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Examining the Role of Crisis Management in Environmental Risk Reduction in Dilapidated Urban Areas

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Original Article

Abstract

INTRODUCTION: Dilapidated urban fabrics, characterized by high population density, physical deterioration, inadequate infrastructure, and limited access to essential public services, are particularly vulnerable to environmental hazards. This study aims to examine the role of crisis management in mitigating environmental risks in such areas and to propose a strategic model for enhancing urban resilience.

METHODS: This qualitative study was conducted using an inductive content analysis approach within a systematic review framework. Approximately 150 scientific sources and documents published between 2000 and 2025 were initially reviewed, of which 58 key sources were selected based on relevance and quality criteria. Data were analyzed using MAXQDA software through three sequential stages: open, axial, and selective coding. This process resulted in the identification of 245 initial codes, which were subsequently organized into 11 axial categories and three overarching dimensions.

FINDINGS: The findings revealed 11 axial categories grouped into three main dimensions: a) physical and infrastructural, b) social and institutional, and c) technological and policy-related. These categories were further structured into three strategic axes: physical and infrastructural retrofitting, enhancement of education and early warning systems, and strengthening of social and institutional capital. The proposed strategic model emphasizes the integration of physical, social, and technological interventions, alongside the reinforcement of institutional and financial mechanisms, to achieve sustainable risk reduction and improve resilience in dilapidated urban areas.

CONCLUSION: The results indicate that effective reduction of vulnerability in dilapidated urban fabrics requires an integrated, cross-sectoral, and participatory approach. The analysis highlights that the interaction between high-risk spatial conditions, infrastructural deficiencies, and institutional inefficiencies constitutes the core drivers of vulnerability in these contexts. Furthermore, the adoption of advanced technologies—such as Geographic Information Systems (GIS), Artificial Intelligence (AI), and nature-based solutions—combined with supportive housing policies, plays a critical role in enhancing long-term urban resilience.

Keywords: Crisis management; Environmental hazards; Urban resilience; Dilapidated urban fabric; Risk reduction.

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Introduction

Urbanization began with the industrial revolution in Europe and accelerated in developing countries after World War II (1-2). The proportion of the world's urban population increased from 3% in the 19th century to 55% in 2018 (3-4). It is projected that more than two-thirds of the world's population will reside in urban areas by 2050 (5).

Modern cities worldwide are increasingly exposed to natural disaster risks due to various factors, including hazardous geographical locations, unplanned urban expansion, and non-compliance with safety standards (6). The importance of crisis management is particularly evident in dilapidated urban areas, where

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continuous exposure to hazards and a lack of preparedness create significant vulnerabilities across residential, social, economic, environmental, and psychological dimensions (7).

Dilapidated urban areas are often characterized by complex socio-spatial challenges, including poverty, limited household economic capacity, social instability, inadequate security, and insufficient access to essential urban services. Physical constraints, such as substandard housing and narrow street networks, further reduce their resilience to disasters.

Crisis management—encompassing prevention, preparedness, response, and recovery—is therefore essential for strengthening resilience in these vulnerable areas. However, there remains a significant gap in understanding its strategic and integrated role, particularly due to the absence of cohesive, multidimensional frameworks. Addressing this gap is crucial for reducing vulnerability, improving emergency response capacity, supporting sustainable urban development, and promoting effective community participation.

Previous studies have contributed significantly to understanding urban vulnerability. Shamai and Mirzazadeh (8), for example, evaluated earthquake resilience across ten districts of Tabriz using social, economic, institutional, and physical indicators. Their findings revealed insufficient levels of physical and institutional resilience and highlighted the need for planning aligned with the different phases of resilience, including mitigation, preparedness, response, and recovery. Similarly, Pourahmad et al. (9) examined the physical resilience of District 10 in Tehran and identified the central, western, and southeastern areas as having low to very low resilience, emphasizing the necessity for targeted and prioritized interventions.

In addition to these structural assessments, recent studies have explored the role of technological innovations in risk mitigation. Binesh and Ehsani (10), for instance, developed an automated wireless fire alarm system incorporating smoke, heat, and gas sensors to enable rapid detection and warning through centralized control and public alert systems, thereby reducing potential damage. From the perspective of urban regeneration, Adham and Adibi Saadinejad (11) investigated renovation strategies in District 15 of Tehran. Their study underscored the importance of active participation by property owners and residents, noting that the combined effects of physical decay and socio-economic decline contribute to reduced quality of life and urban stagnation.

Previous research has extensively documented the vulnerabilities inherent in dilapidated urban fabrics. Studies focusing on the social and institutional dimensions of crisis management emphasize that community participation, social capital, and institutional coordination play a critical role in improving effectiveness. However, these studies often lack integration with physical interventions and technological solutions, limiting their practical applicability. In addition, the architectural characteristics of urban environments introduce further challenges. For example, Li et al. (12) demonstrate that high-rise buildings present complex Fire Safety Engineering (FSE) issues, including rapid smoke propagation and extended evacuation times, which complicate both life safety and property protection.

In the context of spatial optimization, Nyimbili and Erden (13) demonstrated the effectiveness of Multi-Criteria Decision-Making (MCDM) models, including Fuzzy-AHP and the Best-Worst Method (BWM), for optimal emergency service location planning in Istanbul. Despite these advancements, the practical implementation of such models often lags behind theoretical developments. For instance, Esmailnejad and Eskandari Sani (14), using GIS analysis, found that the distribution of fire stations in Birjand does not correspond with the city's physical expansion or the need for rapid emergency response coverage.

Furthermore, Smith and Petley (15) argue that dilapidated urban areas are particularly vulnerable to environmental hazards due to their high-risk locations and inadequate infrastructure. They emphasize that effective crisis management depends on systematic environmental risk assessment and the development of local, data-driven information systems to support accurate and timely decision-making.

Numerous studies (16–17) indicate that technical interventions alone are not sufficient for sustainable risk reduction, as they may reproduce existing vulnerabilities if not supported by institutional and social mechanisms. Therefore, effective crisis management requires an integrated approach that combines technical, institutional, and social solutions.

In this context, the participation of residents of dilapidated neighborhoods in planning and implementation increases the effectiveness of measures, and policies should be designed based on participatory approaches.

From a spatial perspective, research (18–23) highlights that upgrading infrastructure and housing in dilapidated areas must be aligned with principles of spatial justice. Such approaches help reduce physical risks, improve quality of life, strengthen social resilience, and prevent forced displacement.

Technological and environmental strategies also contribute to risk reduction. Nature-based solutions, such as the development of green spaces and restoration of infiltration basins, support flood mitigation and environmental improvement. In addition, early warning systems can significantly reduce human and economic losses when they are locally adapted and accessible. However, several structural barriers limit the effectiveness of these interventions. Digital inequality restricts access to technological solutions, while insecure land tenure discourages investment in resilience. Addressing these challenges requires clear policy frameworks and supportive legal mechanisms.

A review of the existing literature shows that most studies have mainly focused on the physical and technical aspects of crisis management in dilapidated urban areas. In contrast, less attention has been given to social, institutional, and technological dimensions, especially to how these factors interact with each other in an integrated way. In addition, there is a lack of comprehensive strategic models based on systematic reviews and qualitative analyses, which has often resulted in urban interventions that are fragmented and less effective in the long term. Therefore, the main research gap identified in this study is the absence of a multidimensional and data-driven framework for crisis management in dilapidated urban areas. To address this gap, the present study seeks to answer the following questions: How can urban crisis management reduce environmental risks and improve resilience in dilapidated urban areas? What are the most important dimensions and key categories of crisis management in these contexts? How can these dimensions be integrated into a comprehensive and multidimensional strategic model? What roles do physical, social, institutional, and technological factors play in reducing vulnerability in these areas?

Methods

This study employed a qualitative research design using an inductive content analysis approach within a systematic review framework to ensure transparency, reproducibility, and reliability. The review process was conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and included the stages of identification, screening, eligibility assessment, and final inclusion of sources (Figure 1). The aim was to systematically identify and synthesize existing theoretical and empirical evidence related to crisis management and urban resilience in dilapidated urban contexts, and to develop a comprehensive strategic model.

The study population consisted of scientific publications and authoritative documents published between 2000 and 2025. A total of 150 records were retrieved from major scientific databases, including Scopus, Web of Science, PubMed, and Google Scholar, as well as reports and documents from relevant national and international organizations. After removing duplicates and applying inclusion criteria, 58 sources were selected through purposive sampling for final analysis. Table 1 shows the criteria for inclusion.

Table 1. Criteria for selecting sources (source: authors)

Row	Criteria for selecting sources
1	Direct focus on urban crisis management or resilience in degraded contexts
2	Availability of applicable data or generalizable conceptual models.
3	Publication in reputable scientific journals or specialized conferences.
4	Compliance with research objectives in terms of time (2000 to 2025) and topic

Table 2. Indicators

Row	Source selection criteria
1	Study objective Type of crisis management approach
2	Type of crisis management approach
3	Dimensions under study (physical, social, institutional, technological)
4	Key findings and conclusions
5	Policy-related recommendations

Data were collected using a structured checklist and coded in accordance with systematic review guidelines (24) (Table 2).

Data analysis was conducted using an inductive qualitative content analysis approach, following a three-stage framework (25): a) *Open coding*: Key concepts, themes, and meaningful units were identified from the selected texts and labeled as initial codes, resulting in a total of 245 primary codes.

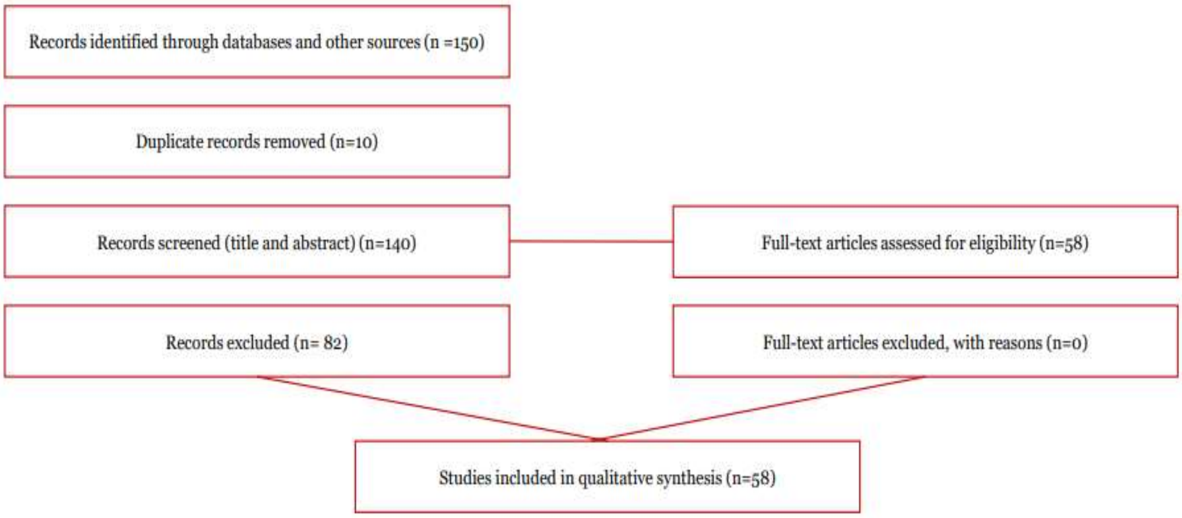

Figure 1. PRISMA flow diagram of the identification, screening, eligibility, and inclusion of research sources (source: authors)

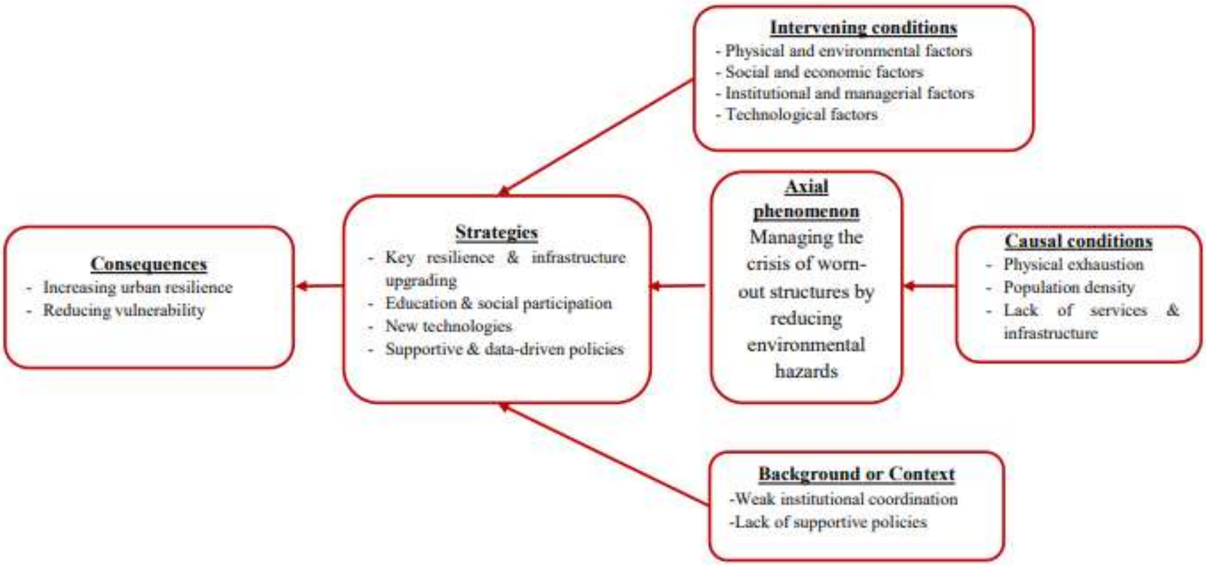

Figure 2. Strategic conceptual model of urban crisis management in dilapidated urban contexts (source: author)

b) *Axial coding:* Related codes were systematically grouped into subcategories and subsequently synthesized into higher-order (axial) categories. This process resulted in the identification of 11 axial categories, which were organized into three main dimensions: 1) physical and infrastructural, (2) social and institutional, and (3) technological and policy-related.

c) *Selective coding:* Through analysis of the relationships among the identified categories, the core research themes were determined, leading to the development of a strategic conceptual model.

All stages of coding and data organization were conducted using MAXQDA software. To ensure the validity and reliability of the findings, three complementary validation strategies were employed: a) *Content validity*, achieved through expert review by three specialists in urban management and crisis planning; b) *Coding reliability*, assessed by measuring inter-coder agreement on 20% of the data (Cohen's kappa coefficient = 0.84), indicating strong agreement; and c) *Theoretical validity*, established by comparing the findings with existing theories and frameworks in resilience and risk management to ensure conceptual consistency.

The spatial scope of the study focuses on dilapidated urban areas, drawing on both domestic and international experiences, while the temporal scope includes scientific sources published between 2000 and 2025.

Findings

The inductive qualitative content analysis, conducted using MAXQDA software, resulted in the identification of 11 axial categories organized into three overarching dimensions of urban resilience in dilapidated contexts: 1) physical and infrastructural, focusing on structural resilience, urban fabric reconstruction, securing public spaces, and mitigating direct hazard impacts; 2) social and institutional, emphasizing education, community participation, institutional capacity, and social resilience; and 3) technological and policy-related, addressing the use of emerging technologies, data-driven decision-making, and the development of supportive policies.

The findings indicate that urban resilience in dilapidated areas is primarily shaped by three interrelated drivers: physical and infrastructural upgrading, the strengthening of social capital and education, and the strategic integration of technology and policy instruments.

A key finding is that purely technical interventions—such as structural reinforcement or physical upgrading—provide only short-term risk reduction and are not sustainable without parallel social and institutional support. This observation is consistent with existing theoretical frameworks (18). Therefore, enhancing resilience in these contexts requires a holistic approach that integrates "hardware" dimensions (e.g., infrastructure improvement, housing quality, and nature-based solutions) with "software" dimensions (e.g., governance, community participation, land tenure security, and social capital).

The results further highlight the critical role of local community participation in ensuring the acceptance and effectiveness of interventions. Moreover, spatial justice and social equity emerge as essential prerequisites for successful housing improvement programs. The establishment of coordinated institutional mechanisms, the development of microfinance systems, and the implementation of context-sensitive early warning systems are also identified as key factors in strengthening economic and social resilience. Importantly, the findings suggest that simple, context-specific indicators are often more effective for local urban management than overly complex systems. In addition, combining short-term actions with medium- and long-term planning is essential for achieving sustainable risk reduction.

Overall, the proposed policy packages should be multidimensional, place-based, and socially responsive to avoid reproducing existing vulnerabilities while promoting long-term resilience, in line with previous research (17–19). The conceptual model (Figure 2) illustrates the dynamic interaction among physical, social, and technological strategies in enhancing resilience.

Finally, frequency analysis of the extracted codes revealed that while categories related to physical resilience and infrastructure improvement had the highest frequency, categories such as social capital and housing support policies hold greater strategic importance for long-term sustainability despite their lower frequency. This finding underscores that the significance of categories in crisis management is not solely determined by frequency, but also by their qualitative and contextual relevance.

Discussion and Conclusion

The findings of this research demonstrate that enhancing resilience is not achieved through isolated physical interventions alone; rather, it emerges from the synergistic interaction of three critical dimensions: physical/infrastructural, social/institutional, and technological/policy-related. The extraction and organization of 11 core categories within these dimensions provide an operational framework for understanding the mechanisms required to promote resilience and reduce vulnerability in dilapidated urban contexts.

A synthesis of the analyzed documents suggests that crisis management can effectively mitigate vulnerability in degraded areas only when it adopts an integrated, cross-sectoral, and participatory approach. Furthermore, the successful implementation of such management depends on the integration of emerging technologies—including GIS and AI—alongside nature-based solutions and the development of supportive housing and land-tenure policies.

The results indicate that the heightened vulnerability of dilapidated areas to environmental hazards stems from a complex interplay of high-risk spatial factors, infrastructural fragility, and institutional inefficiencies. This finding aligns with previous studies on the role of location and infrastructure in the reproduction of risk (16,19). Additionally, the lack of accurate, systematic, and localized data was identified as a major obstacle to the effective planning and implementation of crisis management interventions.

Table 3. Key categories of urban crisis management in dilapidated contexts (Source: Author)

Main dimension	The central category	Brief description
Physical-infrastructure	Physical reinforcement	Increasing the safety of structures and buildings
	Infrastructure upgrade	Improving water, electricity, and road networks
	Securing public spaces	Reducing risk in open spaces
	Nature-based solutions	Reducing floods and environmental hazards
Social-institutional	Education and public awareness	Increasing citizens' preparedness
	Social participation	The role of the local community in crisis management
	Social capital	Trust and local networks
	Institutional coordination	Coherence between devices
Technological–policy-related	New technologies	GIS, Remote sensing, Artificial intelligence
	early warning	Reducing human casualties
	Housing support policies	Security of ownership and risk reduction

Table 4. Strategic operational model of crisis management in dilapidated contexts (source: author)

Row	Strategic layer	Key actionable actions
1	Governance and institutional coordination	Creation of a special headquarters, unit command structure, interdepartmental coordination, risk database
2	Physical and infrastructure	Identifying high-risk areas, retrofitting, emergency routes, strengthening vital arteries
3	Social-participatory	Neighborhood volunteer groups, training exercises, local information and warning network
4	Technology	Risk GIS system, drone for monitoring, smart dashboard, alert and evacuation application
5	Emergency operation	Crisis scenarios, evacuation plans, safe spots, equipment and rapid response teams
6	Reconstruction and resilience	Resilient regeneration, public participation, sustainable financial models, continuous evaluation and improvement

Based on these findings, three strategic axes were identified as having the greatest impact on urban resilience: (a) physical reinforcement and infrastructural upgrading; (b) enhancement of public education and the development of early warning systems; and (c) strengthening of social capital and institutional capacities (Table 3).

Departing from much of the existing literature, which has predominantly focused on physical and technical dimensions, this study highlights the critical—yet often overlooked—importance of social capital, local education, and microfinance mechanisms as essential components of sustainable crisis management.

To enhance resilience in dilapidated urban areas, several measures are recommended: establishing comprehensive local databases and data-driven systems to monitor and identify high-risk zones; empowering local institutions and neighborhood councils through the provision of financial, technical, and educational resources; prioritizing the retrofitting of housing units and the reinforcement of emergency access routes; implementing nature-based solutions, such as the expansion of green spaces and sustainable drainage systems; ensuring land and housing tenure security; and designing localized, accessible early warning systems.

In addition, it is important to strengthen social capital and public awareness through structured preparedness exercises and community workshops; develop microfinance mechanisms, including low-cost insurance and micro-loans tailored for low-income households; enhance cross-sectoral coordination by integrating short-term emergency responses with long-term strategic planning; and employ advanced technologies—such as remote sensing, Unmanned Aerial Vehicles (UAVs/drones), and AI-driven monitoring systems—to support continuous evaluation (Table 4).

Compliance with Ethical Guidelines

No ethical issues were involved in this research.

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Author's Contributions

This article is based on Mohammad Farajpour's PhD thesis at Islamshahr University. Mohammad Farajpour was responsible for conducting the research, as well as data collection and analysis. Fatemeh Adibi Saadinejad supervised the study. Azadeh Arbabi Sabzevari and Fereshteh Navidi Majd contributed to the study design and methodology. Mohammad Farajpour also served as the corresponding author and was responsible for editing the final manuscript submitted to the journal.

Conflict of Interests

The authors declare no conflict of interest.

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