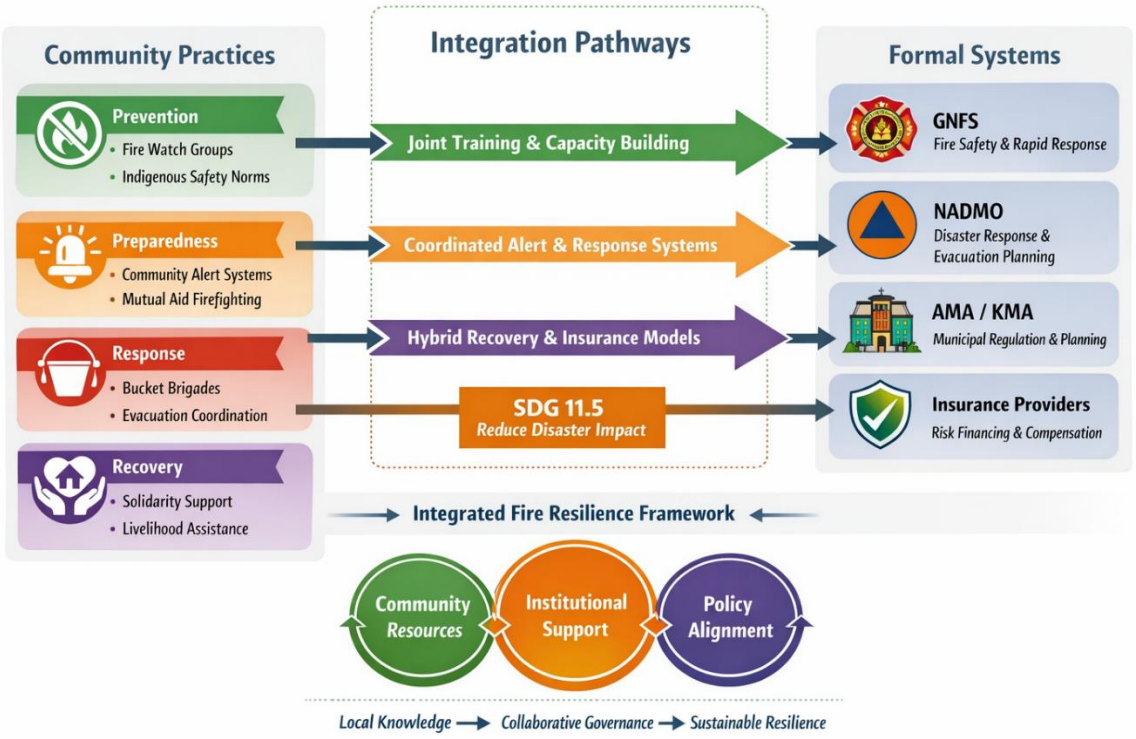

Figure 7. Community-led fire resilience integration pathways adoption across study sites.

3.5. Resilience model

This section presents results addressing Objective 5, which sought to develop an integrated urban fire resilience framework aligning spatial planning, governance reforms, and community participation within the scope of SDG 11.5, and responds to the research question: *How can an integrated and rights-based fire resilience framework align local actions and national policy reforms with SDG 11.5 targets to reduce disaster impacts?* Results are presented sequentially, covering indicator identification and validation, weighting and integration, rights-based performance assessment, SDG 11.5 alignment, and stakeholder validation. All analyses were conducted at the market and city scales, consistent with the empirical scope of the study.

The analytical process began with the identification of measurable indicators capable of structuring an integrated urban fire resilience framework. A total of 23 candidate indicators were derived from market-level field reconnaissance in Accra and Kumasi, policy document analysis, and multi-stakeholder engagements involving urban planners, emergency service officers, market leaders, and traders. Indicators were assessed using a 5-point Likert scale measuring perceived priority, feasibility, and contribution to fire risk reduction at the market scale. Statistical screening using descriptive and inferential criteria retained indicators with a mean score (μ) ≥ 3.5 and standard deviation ≤ 1.2, indicating high relevance and acceptable consensus. Fourteen indicators met these criteria and were retained as core components of the framework. Table 7 presents the validated

indicators, their mean scores, dispersion measures, significance levels, and acceptance decisions, based on market-level assessments aggregated to the city scale.

Table 7. Prioritisation of proposed urban fire resilience indicators for framework development.

Code	Proposed Fire Resilience Indicator	Mean score (μ)	Std. Dev. (σ/SD)	p-value Sig.	Decision
I1	Infrastructure retrofit and compartmentalisation	4.62	0.84	0.013	Accepted
I2	Market spatial re-engineering (re-layout & demarcation)	4.55	0.93	0.031	Accepted
I3	Emergency access zoning and fire escape corridors	4.41	0.88	0.047	Accepted
I4	Decentralised fire hydrant and water points systems	4.33	0.92	0.089	Accepted
I5	Hazard-responsive building codes for wooden stalls	4.26	1.02	0.144	Accepted
I6	Thermal surveillance and fire sensor deployment	4.11	1.05	0.152	Accepted
I7	Community emergency response units (CERU)	4.07	1.09	0.022	Accepted
I8	Market user insurance inclusion (informal & formal)	3.97	1.11	0.041	Accepted
I9	Institutional and regulatory reform for market governance	3.92	1.07	0.083	Accepted
I10	Risk communication and alarm signalling systems	3.88	1.14	0.092	Accepted
I11	Fire-risk based market zoning policy (hazard-tier class)	3.76	1.19	0.138	Accepted
I12	Periodic inspection and compliance enforcement mandates	3.68	1.18	0.162	Accepted
I13	Waste-fuel load management & combustible control plans	3.61	1.21	0.183	Accepted
I14	SDG 11.5-driven monitoring and evaluation systems	3.52	1.16	0.201	Accepted
I15	Market automatic sprinkler obligations	3.41	1.37	0.347	Rejected
I16	Standardised stall electrical certification sticker policy	3.29	1.42	0.384	Rejected
I17	Mandatory fire drill training for traders	3.27	1.56	0.396	Rejected
I18	Digital-based fire permit application systems	3.18	1.47	0.443	Rejected
I19	Fire safety licensing for every stakeholder association	3.09	1.62	0.477	Rejected
I20	Market fire safety tax or levy for fire infrastructure	3.07	1.78	0.493	Rejected
I21	Private-sector corporate fire investment scheme	2.73	1.96	0.521	Rejected
I22	Vendor-based micro-credit fire compliance loans	2.45	2.01	0.575	Rejected
I23	Predictive fire AI analytics for market risk assessment	2.28	2.17	0.621	Rejected

Inferential testing further identified indicators with statistically significant predictive potential for fire risk reduction. Infrastructure retrofit and compartmentalisation ($p = 0.013$), market spatial re-engineering ($p = 0.031$), and emergency access zoning ($p = 0.047$) emerged as significant spatial predictors at the 95% confidence level. Governance and social indicators, including community emergency response units ($p = 0.022$) and market user insurance inclusion ($p = 0.041$), also demonstrated significant effects. These results confirm that effective urban fire resilience is contingent on the interaction of spatial configuration, institutional capacity, and participatory mechanisms rather than isolated interventions.

Following indicator validation, a multi-criteria weighting analysis was undertaken using the analytic hierarchy process (AHP) to determine the relative importance of three resilience dimensions derived from the indicators: spatial planning, governance reforms, and community participation. Expert-informed pairwise comparisons produced normalised eigenvectors assigning weights of 0.46, 0.33, and 0.21, respectively, indicating that spatial transformation represents the dominant leverage point for reducing fire vulnerability at the market scale. Consistency testing yielded a consistency index (CI)

of 0.087 and consistency ratio (CR) of 0.056, both below the accepted threshold of 0.10, confirming internal reliability. Figure 8 illustrates the interaction matrix, showing the strongest alignment between spatial planning and governance reforms (0.83), while community participation demonstrated moderate interactions with spatial planning (0.52) and governance reforms (0.49), reflecting uneven empowerment across market contexts.

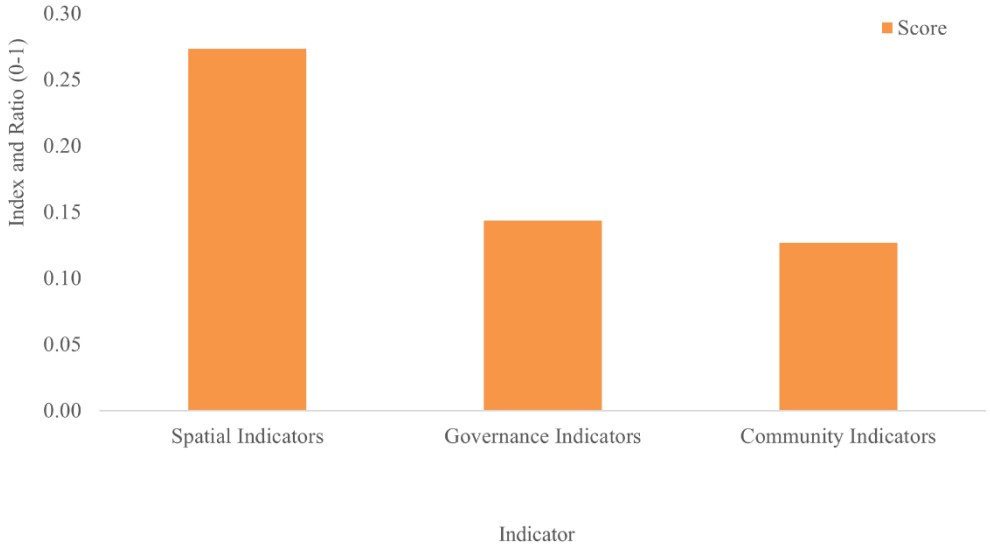

Figure 8. Integrated urban fire resilience interaction matrix (AHP-structured inputs).

A rights-based audit was conducted to evaluate whether the emerging framework upholds core Right to the City principles, focusing on protection, accessibility, inclusiveness, and participation. A four-dimensional rights index (0–100) was constructed using market-level survey and interview data aggregated at the city scale. Mean scores show higher performance in protection rights (67.4) and non-discriminatory inclusion (54.2), while accessibility rights (41.3) and participatory governance rights (39.5) recorded substantially lower values, indicating deficits in emergency access, evacuation safety, and meaningful market-user participation. Correlation analysis revealed strong positive associations between accessibility rights and emergency access zoning ($r = 0.79$) as well as infrastructure retrofit and compartmentalisation ($r = 0.69$). Participatory governance rights were significantly correlated with community emergency response units ($r = 0.72$) and market user insurance inclusion ($r = 0.58$), demonstrating that empowerment mechanisms measurably enhance resilience capacity.

To assess global policy relevance, the validated indicators were evaluated for alignment with SDG 11.5, which targets reductions in disaster mortality and economic losses. Indicators were scored using a 0–5 rubric measuring conformity with SDG 11.5 action domains, including risk reduction, asset protection, and vulnerability mitigation. Infrastructure retrofit (4.7), emergency access zoning (4.5), and hazard-responsive spatial planning (4.3) showed the strongest convergence with SDG 11.5 objectives, while disaster risk insurance for informal traders (2.1) and market user governance inclusion (2.4) demonstrated weaker alignment, reflecting institutional and financial constraints. Variance decomposition indicates that spatial planning variables account for 61.8% of SDG 11.5 alignment variance, followed by governance reforms (24.6%) and community participation (13.6%). Figure 9 presents the SDG 11.5 convergence gradient across the 14 validated indicators.

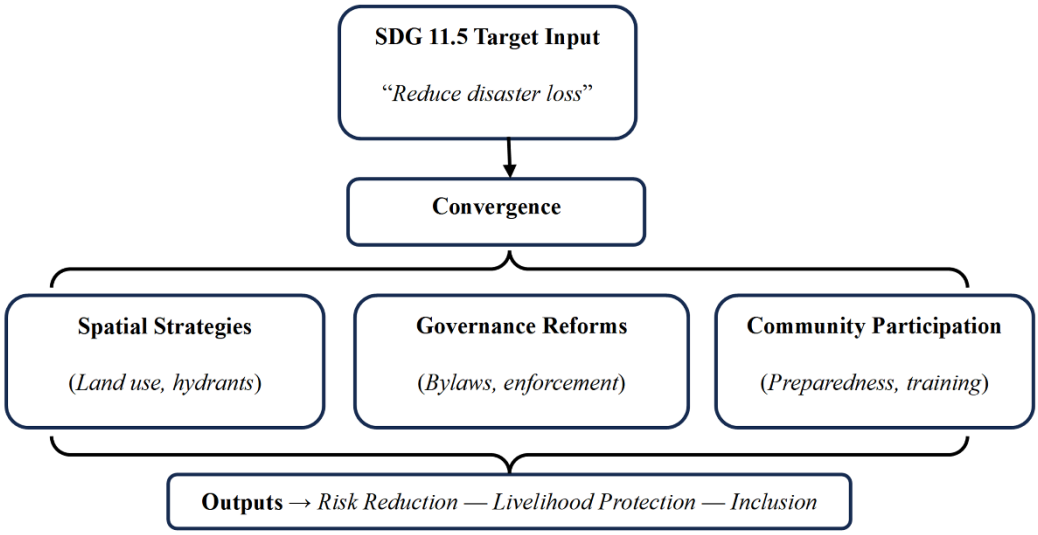

Figure 9. SDG-aligned fire resilience framework (convergence model with SDG 11.5 target).

Synthesising the validated indicators, weights, rights-based scores, and SDG alignment outcomes, the Integrated Urban Fire Resilience Framework was constructed as a four-tier operational model (see Figure 10). The framework operates at the urban market and city governance scales. Tier 1 (*preventive spatial reconfiguration*) functions as the primary driver through market re-layout, emergency corridor enforcement, and hazard-sensitive construction standards. Tier 2 (*institutional and regulatory transformation*) addresses coordination, enforcement capacity, and governance reform. Tier 3 (*market user empowerment*) focuses on insurance inclusion, decentralised emergency units, and participatory safety mechanisms. Tier 4 (*continuous monitoring and SDG 11.5 evaluation*) enables systematic tracking of mortality reduction, asset protection, and access equity.

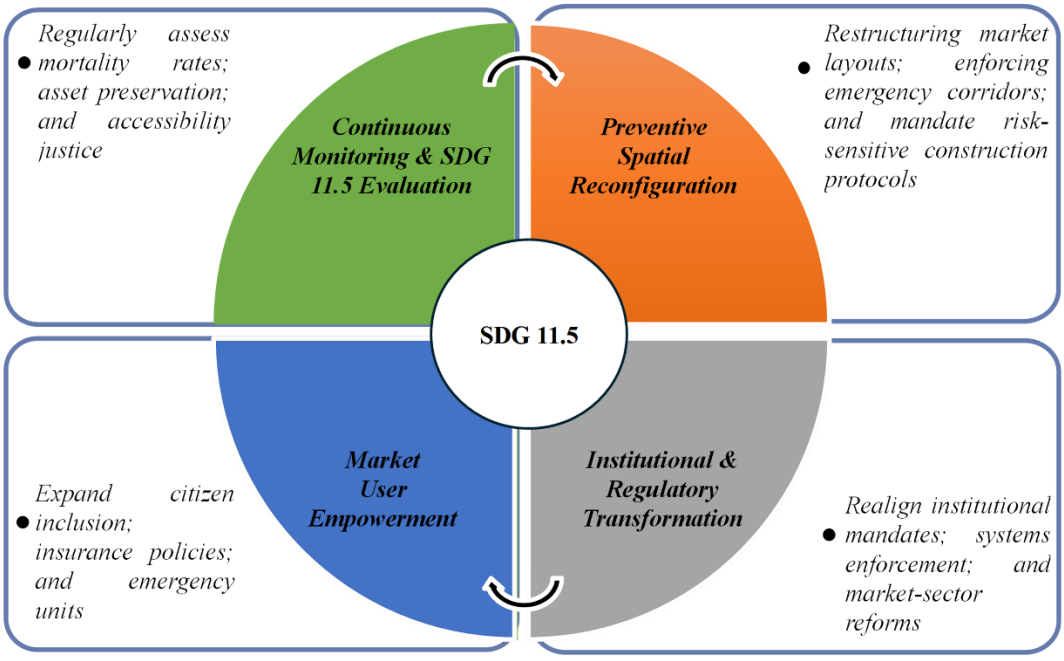

Figure 10. Integrated urban fire resilience model for SDG 11.5 performance.

Stakeholder validation involving planners, emergency service officials, market authorities, traders' representatives, and metropolitan officers indicates strong practical relevance. 92.0% of participants agreed that the framework provides a realistic mechanism for reducing fire disaster losses, while 87.4% confirmed that its rights-based structure enhances accountability. However, only 49.6% reported that local governments currently possess sufficient capacity to independently implement spatial restructuring, highlighting a governance–resource gap explicitly embedded within the framework's shared responsibility design. Overall, the results demonstrate that the proposed framework is empirically grounded, policy-aligned, and operationally scalable, providing a coherent basis for interpreting urban fire resilience through spatial, institutional, and rights-based lenses.

4. Discussion

This section interprets the empirical findings using established theoretical perspectives to explain how recurrent urban fire disasters in Ghana are produced, governed, and experienced, and to clarify their implications for urban resilience, rights-based planning, and policy reform. Drawing on the results presented in Section 3 (Figures 2–10; Tables 2–7), the discussion demonstrates that urban fire risk in Accra and Kumasi is not an episodic or accidental phenomenon but the outcome of interacting spatial, institutional, and socio-economic processes embedded in contemporary urbanisation patterns.

The findings indicate that recurrent fire outbreaks in Ghanaian markets and settlements are fundamentally shaped by spatial configurations and infrastructural deficiencies. Congested market layouts, the absence of firebreaks, limited emergency access routes, unsafe electrical installations, and inadequate water infrastructure were consistently associated with high-incidence fire zones identified through spatial analysis. These results corroborate earlier studies linking informal spatial expansion and weak enforcement of planning regulations to urban risk in Ghana [40,41], while extending the literature by empirically demonstrating how these spatial characteristics interact to produce self-reinforcing fire hazard landscapes rather than isolated accident-prone sites. High-density commercial nodes such as Makola, Kejetia, and Kantamanto illustrate how cumulative spatial constraints amplify fire exposure once ignition occurs.

Interpreted through urban resilience theory, these spatial patterns reflect low adaptive and absorptive capacity within Ghanaian cities. Meerow et al. [41,42] emphasise that resilient urban systems require redundancy, modularity, and spatial flexibility to withstand shocks without cascading failure. In contrast, the rigid and centralised layouts observed in the studied markets lack alternative access routes and decentralised service infrastructure, rendering emergency response ineffective and escalating damage. Fire disasters in these spaces therefore signal systemic weaknesses in urban design rather than failures of emergency services alone. These finding challenges policy approaches that prioritise post-disaster response over preventative spatial restructuring and underscores the need to integrate fire-sensitive planning standards into market redevelopment and informal settlement upgrading.

From a political ecology of urban disasters perspective, the spatial production of fire risk reflects deeper governance and power relations. The tolerance of illegal extensions, politically motivated planning exemptions, and revenue-driven densification demonstrates how vulnerability is actively produced through governance decisions rather than emerging naturally from informality [43,44]. Fire risk is thus reframed as a political and institutional construct, advancing scholarship that positions disasters as outcomes of spatial injustice rather than technical anomalies. This perspective helps explain why similar fire incidents recur in the same locations despite repeated interventions.

Institutional analysis further reveals that urban fire resilience in Ghana is constrained by fragmented governance, weak inter-agency coordination, and politicised decision-making. Limited operational integration between NADMO, the GNFS, metropolitan assemblies, and utility agencies confirms earlier findings that disaster governance in Ghana is characterised by siloed mandates and overlapping responsibilities [18,25]. This study extends existing knowledge by empirically linking governance fragmentation to delayed response times, ineffective prevention strategies, and the routine reproduction of unsafe reconstruction practices following fire incidents, as observed in post-fire rebuilding patterns documented in Section 3.

Viewed through systems thinking and risk governance frameworks, these institutional failures represent breakdowns in feedback loops, learning mechanisms, and adaptive coordination [45]. Effective risk governance requires interoperable data systems, shared information platforms, and decentralised decision-making authority. The absence of integrated fire risk databases, vulnerability-driven hydrant placement, and coordinated enforcement mechanisms indicates that Ghana's fire governance system remains predominantly reactive rather than adaptive. This systemic rigidity explains why recurrent fires persist despite repeated policy attention and emergency interventions.

Beyond operational inefficiency, governance fragmentation has significant normative implications when examined through a Right to the City lens. The failure of state institutions to prevent foreseeable disasters, combined with the exclusion of affected traders from recovery and planning processes, undermines collective rights to safety, participation, and livelihood security [40,46]. This finding deepens rights-based urban scholarship by empirically linking governance failure to the erosion of urban citizenship, particularly among informal economic actors whose livelihoods depend on market spaces. Fire disasters thus function not only as physical hazards but also as mechanisms that reproduce socio-economic exclusion.

The study further demonstrates that recurrent urban fires disproportionately affect informal traders and low-income households, reinforcing cycles of vulnerability. Loss of livelihoods, absence of compensation mechanisms, and limited access to insurance align with broader assertions that urban marginalisation operates simultaneously through spatial, economic, and institutional pathways [47,48]. Importantly, the findings extend existing literature by revealing how fire disasters can facilitate post-disaster urban restructuring that displaces informal actors from valuable urban land, particularly where redevelopment prioritises capital-intensive investments over livelihood restoration.

Applying Right to the City theory, fire risk is shown to undermine not only physical safety but also the right to inhabit, use, and shape urban space [28,40]. Lefebvre's emphasis on participation and appropriation is contradicted by reconstruction processes that marginalise traders from decision-making and prioritise redevelopment agendas disconnected from local needs. This aligns with political ecology perspectives that view disasters as moments when existing inequalities are intensified rather than alleviated [43,44]. The novelty of this study lies in framing fire vulnerability as a rights-based injustice, challenging technocratic narratives that treat fire management solely as an engineering or emergency response issue.

At the same time, the findings reveal that market communities possess substantial endogenous capacities for fire risk management, including volunteer surveillance systems, collective stall reconfiguration, informal electrical monitoring, and community-led emergency response practices. These findings support prior research highlighting the importance of local knowledge in disaster risk reduction [49], while extending it by demonstrating how such practices are spatially organised and function as informal governance systems within high-risk environments. Interpreted through urban

resilience theory, these practices represent social adaptive capacity, a critical yet under-recognised dimension of resilience [42].

Despite this potential, formal institutions rarely integrate community-based strategies into official planning or disaster management frameworks. Resilience remains framed predominantly as a technical function of infrastructure and emergency services, reflecting institutional rigidity that suppresses adaptive learning from local actors [45]. As a result, resilience-building efforts remain partial and inefficient. Hybrid governance models that formally recognise and support community-led fire prevention initiatives could significantly enhance urban fire resilience at relatively low cost, challenging assumptions that informality is inherently hazardous and repositioning informal practices as resilience assets when appropriately supported.

The integrated urban fire resilience framework developed in this study synthesises spatial planning, institutional coordination, and community participation within the normative ambition of SDG 11.5, which seeks to reduce disaster-related losses, particularly among vulnerable populations. Unlike conventional resilience models focused primarily on infrastructural robustness, this framework embeds the Right to the City as a foundational principle, positioning urban safety as an entitlement rather than a discretionary state service. By aligning systems thinking with rights-based urbanism, the framework advances a context-specific model of resilience suited to African cities where informality remains a dominant mode of urbanisation [50,51].

While the study makes significant contributions, limitations must be acknowledged. Data on informal electrical networks were constrained by regulatory sensitivities, limiting the precision of some quantitative estimates. Institutional interviews were subject to bureaucratic delays, restricting access to certain internal policy documents. The focus on major metropolitan centres limits generalisability to secondary cities and peri-urban contexts, while the ethnographic depth of community practices was constrained by time-bound field engagement. These limitations highlight opportunities for future longitudinal, comparative, and multi-scalar research on urban fire resilience across diverse African urban contexts.

Figure 11. Implementation strategy to achieving the right to the city and SDG 11.5.

Overall, the discussion demonstrates that recurrent urban fires in Ghana are not random or inevitable events but the outcome of interacting spatial, institutional, socio-economic, and political

processes. By integrating *urban resilience theory, political ecology, systems thinking*, and *the Right to the City*, this study advances a holistic understanding of urban fire disasters as manifestations of structural inequality and governance failure. The findings underscore the need to move beyond reactive, technocratic interventions towards inclusive planning, coordinated governance, and recognition of vulnerable urban residents as rights-bearing co-producers of urban safety, a synthesis that informs the concluding policy pathways presented in Figure 11, as the implementation strategy for Section 5.

5. Conclusions

This study set out to address a critical but under-examined gap in urban resilience scholarship: The limited integration of urban fire risk into rights-based and governance-oriented analyses of rapidly urbanising African cities. While existing literature has extensively examined flooding and climate-related hazards, urban fire disasters—particularly within informal markets and settlements—have remained marginal in both empirical research and policy discourse. By focusing on Ghanaian cities, this study responds directly to this gap, demonstrating that recurrent urban fires are not isolated or accidental events, but structurally produced outcomes of spatial congestion, infrastructural neglect, fragmented governance, and socio-economic vulnerability.

The principal contribution of this research lies in its integrated analysis of spatial, institutional, and community dimensions of urban fire risk through the lens of the Right to the City and urban resilience theory. The findings establish that market fire disasters in Accra and Kumasi are systematically concentrated in high-density, informally developed commercial spaces where regulatory enforcement is weak, infrastructure is overstretched, and emergency accessibility is limited. By empirically linking spatial configurations with governance failures and community preparedness gaps, the study advances understanding of how everyday urban risk is produced and unevenly distributed, particularly among informal traders and low-income households whose livelihoods depend on market economies. In doing so, the research reframes urban fire risk as a socio-spatial justice issue rather than a purely technical or behavioural problem.

The study further contributes conceptually by proposing the urban fire resilience integration model, which offers a structured framework for aligning spatial planning, institutional coordination, and community participation within a rights-based resilience agenda. This framework demonstrates how fire risk considerations can be mainstreamed into urban development processes without displacing informal economic actors, thereby operationalising the Right to the City in disaster risk governance. In theoretical terms, the findings extend urban resilience debates by illustrating how resilience is constrained or enabled by governance arrangements and spatial form, while reinforcing the argument that resilience must be inclusive, participatory, and grounded in everyday urban realities.

From a policy and practice perspective, the study provides clear implications for urban planners, disaster management agencies, and local authorities. It underscores the need to move beyond reactive post-fire interventions towards preventive, spatially informed planning that integrates fire risk audits, infrastructure provision, and participatory governance mechanisms into market redevelopment and urban management. Aligning such interventions with SDG Target 11.5 strengthens the relevance of global development commitments by demonstrating how they can be realised through locally grounded, evidence-based action. Importantly, the findings highlight that safeguarding informal markets from fire disasters is not only essential for disaster risk reduction but also for protecting livelihoods, sustaining urban economies, and promoting inclusive urban citizenship.

In conclusion, this study demonstrates that enhancing urban fire resilience in Ghana requires an integrated approach that simultaneously addresses spatial vulnerability, institutional coordination, and community agency. By bridging empirical evidence with rights-based and resilience frameworks, the research contributes novel insights to urban studies and disaster governance, while offering practical pathways for creating safer, more equitable, and resilient cities. In doing so, it affirms that reducing urban fire risk is central to achieving sustainable urban development and upholding the Right to the City for vulnerable populations in Ghana and comparable contexts across the Global South.

Use of AI tools declaration

The authors hereby declare that no Artificial Intelligence (AI) tools were used in this study, except for assistance in designing the graphical abstract.

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Conflict of interest

The authors hereby declare no conflict of interest in this study.

Author contributions

The corresponding author (PM) conceptualised, designed the methodology, software, formal analysis, data curation, writing—original draft preparation, review and editing, visualisation, project administration, supervision, and prepared the manuscript for publication. All co-authors (EB, EKA, & FKN) provided critical investigation, resources, and feedback that improved the overall rigor of the study. All authors have read and agreed to the published version of the article.

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