Journal of Civil Engineering, Science and Technology
Volume 16, Issue 2, September 2025, 269-279

CHALLENGES IN EMERGENCY RESPONSE INFRASTRUCTURE: A SYSTEMATIC LITERATURE REVIEW

Haruna Domanamwin Abudu[1*], Cecilia Modupe Mewomo[1,2], Kofi Owusu Adjei[3,4] and Francis Kwesi Bondinuba[4,5,6]
[1]Department of Construction Management and Quantity Surveying, Faculty of Engineering and the Built Environment, Durban University of Technology, P. O. Box 1334, Durban, 4000, South Africa.
[2]Department of Engineering Technology, Tarleton State University, Stephenville, Texas, USA, 76402
[3]Department of Construction Management and Quantity Surveying, Sustainable Human Settlement Construction Research Centre, University of Johannesburg– Doornfontein Campus, Doornfontein, South Africa.
[4]Department of Construction Technology and Quantity Surveying, Faculty of Built and Natural Environment, Kumasi Technical University, P. O. Box 854, Kumasi, Ghana.
[5]Faculty of Engineering and the Built Environment, Durban University of Technology, P. O. Box 1334, Durban, 4000, South Africa.
[6]The Urban Institute, School of Energy, Geoscience, Infrastructure and Society, Heriot Watt University, EH14, 5AS, UK.

Date received: 05/02/2025 **Date revised**: 19/08/2025 **Date accepted**: 19/08/2025 **Date published**: 30/09/2025
*Corresponding author's email: 22494813@dut4life.ac.za
DOI: 10.33736/jcest.8972.2025

Abstract — This study identifies critical disaster preparedness and response capacity improvement areas. This study examines the challenges that emergency response infrastructure faces on the global level. The analysis of current trends, case studies, and expert opinions regarding emergency response infrastructure was conducted through a thorough literature review. The study reveals 15 significant challenges and is grouped into 7 categories: resource constraints and infrastructure issues; technological and information disparities; coordination and governance; social, cultural, and religious considerations; urbanisation and population dynamics; vulnerability and risk factors; and community engagement and participation. Moreover, disparities in resource access intensify vulnerabilities in marginalised communities, hindering equitable disaster response outcomes. Insights from this study can inform policymakers, emergency responders, and humanitarian organisations in prioritising investments, developing robust infrastructures, and fostering cross-border collaborations to mitigate disaster impacts effectively. Addressing the identified challenges can improve societal resilience, ensuring more equitable and efficient emergency response efforts that safeguard vulnerable populations and promote community well-being. This study contributes by synthesising diverse perspectives on global emergency response infrastructure challenges, offering a nuanced understanding of the interconnected issues.

2462-1382 / © 2025 The Author(s). Published by UNIMAS Publisher. This is an open access article under the CC BY-NC-SA 4.0 license (http://creativecommons.org/licenses/by-nc-sa/4.0/).

***Keywords*:** emergency response, infrastructure, disaster risk management, global challenge, resilience

1. INTRODUCTION

Sub-Saharan Africa is facing a surge in natural and artificial emergencies, causing significant loss of lives and properties in recent years [1]. The region's inadequate infrastructure has worsened emergencies, necessitating the development of modern emergency response infrastructure. Congestion and delays in evacuations, particularly for children and elderly residents, can lead to fatalities [2]. However, a lack of or insufficient emergency response infrastructure exacerbates crises. The US national security policy prioritises increasing resilience to natural and artificial disasters. 'Resilience', derived from the Latin word 'resilient', refers to a system's ability to adapt and endure change. In social systems, it refers to a community's ability to absorb and recover from shocks [3].

Research on evacuation risk in building infrastructure primarily involves personnel and fire simulations, with academics studying evacuation mechanisms [4, 5]. However, these factors have turned emergency response infrastructure into a worldwide concern. High-rise building fire protection is crucial due to increased risks, such as the 2017 London Tower fire, raising questions about the dependability of evacuation systems [6]. Underground buildings have fewer safety exits, less evacuation space, and narrower passageways, leading to chaos during

catastrophes. The Dongdu Commercial Building fire in Luoyang, China, resulted in 309 deaths, 7 injuries, and a 2.75-million-yuan loss [4]. Disasters like fires, storms, floods, and explosions cause structural damage, resulting in loss of lives and properties. On the other hand, emergencies have a socioeconomic impact on people's lives and the overall state of the world economy. The main challenge is aiding search and rescue personnel in swiftly locating survivors [7]. Modernisation has transformed cities into social organs, transforming urban problems into urban risks and exposing large populations and public facilities to earthquakes, storms, and floods [8, 9]. These situations occurring are not different from those in Sub-Saharan Africa.

Emergencies, from artificial crises to natural calamities, have beset Sub-Saharan Africa. Recent crises have become more frequent and severe, causing significant loss of life and property, often hindered by inadequate infrastructure in the region. Thus, a paradigm that can direct the creation of contemporary emergency response infrastructure in Sub-Saharan Africa is required. A study was conducted by Ouyang [10] examining interdependent critical infrastructure system modelling and simulation. [4] carried out research on assessing and analysing barriers to China's emergency response capabilities. Damaševičius et al. [11] studied the Internet of Emergency Services (IoES) for Disaster Management and Emergency Response: Transitioning from Sensors to Safety. Sutton et al. [12] investigated the warning lexicon: a multiphase investigation to determine, create, and produce warning message content. However, research has not dealt with the challenges of emergency response infrastructure; therefore, this study needs to be conducted.

2. LITERATURE REVIEW

2.1 Emergency Response

Emergencies are random, public events causing serious threats to public order, safety, property rights, and national security, categorised into public health, social security, natural hazards, and accident disasters [4]. The response involves emergency actions taken during and after a catastrophe, focusing on rescuing casualties and addressing the immediate needs of survivors [13]. Vulnerability is the "ability of an individual or group to anticipate, cope with, resist, and recover from the impact of a natural hazard." [14]. Emergency response occurs when personnel and material assistance converge in damaged infrastructure, including buildings, public facilities, transit systems, telecommunications, and power systems designed to withstand natural hazards [15].

2.2 Challenges in Emergency Response Infrastructure

The Global South faces numerous anthropogenic and natural hazards, and despite the global emergency response management systems that have been adopted and implemented, emergency response issues have not come to rest. The challenges facing emergency response infrastructure are:

2.2.1 Rapid urbanisation and population growth

Urban areas are ecosystem-dependent systems that call for novel strategies to recognise the interdependence of human societies and natural systems, such as ecosystem services and nature-based solutions (NBS) [16]. According to Kofi Annan, "*At no time in human history have so many people lived in cities. Poor land-use planning and environmental management will increase risk and exacerbate the effects of natural hazards."* Urbanisation is a socio-economic process that transforms rural areas into urban settlements, leading to a higher city population density [17]. Urbanisation, population growth, and human settlement have increased disaster vulnerability [18]. Urbanisation increases disaster likelihood globally, with 55% of people living in cities and 68% predicted by 2050, with natural hazards in 60% of cities with 500,000 or more residents [19]. However, important establishments like shelters, hospitals, and emergency centres may fill up too quickly, making it difficult for them to manage major emergencies effectively. Planners may question investing in vulnerability reduction if they are uncertain about future natural hazards' extent, frequency, and risk characteristics or if local mitigation efforts will be effective [20]. On the other hand, rapid urbanisation often leads to inadequate infrastructure development, resulting in insufficient utilities, roads, and communication systems, making emergency response difficult and less accessible. By 2030, urban settlements will house over 4 billion urban residents and 863 million unofficial residents, constituting over 60% of the global population [21]. Urban areas require resilient transportation, water, and energy infrastructure, requiring a comprehensive Disaster Risk Reduction plan and changing building codes [22]. Climate change-induced flooding is escalating globally, affecting developing and industrialised regions due to factors like urbanisation, population growth, and the interdependence of infrastructure [23]. However, as cities expand and

become denser, the demand for emergency services increases, potentially overburdening existing infrastructure and causing delayed response times and subpar care.

2.2.2 Limited resources and funding

Senior high school education lacks Disaggregated Disaster Risk Reduction (DRR) content, particularly in geography and agriculture, hindering the effective teaching of catastrophe risk reduction and vulnerability [24]. Local decision-makers often feel disempowered due to the global scope of risk and their limited human and financial resources at the municipal or city level [20]. On the other hand, financial constraints can lead to delayed deployment and limited coverage of emergency response teams, causing delays and uneven response efforts in remote or underserved areas. Emergency response impacts in the global South are exacerbated by incompetent local governments and inadequate housing, infrastructure, services, and institutional capacity, leading to conflict over scarce financial resources [25]. However, limited funding can hinder emergency responder training and reduce readiness and capacity during emergencies. Insufficient equipment and medical supplies can also hinder the response. Improving physical infrastructure is essential for better data management and surveillance aimed at accident prevention, crime prevention, and disaster mitigation [26].

A nation's development plan should guide public infrastructure investment, including multi-hazard assessment for Disaster Risk Reduction (DRR), to enhance cultural, social, health, and economic resilience [27]. The task necessitates all stakeholders and authorities at the local, regional, and international levels to effectively plan and execute solutions utilising limited financial resources [24]. Economic, institutional, political, and development factors often hinder climate adaptation efforts and obscure issues despite robust municipal departments, policies, and funding [25]. However, insufficient funding can hinder critical infrastructure development and maintenance, hindering response and recovery efforts. Lack of upgrades can also affect the ability to handle large-scale disasters. Response resources are determined by the type of event, such as a mass shooting or explosion. Trauma patients frequently need emergency and surgical services, which results in an abrupt spike in demand [28].

2.2.3 Vulnerability to natural hazards

Pre-existing conditions called vulnerability enable natural hazards to turn into disasters, impacting social factors like poverty and income inequality as well as the location and quality of infrastructure [27]. Floods severely impact the poorest households, causing loss of life, property, livestock, and subsistence, weakening agricultural systems, and increasing susceptibility to waterborne diseases [14]. Inadequate planning and legislation can diminish the appeal of traditional disaster mitigation tools, suggesting a need to emphasise social and physical risk features in urban societies [20]. Conversely, high-vulnerability areas face increased risks from natural hazards, leading to more frequent emergencies and increased demand for emergency services and resources.

The conditions of urban poverty and the projected effects of disaster catastrophes must be considered by policymakers, who must also consider geographic distribution, growth patterns, and urban poverty [25]. Human settlement patterns, population growth, and rapid urbanisation are the main causes of the region's vulnerability [15]. Hazard events like river overflow, urban flooding, rising sea levels, monsoonal precipitation, and public health problems are likely to occur in the city [25]. Disaster Risk Management (DRM) is a comprehensive approach that reduces disasters' economic and social effects by lowering vulnerability and strengthening coping mechanisms [27]. Hazard vulnerability analysis evaluates potential events in a facility based on location, conditions, and surroundings, considering factors like geographic location and industrial explosions for mass casualty incident (MCI) risk planning [28]. Variables such as population density, dependence on vital infrastructure, and a society's ability to respond and recover from disasters can significantly impact its vulnerabilities [22]. Urban residents are particularly susceptible to extreme weather events, diseases, food insecurity, and financial losses due to their urban location [25]. However, natural hazards and pre-existing weaknesses can cause prolonged recovery times and increased costs in vulnerable areas, necessitating the need to address underlying vulnerabilities and enhance disaster resilience.

2.2.4 Inadequate infrastructure

Regular risk assessments, performance monitoring, learning from incidents, continuous improvement, and staying updated with best practices, scientific discoveries, and technological advancements are crucial for enhancing the resilience of critical infrastructure [22]. The government's current structures have not effectively prevented flood

incidents, and inadequate buildings and infrastructure in flood-prone areas contribute to fatalities [29]. Building a cutting-edge big data city control system incorporating intelligent CCTV, IoTs, and multi-image analysis as a real-time data service platform [26]. However, disasters often result in overcrowded emergency facilities and resource shortages, straining resources and reducing the capacity of care and support. Vulnerable groups often lack basic amenities for receiving warning messages during natural hazards, such as power outages, limited TV, radio, and mobile phone signals, and limited awareness of emergency websites [30]. In addition, inadequate infrastructure, including poorly constructed buildings and weak drainage systems, increases disaster risk and vulnerability, further worsening these effects through inadequate hazard mitigation systems.

To mitigate the likelihood of disasters, Saudi Arabia is enhancing its critical infrastructure, which includes hospitals, power plants, and emergency services. This dynamic process requires regular updates to accommodate the evolving nature of disaster risks [22]. Vulnerability can be made worse by inadequate planning and legislation, frequently due to disjointed development strategies or ineffective administrative procedures [20]. The resilience of vital infrastructure, such as schools, hospitals, and emergency response centres, is being improved for community resilience during times of crisis [22, 31]. Building adaptive capacity in cities involves enhancing resilience, sustainable outcomes, and liveable outcomes through climate data, preventive plans, and infrastructure investments [29]. Healthcare professionals undergo disaster preparedness training to manage patient surges, protect supplies, and establish protocols integrated into their professional development [22]. To be resilient in emergency response infrastructure, other professions should undergo disaster preparedness training and establish protocols that can be integrated into their professional development. Functions reliant on a single resource are the most vulnerable, but having multiple sources of income makes people more resilient. For large companies, cultivating relationships with suppliers can help reduce production delays [20]. DRR strategies depend heavily on early warning systems, which offer precise and timely alerts about possible hazards, facilitating efficient planning and response [22]. On the other hand, infrastructure deficits can delay recovery efforts and increase costs, potentially affecting the community and economy and diverting funds from other critical areas.

2.2.5 Lack of technology

Emerging technology can completely transform response operations to disasters, but its limited geographic applicability, inability to identify end users, and difficulties with field implementation stand in the way [19]. The 9-1-1 telecommunications and response systems, like other US and developed country agencies, lack the technology required to handle the perceived threat of terrorism adequately [15]. However, modern communication technology can address information gaps and coordination challenges in emergency response, ensuring timely decision-making and efficient resource use. Urban risk management uses human features like building types, population density, and housing tenure in geographical information systems and risk maps. However, this technology may overlook its limitations and legislators' suggestions [18]. The lack of scenarios and technological advancements should not be an excuse for the region to keep failing to prepare for the effects of climate change on its territory [29]. Assisting people quickly by attending to various injuries, crises, or distresses requires the ability to identify, locate, and track [15]. Internet of Emergency Services (IoES) is revolutionising services by enabling real-time data collection and improved agency coordination, integrating internet-connected devices and systems into emergency management [11]. On the other hand, technology-based early warning systems may be outdated, limiting timely warnings and reducing preparedness for disasters, increasing vulnerability and risk in vulnerable communities.

2.2.6 Political factors

The federal government, local governments, and community members are crucial in addressing urban risk through policies, mitigation techniques, emergency response protocols, land-use planning, construction regulations, and disaster preparedness programmes [21]. Development expenditure needs to be reviewed due to the preference for disaster relief spending over long-term disaster prevention, which is linked to development spending. However, institutionalised parties and political competition resulted in better service delivery and reduced disaster mortality [14]. However, political factors can cause uneven resource distribution, with some areas receiving more support based on political influence, leading to disparities in response capabilities and recovery efforts. Infrastructure in peripheries poses a liability for environmental justice adaptation and anticipatory governance strategies, necessitating liability recovery and innovation development [29]. External construction regulations impose restrictions on large, quickly growing cities, making it impractical for a few highly qualified personnel to perform thorough inspections and site visits [20]. The "e-government 2020" project, which the Korean government

unveiled in 2016, aims to improve city governments' capacity and transparency. With the integration of digital new deals, intelligent government, and citizen experiences, this vision facilitated the transformation from an information-based society to a hyperconnected society [26].

The desire to harm a sizable portion of the populace to further one's political agenda is frequently the driving force behind terrorist attacks [28]. Insufficient agency coordination, political commitment to risk mitigation, and post-disaster assistance often hinder major government players' preparedness, leading to a scarcity of financial and technical resources and affecting their ability to respond and allocate resources effectively [30]. Disaster Risk Management (DRM) is not adequately integrated into urban planning tools and laws, nor is it given high priority in public interventions [29]. Conflicts of interest between promoting environmental and human resource exploitation for economic surplus extraction and safeguarding environmental assets and social welfare frequently cause government inefficiencies [20].

Strengthening government integration, promoting vulnerable group participation, and fostering urban resilience require consistent political leadership, departmental engagement, and stakeholder involvement for effective decision-making and long-term programme institutionalisation [25]. Notwithstanding its important role in collecting and using big data, the Gimpo Big Data Corporation failed in 2018 due to local media criticism and disputes between project directors, the mayor, and expert groups. It restricted private sector profit generation due to personal information protection laws [24]. Conversely, regulatory barriers and legislative support can hinder effective emergency response, with outdated policies and bureaucratic red tape affecting resource approval and intervention effectiveness.

2.2.7 Ineffective building by-laws

Even though land use planning and building codes are crucial for preparing for large-scale disasters, they are frequently ignored in developing nations, which results in badly built structures [17]. The government is dedicated to improving infrastructure resilience using programmes such as the Building Code (BC), which addresses environmental sustainability and disaster resilience. The BC addresses energy efficiency, fire safety, structural design, and accessibility for people with disabilities to greatly enhance the built environment's resistance to risks [22]. The pillar emphasises the implementation of mandatory building codes that include basic infrastructure, including water, energy, telecommunications, food storage, health, and education, to guarantee that these facilities are built and designed to withstand common hazards and improve the functioning of society and the economy [25]. However, ineffective building codes can lead to structural failures and environmental hazards, increasing casualties and emergency response efforts during disasters and escalating the demand for emergency services.

2.2.8 Inadequate institutional/organisational structures

Lack of funding, systems, and frameworks has made it more difficult for citizens to participate in disaster risk reduction and management processes. However, because of their great degree of independence, municipal employees can consult academic institutions or private businesses for professional advice and assessments, which helps with climate change adaptation [16]. In addition, inadequate organisational structures and poor collaboration can lead to fragmented emergency response efforts, overlapping efforts, and delayed responses due to inefficient resource use and resource allocation.

2.2.9 Policy/legal issue

Public participation is essential for lawful government action, particularly when densification is needed to meet housing demand. Although the policy landscape is growing to support new planning approaches, no regulatory framework currently considers disaster risk reduction and disaster risk management in all planning phases [16]. However, bureaucratic delays and restrictive policies can impede emergency response, delaying resource deployment and plan execution and limiting the flexibility for effective disaster management.

2.2.10 Lack of human resources

The organisation faces significant financial challenges, but external funding for initiatives at disaster risk reduction, disaster risk management, and using natural solutions is increasing. This includes partnerships with government agencies, the commercial sector, and academic institutions. Despite the lack of funding for extensive citizen

involvement, trained staff members are increasingly interested in these subjects [16]. In addition, a shortage of personnel can cause delays in emergency responder deployment, intensify disaster impact, and reduce coverage, resulting in slower response times in affected areas.

2.2.11 Lack of knowledge/capacity

There is a growing deficiency of local knowledge regarding disaster risk reduction and management, but actions that impact private property require involvement and consent. Even though most people are not interested in nature-based remedies or preparing for climate change, powerful groups have strong beliefs and stakes in the matter [16]. On the other hand, insufficient knowledge can lead to inadequate emergency response plans and inadequate preparedness, resulting in gaps in readiness and increased vulnerability during disasters.

2.2.12 Coordination issues among stakeholders

The strategy to promote disaster risk reduction, disaster risk management, and natural remedies involves participation from the private sector, academic institutions, and local government organisations. The underlying presumption is that sound knowledge produces sound decisions, even with limited institutional knowledge [16]. External stakeholders work together to create expert assessments and recommendations on the effects of disaster risk reduction and disaster risk management to generate knowledge and foster mutual learning [16]. On the other hand, inadequate coordination can result in underserved areas, fragmented efforts, overlapping efforts, and resource gaps, which can all be made worse by delays in disaster response.

2.2.13 Social Practices

Social practices focus on how individuals' abilities, knowledge, and understanding impact emergency response systems and cultivate practitioner-community relationships. Religious practices and beliefs heavily influence social norms in faith-orientated communities, as seen in households that believe disasters occur spontaneously [16]. Public confidence in collaborative community work is demonstrated by community-based organisations, which are vital to disaster relief efforts. Evaluating community complaint mechanisms and disaster management systems' functionality and capacity is crucial for building community resilience and fostering social trust in these systems [16]. However, social practices and cultural norms influence community preparedness, information dissemination, compliance, risk perception, resource availability, and volunteering. Strong self-reliance communities may engage in extensive preparedness, while others rely on external assistance. Respect for authority can influence compliance with directives.

2.2.14 Cultural and Religious Norms/ Practices

Cultural and religious practices significantly influence social interactions and norms, especially in emergent response scenarios. The number of cultural and faith-based organisations and their disaster management projects can help evaluate local cultural and indigenous practices. Engaging in religious activities fosters trust in religious leaders and institutions, which authorities can use to spread early warning systems and increase public awareness of disaster risk reduction techniques [16]. Cultural practices of women during disasters can impact their resilience, as they often require male companions, and their clothing can cause issues during evacuations. Religious institutions provide special needs facilities, and people of faith often seek refuge in these locations [16]. On the other hand, cultural beliefs and religious observances can impact community preparedness for emergencies, with traditional practices and religious holidays potentially affecting the timing and focus of preparedness activities.

2.2.15 Lack of community engagement

Community action groups were formed for high-risk demographics, and capacity-building workshops were organised to identify local issues and mitigate risks, increasing volunteer involvement [30]. The initiative involves establishing community-based early warning systems, educating communities on disaster preparedness and response, and promoting public involvement in emergency planning and decision-making [20]. Collaboration and participation are crucial for transparency and efficiency in urban adaptation planning and execution procedures [25]. The public's lack of interest in community response to natural hazards is largely due to unclear roles, sporadic awareness campaigns, and inadequate tactics [30]. Urban areas establish climate action committees, task forces, and knowledge brokers to engage local stakeholders, modify adaptation planning, and raise public awareness of

climate adaptation [25]. Community members can provide valuable insights into regional risks and weaknesses, enabling the development of effective strategies [20]. The public's indifference towards community response to natural hazards is often due to a lack of awareness, confusion about community roles, and occasional organisational awareness initiatives [30]. Community engagement is essential to ensure effective coordination, lessen vulnerability during disasters, prevent fragmented efforts and inefficient resource utilisation, and ensure successful emergency preparedness drills. A summary of the challenges of emergency response infrastructure in sub-Saharan Africa is presented in Table 1.

Table 1 Summary of challenges of emergency response infrastructure in sub-Saharan Africa.

S/No.	Main Challenges	Sub-Challenges	Source
1	Resource constraints and infrastructure issues	Inadequate funding	[20, 24-28]
		Limited resources	[20, 24-2]
		Inadequate infrastructure	[14, 20, 22, 25-30]
		Inadequate institution/organization	[16]
2	Technological and information disparities	Technological disparities	[11, 15, 19-20, 22, 29-30]
		Lack of knowledge or capacity	[16, 18, 20, 22, 25, 30]
		Lack of capacity building	[16]
3	Coordination and governance challenges	Coordination issues among stakeholders	[16]
		Ineffective building by-laws	[17, 22, 27]
		Policy/legal issues	[16]
4	Social, cultural, and religious considerations	Lack of consideration of social, cultural, and religious norms and practices in emergency response infrastructure	[16]
5	Urbanization and population dynamics	Rapid urbanization and population growth	[16-23]
6	Vulnerability and risk factors	Vulnerability to natural hazards	[14-15, 20, 22, 25, 27-28]
		Socio-political barriers	[14, 20-22, 25-30]
7	Community engagement and participation	Lack of community engagement	[20, 22, 25, 30]

3. METHODOLOGY

This study examines the challenges affecting emergency response infrastructure through a systematic literature review. Researchers have widely used systematic literature reviews to conduct studies [32-34]. The methodology employs a systematic approach to locate, select, and evaluate pertinent academic literature from a variety of fields and geographical settings [32].

3.1 Search Strategy

Database Selection: Relevant studies were systematically searched through electronic databases of Taylor and Francis, Science Direct, Emerald, Scopus, ASCE, Web of Science, and Google Scholar [32-34]. *Search Terms:* The terms "emergency response infrastructure", "challenges", "Global South", "developing countries", "barriers", "limitations", and "constraints" were among the combinations of keywords. *Inclusion Criteria:* Studies that addressed issues on emergency response infrastructure in Global South nations, covering a range of emergency scenarios and disaster types, were included [32-34].

3.2 Selection of Studies

Screening Process: The study's objectives were evaluated by screening the titles and abstracts of the retrieved articles [29]. *Inclusion Criteria*: Articles in full that satisfied the requirements for addressing issues with emergency response systems in Global South nations were given additional consideration [29-30]. *Exclusion Criteria:* Research only concerned with developed nations or that did not specifically address infrastructure-related issues was not included [32-34].

3.3 Data Extraction

Data Collection: Relevant information, such as the identified challenges, their descriptions, the factors that led to them, and how they affected emergency response, was taken from a few chosen studies [29-30]. *Synthesis of Findings*: Synthesised data were used to group problems into thematic areas, which included governance problems, resource shortages, infrastructure deficiencies, socioeconomic inequality, and technological constraints [32-34].

3.4 Analysis and Synthesis

Thematic Analysis: Challenges were analysed to identify common themes and patterns across countries in the Global South [32]. *Comparative Analysis:* Challenges' prevalence, severity, and distinctive features in various geographic and socioeconomic contexts were compared [32].

3.5 Reporting

Structure of the Review: The results summarise the issues found, their consequences for emergency response plans, and suggestions for best practices and policy [32].

4.0 LESSONS LEARNT

The study yielded the following insights:

Resource Limitations and Infrastructure Development: The availability of resources has a major impact on the capacity and effectiveness of disaster preparedness and response activities. There is frequently inadequate institutional or organisational structure and financial and resource limitations when constructing and maintaining vital infrastructure, such as hospitals, shelters, and communication networks. This lack of funding can make the impact on impacted communities worse and impede or delay the development of these essential components.

Technology: Disparities in technology access and information dissemination can significantly impact the effectiveness of emergency response. Inadequate availability of current information and communication tools can result in disinformation, delayed reaction times, and difficulties organising relief activities. Lack of knowledge and capacity building in modern technology in emergency response affects emergency preparedness and response capabilities. This technological gap can make it more difficult to provide accurate assistance promptly, leading to poor emergency management.

Coordination Among Stakeholders: Coordination between stakeholders, such as governmental agencies, non-governmental organisations (NGOs), and community groups, is necessary for an effective emergency response. Ineffective coordination can lead to wasted effort, gaps in services, and delays in delivering vital aid. A well-coordinated response depends on these groups working together seamlessly by improving policies and effectively building bylaws.

Cultural and Social Factors: It is crucial to comprehend and incorporate religious beliefs, cultural norms, and customs into emergency response plans. Ignoring these elements may cause impacted communities to become distrustful and resistant, which would hinder the effectiveness of the response and result in wasteful use of resources. A culturally aware approach promotes improved cooperation and trust-building.

Urbanisation and Vulnerable Populations: Rapid urbanisation and population growth increase the density of vulnerable populations in urban areas. Issues like overcrowding, informal settlements, and poor infrastructure increase emergency risks. Disasters disproportionately impact difficult populations, such as the elderly, the disabled, and marginalised people. These vulnerabilities must be addressed to lessen their effects and encourage equitable recovery efforts.

Community Engagement: Effective emergency response depends on the active participation and engagement of the community. Interacting with communities actively contributes to the development of resilience by promoting trust, utilising local resources and expertise, and enabling people to participate in preparation and recovery. Communities' involvement guarantees that response activities align with local conditions and needs.

These challenges underscore the need for a comprehensive approach to emergency response infrastructure that addresses resource constraints, bridges technology, enhances stakeholder coordination, respects cultural contexts, manages urban risks, and involves community participation.

5.0 CONCLUSION

Local, national, and international collaboration is necessary to address challenges in emergency response infrastructure. Global resilience and disaster preparedness can be enhanced by addressing infrastructure and resource limitations, technology and information gaps, coordination and governance issues, social, cultural, and religious factors, urbanisation and population dynamics, vulnerability and risk factors, and community engagement and participation barriers. Distinguished strategies are required for various environmental and socioeconomic contexts.

The study of emergency response infrastructure challenges aids in understanding disaster impact, identifying areas for improvement, and developing strategies to enhance preparedness, response, and recovery efforts. Emergency response infrastructure challenges require adequate funding, improved technology, coordination, and consideration of social, cultural, and religious factors for effective communication, coordination, and sustainable city design. Addressing challenges in emergency response infrastructure saves lives, fosters community resilience, strengthens trust, and ensures equitable access to resources, promoting social justice and inclusiveness.

Emergency response infrastructure faces challenges like secondary data reliance and real-time global variations, requiring tailored strategies for regional-specific issues and international cooperation.

Conflicts of Interest

The authors of this paper declare that they don't have conflicts of interest concerning its publication.

References

[1] Fu, M., Liu, R., & Liu, Q. (2024). Why individuals do not use emergency exit doors during evacuations: A virtual reality and eye-tracking experimental study. Advanced Engineering Informatics, 60, 102396. https://doi.org/10.1016/j.aei.2024.102396

[2] Ding, N., Chen, T., Zhu, Y., & Lu, Y. (2021). State-of-the-art high-rise building emergency evacuation behaviour. Physica A: Statistical Mechanics and its Applications, 561, 125168. https://doi.org/10.1016/j.physa.2020.125168

[3] Longstaff, P. H., Armstrong, N. J., Perrin, K., Parker, W. M., & Hidek, M. A. (2010). Building resilient communities: A preliminary framework for assessment. Homeland Security Affairs, 6, 3, 1-23.

[4] Wang, N., Gao, Y., Li, C. Y., & Gai, W. M. (2021). Integrated agent-based simulation and evacuation risk-assessment model for underground building fire: A case study. Journal of Building Engineering, 40, 102609. https://doi.org/10.1016/j.jobe.2021.102609

[5] Adjei, K.O., Abudu, H.D., Nana-Addy, E. and Musonda, I. (2025). The motivation for occupants' adoption of hidden emergency exits in buildings, Engineering, Construction and Architectural Management, 32, 13, 133-147. https://doi.org/10.1108/ECAM-04-2023-0326

[6] Egodage, N., Abdeen, F. N., & Sridarran, P. (2020). Fire emergency evacuation procedures for differently-abled community in high-rise buildings. Journal of Facilities Management, 18, 5, 505-519. https://doi.org/10.1108/JFM-07-2020-0043

[7] Soltaninejad, M., Noorzai, E., & Faraji, A. (2023). Enhancing the level of confidence in the safe fire evacuation operation employing a combination of BIM and fuzzy TOPSIS method. Smart and Sustainable Built Environment. https://doi.org/10.1108/SASBE-11-2022-0258

[8] Liang, Y., Xie, Z., Chen, S., Xu, Y., Xin, Z., Yang, S., & Wang, Q. (2023). Spatial accessibility of urban emergency shelters based on Ga2SFCA and Its improved method: A case study of Kunming, China. Journal of Urban Planning and Development, 149, 2, 05023013. https://doi.org/10.1061/JUPDDM.UPENG-4325

[9] Abudu, H. D., Mewomo, C. M., Adjei, K. O., & Bondinuba, F. K. (2025). A systematic review of the mitigating factors for emergency response in facilities. In CIB Conferences, 1, 1, 187. https://doi.org/10.7771/3067-4883.1856

[10] Ouyang, M. (2014). Review on modelling and simulation of interdependent critical infrastructure systems. Reliability Engineering and System Safety, 121, 43-60. https://doi.org/10.1016/j.ress.2013.06.040

[11] Damaševičius, R., Bacanin, N., & Misra, S. (2023). From sensors to safety: Internet of Emergency Services (IoES) for emergency response and disaster management. Journal of Sensor and Actuator Networks, 12, 3, 41. https://doi.org/10.3390/jsan12030041

[12] Sutton, J., Olson, M. K., & Waugh, N. A. (2024). The Warning Lexicon: A multiphased study to identify, design, and develop content for warning messages. Natural Hazards Review, 25, 1, 04023055. https://doi.org/10.1061/NHREFO.NHENG-1900
[13] Dwarakanath, L., Kamsin, A., Rasheed, R. A., Anandhan, A., & Shuib, L. (2021). Automated machine learning approaches for emergency response and coordination via social media in the aftermath of a disaster: A review. IEEE Access, 9, 68917-68931. https://doi.org/10.1109/ACCESS.2021.3074819
[14] Deen, S. (2015). Pakistan 2010 floods. Policy gaps in disaster preparedness and response. International Journal of Disaster Risk Reduction, 12, 341-349. https://doi.org/10.1016/j.ijdrr.2015.03.007
[15] Gilmore, J. N., & DuRant, M. (2021). Emergency infrastructure and locational extraction: Problematizing computer-assisted dispatch systems as a public good. Surveillance and Society, 19, 2, 187-198. https://doi.org/10.24908/ss.v19i2.14116
[16] Wamsler, C., Wickenberg, B., Hanson, H., Olsson, J. A., Stålhammar, S., Björn, H., & Zelmerlow, F. (2020). Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation. Journal of Cleaner Production, 247, 119154. https://doi.org/10.1016/j.jclepro.2019.119154
[17] Abdul, L., & Yu, T. F. (2020). Resilient urbanization: a systematic review on urban discourse in Pakistan. Urban Science, 4, 4, 76. https://doi.org/10.3390/urbansci4040076
[18] Ajibade, I. (2022). The resilience fix to climate disasters: Recursive and contested relations with equity and justice-based transformations in the Global South. Annals of the American Association of Geographers, 112, 8, 2230-2247. https://doi.org/10.1080/24694452.2022.2062290
[19] Kedia, T., Ratcliff, J., O'Connor, M., Oluic, S., Rose, M., Freeman, J., & Rainwater-Lovett, K. (2022). Technologies enabling situational awareness during disaster response: a systematic review. Disaster Medicine and Public Health Preparedness, 16, 1, 341-359. https://doi.org/10.1017/dmp.2020.196
[20] Pelling, M. (2012). The vulnerability of cities: natural disasters and social resilience. 1st Edition, Routledge, London.
[21] Rezvani, S. M., Falcão, M. J., Komljenovic, D., & De Almeida, N. M. (2023). A systematic literature review on urban resilience enabled with asset and disaster risk management approaches and GIS-based decision support tools. Applied Sciences, 13, 4, 2223. https://doi.org/10.3390/app13042223
[22] Al-Wathinani, A. M., Barten, D. G., Borowska-Stefańska, M., Gołda, P., AlDulijan, N. A., Alhallaf, M. A., & Goniewicz, K. (2023). Driving sustainable disaster risk reduction: A rapid review of the policies and strategies in Saudi Arabia. Sustainability, 15, 14, 10976. https://doi.org/10.3390/su151410976
[23] Merz, B., Kuhlicke, C., Kunz, M., Pittore, M., Babeyko, A., Bresch, D. N., & Wurpts, A. (2020). Impact forecasting to support emergency management of natural hazards. Reviews of Geophysics, 58, 4, e2020RG000704. https://doi.org/10.1029/2020RG000704
[24] Kalogiannidis, S., Toska, E., Chatzitheodoridis, F., & Kalfas, D. (2022). Using School Systems as a Hub for Risk and Disaster Management: A Case Study of Greece. Risks, 10, 5, 89. https://doi.org/10.3390/risks10050089
[25] Anguelovski, I., Chu, E., & Carmin, J. (2014). Variations in approaches to urban climate adaptation: Experiences and experimentation from the global South. Global Environmental Change, 27, 156-167. https://doi.org/10.1016/j.gloenvcha.2014.05.010
[26] Myeong, S., Kim, Y., & Ahn, M. J. (2020). Smart city strategies-technology push or culture pull? A case study exploration of Gimpo and Namyangju, South Korea. Smart Cities, 4, 1, 41-53. https://doi.org/10.3390/smartcities4010003
[27] Bello, O., Bustamante, A., & Pizarro, P. (2021). Planning for disaster risk reduction within the framework of the 2030 Agenda for Sustainable Development.
[28] Binkley, J. M., & Kemp, K. M. (2022). Mobilization of resources and emergency response on the national scale. Surgical Clinics, 102, 1, 169-180. https://doi.org/10.1016/j.suc.2021.09.014
[29] Travassos, L., Torres, P. H. C., Di Giulio, G., Jacobi, P. R., Dias De Freitas, E., Siqueira, I. C., & Ambrizzi, T. (2021). Why do extreme events still kill in the São Paulo Macro Metropolis Region? Chronicle of a death foretold in the global south. International Journal of Urban Sustainable Development, 13, 1, 1-16. https://doi.org/10.1080/19463138.2020.1762197
[30] Perera, D., Agnihotri, J., Seidou, O., & Djalante, R. (2020). Identifying societal challenges in flood early warning systems. International Journal of Disaster Risk Reduction, 51, 101794. https://doi.org/10.1016/j.ijdrr.2020.101794
[31] Abudu, H. D., Mewomo, C. M., Adjei, K. O., & Bondinuba, F. K. (2025). Assessing emergency response systems and their impact on infrastructure resilience: A literature review. In Abimnola (ed), Proceedings of the International Conference on Construction Business & Project Management Conference 2025(CBPMC) (pp. 425-431). University of Cape Town, South Africa. https://cbpmconference.wixsite.com/website-6/copy-of-cbpm-editions-1.
[32] Adjei, K. O., Aigbavboa, C. O., & Thwala, W. D. (2018). The challenges of cost control practice in the construction industry: A literature review. In International Conference on Applied Science and Technology Conference Proceedings, 4, 1, 14-24.
[33] Bonney, S. O., Yankah, J. E., Adjei, K. O., & Tieru, C. K. (2024). Software and mobile apps as a strategy for productivity improvement in the construction industry. Journal of Building Construction and Planning Research, 12, 1, 1-35. https://doi.org/10.4236/jbcpr.2024.121001

[34] Yankah, J. E., Adjei, K. O., & Tieru, C. K. (2024). Apps as partial replacement for robotics and automation systems in construction health and safety management. Frontiers in Engineering and Built Environment, 4, 2, 90-100. https://doi.org/10.1108/FEBE-07-2023-0033