

Resilient Housing in the Face of Climate Change: A Review of Adaptation Strategies, Disaster-Resistant Designs, and Community-Based Initiatives

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Abstract

Climate change has increased the incidence and intensity of extreme weather, which has made housing infrastructure extremely vulnerable throughout the globe. Traditional building styles were unable to cope with the devastating impacts of floods, hurricanes, heat waves, wildfires and sea-level rise, leading to substantial economic losses and displacement as well as public health and livelihood risks. As such, climate-resilient housing has been identified as an essential part of sustainable development and climate adaptation. This review summarizes the literature published in validated research data that discusses strategies for adaptation, disaster-resistant designs, community-based efforts for climate-resilient housing. It explores the impact of various design and infrastructure measures such as raised platforms and flood-resilient components, passive cooling and nature-based measures, smart homes and multi-hazard engineering, community and Indigenous knowledge, as well as government policies and public-private collaborations on housing resilience, and it evaluates the challenges associated with housing resilience development such as high costs, policy challenges, social issues and technological constraints in the Global South. In response to rise in number and severity of extreme events driven by climate change, housing infrastructure is vulnerable on a global level. Conventional construction methods failed to withstand extreme events, thus resulting in damage to the existing buildings and heavy economic losses, population displacements as well as health and livelihood risks from natural disasters such as floods, storms, droughts and heatwaves, wild-fires and sea-level rise. Therefore, climate resilient housing has emerged as an important issue on the forefront of sustainable development and climate adaptation. This paper presents a review of literature published on disaster resistant design, community-based approaches and strategies for climate resilient housing in peer-reviewed indexed journal articles. The study identifies various adaptation strategies and disaster resilient measures like, use of raised platforms and flood resistant structures, use of natural components and passive cooling measures and smart homes and multi hazard engineering, use of community based approaches and Indigenous knowledge and use of governmental policies and public-private partnership on climate resilience and identifies the barriers of developing housing resilience like high cost, policy issues, social aspects and technological barriers in the global south.

Keywords: Climate-resilient housing, Disaster-resistant design, Adaptation strategies, Nature-based solutions, and Hazard

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INTRODUCTION

Climate change is arguably one of the most critical challenges of the 21st Century; significantly impacting on conditions of the natural environment and intensifying the exposure of settlements to varied hazards throughout the globe (Hussainzad & Gou, 2024). The impact of greenhouse gas emissions caused by human activity has increased temperatures, changed precipitation patterns and influenced the frequency and intensity of severe weather events; consequently, the housing infrastructure in many developing and even developed contexts has become highly susceptible to these risks, especially within the urbanizing regions, coastal zones, and low-lying areas. Traditional building structures and design which are often based on a past climatic context now fail to cope with increasing exposure to such hazards, leading to significant damages, relocation and financial loss (IPCC, 2022).

There are several intertwined mechanisms of housing vulnerability to climate change. Storm and heavy rains contribute to flooding which causes soil erosion and infiltration into housing structures and contaminated water entering buildings (Hussainzad & Gou, 2024). In many instances in the developing countries the foundations and elevation in the informal housing structures are not sufficient to cope with storm surges and extreme events, contributing to massive loss. Storms and hurricanes bring intense wind, storms surge, and heavy precipitation, which are destructive for the foundations and walls of light frame or wooden housing structures. The sea level rise exacerbates the effects of storm surges on coastal areas by increasing baseline flooding and erosion; this poses threat of irreversible land inundation and salinization to entire communities (Hussainzad et al., 2024).

Heat waves also represent a considerable threat, since densely built areas often suffer exacerbated urban heat islands. Non-well-insulated houses lack ventilation, and occupants of heat-trap homes are at risk due to the excessive indoor temperatures, particularly elderly people, children and poor groups unable to use cooling resources (Ebi et al., 2021). Wildfires, which are likely to become more frequent due to prolonged droughts and hotter temperatures, threaten housing by engulfing structures with direct flame, intense thermal radiation, and embers igniting combustible materials. Smoke from such fires can degrade the air quality of extensive regions. Cascading climate-amplified effects can occur, for example, an increased risk of flooding occurs in burned areas due to lack of vegetation and stability of soil (Ebi et al., 2021).

The literature is rife with examples of these impacts. Studies demonstrate that climate-amplified events have led

to doubled damage from disasters over the past decades, where homes accounted for a large percentage, due to their static nature and vulnerability to damage (Hussainzad et al., 2024). In areas of coastline or near rivers, sea-level rise and more extreme storms disproportionately affect the affordable housing stock and increase inequities. The compound threats of floods, temperatures extremes, storms and droughts faced by the urban poor and informal communities in the Global South is often characterized by poor materials and planning which increase mortality and livelihood losses (IPCC, 2022).

Resilient housing emerges as a cornerstone of sustainable development, aligning with the United Nations Sustainable Development Goals (particularly SDG 11 on sustainable cities and communities, and SDG 13 on climate action). It integrates adaptation measures that reduce exposure and sensitivity while enhancing adaptive capacity through improved design, materials, and siting. Beyond mere structural integrity, resilient housing supports broader sustainability by incorporating energy efficiency, low-carbon materials, and nature-based solutions, thereby mitigating emissions while adapting to change (IPCC, 2022).

The linkage between housing resilience, public health, and economic stability is well-established. Inadequate housing during extreme events contributes to direct injuries, heat-related illnesses, respiratory issues from mold or smoke, and mental health strains from displacement or loss (Satterthwaite et al., 2020). Vulnerable populations in substandard homes experience higher morbidity and mortality rates. Economically, repeated repairs or reconstruction drain household and public resources, disrupt livelihoods, depress property values, and hinder long-term investment. Resilient designs, conversely, reduce recovery times, lower insurance costs, preserve wealth especially for low-income owners and support community stability. They also yield co-benefits such as improved indoor air quality and energy savings, enhancing overall well-being and reducing healthcare burdens (Li et al., 2025).

This review reveals evidence from validated research data on adaptation strategies, disaster-resistant designs, and community-based initiatives for resilient housing. It examines technical approaches such as elevated structures, flood-proofing, passive cooling, fire-resistant materials alongside socio-institutional dimensions, such as participatory planning, policy frameworks, and local knowledge integration. Emphasis is placed on equity, scalability, and context-specific solutions across diverse geographies, from urban retrofits to new builds in hazard-

prone areas. By highlighting synergies between mitigation and adaptation, this study aims to inform policymakers, architects, planners, and communities on pathways toward climate-resilient housing. Ultimately, investing in such housing not only safeguards lives and assets but advances transformative, equitable, and sustainable development in an era of accelerating climate risks.

CLIMATE CHANGE AND HOUSING VULNERABILITY

Climate change compounds multiple hazards that directly affect the buildings in which people live and the communities they exist within. The hazards include floods, storms, heat waves, wild fires, droughts and sea level rise which can compound existing structural deficiencies both in the urban environment and the rural one. The building

materials and the foundations of typical housing structures will probably not be able to stand up to these stresses in the changing environment and material degradation may occur faster (Hussainzad & Gou, 2024). Structural weaknesses occur in both urban and rural environments. In the urban context high density, lack of ventilation and urban heat island effects will exacerbate risks to homes. In rural areas less robust, locally procured materials are subject to the open elements. Low income, coastal and informal settlements are more vulnerable due to poor construction methods, weak infrastructures and fewer adaptive resources. Informal settlements themselves will often be situated in high-risk areas like floodplains and steep slopes, where houses constructed from poor quality non-engineered materials will pose a threat to occupants (Satterthwaite et al., 2020).

Table1. Major climate hazards and their effects on housing infrastructure

Climate Hazard	Housing Impact	Most Vulnerable Regions	Common Structural Damage
Floods& Storms	Water ingress, erosion, contamination	South Asia, Global South informal settlements	Foundation weakening, wall collapse, material rot
Heat Waves	Overheating, material degradation	Urban areas in Global South	Reduced insulation performance, cracking, ventilation failure
Wild fires & Drought	Fire damage, soil instability	Western USA, Australia, Mediterranean	Charred framing, ember ignition, post-fire erosion
Sea-Level Rise & Coastal Erosion	Inundation, salinization, undermining	Low-lying coasts (Bangladesh, Small Island States)	Foundation corrosion, permanent flooding, structural instability

Source: Hussainzad & Gou (2024)

As shown in Table 1 above, these hazards produce distinct yet often compounding effects on housing components such as building materials, foundations, ventilation systems, and supporting infrastructure.

FLOOD AND STORM VULNERABILITY

Floods and storms, intensified by heavier precipitation and extreme weather, severely affect housing through direct water damage and hydrodynamic forces. In low-lying and informal settlements, floodwaters erode foundations, leading to settlement or collapse, while prolonged exposure causes rot in timber elements and corrosion in metal components (Bhanye, 2025). Poor ventilation exacerbates mold growth and indoor air quality issues post-flood. Infrastructure such as drainage and roads often fails, isolating communities (Hussainzad & Gou, 2024).

Examples illustrate global patterns. In Pakistan and other parts of South Asia, devastating floods have damaged millions of homes, particularly mud-built structures in rural and low-income areas. Informal settlements in the

Global South face repeated inundation due to location in floodplains and use of non-resilient materials (Bhanye, 2025).

HEAT STRESS AND URBAN HOUSING

Heat waves amplify indoor temperatures, particularly in urban environments where the urban heat island effect raises ambient conditions. Poorly insulated roofs and walls, lack of shading, and inadequate ventilation trap heat, degrading comfort and material performance (e.g., expansion and cracking in concrete or reduced efficacy of insulation). Foundations may experience differential settlement from soil desiccation during associated droughts (Hussainzad & Gou, 2024).

In tropical and subtropical cities across the Global South, informal settlements with high-density, low-albedo roofing suffer extreme indoor heat, disproportionately affecting low-income residents and vulnerable groups such as the elderly (Bhanye, 2025).

WILDFIRES AND DROUGHT EFFECTS

Wildfires directly ignite or damage homes through flames,

radiant heat, and wind-blown embers, while droughts weaken timber and increase soil instability around foundations. Post-fire landscapes heighten subsequent flood and erosion risks. Ventilation systems can draw in smoke, compromising indoor air quality (Radeloff et al., 2023). Notable cases include the western United States, where wildfires have destroyed thousands of homes, particularly in wildland-urban interface zones with wood-frame construction. Similar risks affect Australia and Mediterranean regions, where drought-stressed vegetation increases fire intensity.

COASTAL EROSION AND SEA-LEVEL RISE

Sea-level rise and associated storm surges accelerate coastal erosion, inundation, and saltwater intrusion that corrodes foundations and materials. Elevated groundwater weakens pilings and causes structural instability, while repeated flooding damages ventilation and electrical infrastructure (Çal, 2024). Coastal populations in low-lying areas and Small Island Developing States face progressive threats to housing stock, with informal or older structures particularly vulnerable due to limited elevation or protective measures.

Table 2. Adaptation strategies and their benefits

Strategy	Climate Threat Addressed	Key Benefits	Limitations
Elevated & Flood-Resistant Design	Floods & Storms	Reduces water ingress; faster recovery	Higher initial cost; site constraints
Passive Cooling & Heat-Resilient	Heat Waves	Lowers indoor temperatures; energy savings	Climate-specific performance
Nature-Based Solutions	Floods, Heat, Erosion	Multiple co-benefits; cost-effective long-term	Slower establishment; maintenance needs
Smart Technologies & EWS	Multiple (early action)	Real-time alerts; optimized performance	Technology access; power dependency

spaces above projected flood levels using stilts, piers, or raised plinths, allowing floodwaters to flow underneath with minimal structural damage (Ma et al., 2025). Flood-resistant features include water-resistant materials such as concrete bases, treated timber, or masonry, breakaway non-structural walls, and elevated utilities. Traditional approaches in flood-prone regions often use vernacular stilt constructions with local materials, while modern methods apply engineered designs with hydraulic modeling and FEMA/ASCE standards for precise elevation and flow-through foundations (Chohan et al., 2024).

In Pakistan, synergistic strategies combine elevated concrete plinths with locally sourced bamboo framing and lime-stabilized mud walls, demonstrating improved flood resilience and affordability (Ma et al., 2025). These hybrid approaches outperform purely traditional mud homes while maintaining lower environmental footprints than

ADAPTATION STRATEGIES FOR CLIMATE-RESILIENT HOUSING

Adaptation strategies for climate-resilient housing encompass structural measures, technological innovations, and sustainable construction practices that reduce vulnerability while enhancing long-term performance (Ma et al., 2025). These approaches address multiple hazards through improved design, materials, and systems integration, shifting from reactive repairs to proactive resilience. Traditional methods often rely on local knowledge and low-cost materials, whereas modern strategies incorporate engineered solutions, performance modeling, and digital technologies for greater precision and scalability (Chohan et al., 2024).

Source:Chohan et al. (2024); Al-Assaad et al. (2025)

As shown in Table 2, each strategy targets specific threats while offering distinct advantages and trade-offs that must be evaluated contextually.

ELEVATED AND FLOOD-RESISTANT HOUSING

Elevated housing works mechanistically by raising living

fully concrete structures. Sustainability benefits include reduced reconstruction needs and integration of passive features like rainwater harvesting (Chohan et al., 2024).

HEAT-RESILIENT BUILDING STRATEGIES

Resilience in high temperature requires more passive systems that reduce heat gains and improve heat dissipation with low energy demand for mechanical equipment. Technologies are Solar shading (overhangs and louvers), cool envelope material (high albedo roof and walls), innovative glazing with low solar heat gain coefficient, and ventilative cooling with optimized openings and night purge. The mechanistic approach decreases absorptency and convection rate while improving temperature buffer by building mass (Al-Assaad et al., 2025). Natural thermal mass in tropical vernacular architecture like thick earthen wall and courtyard provides thermal stability; the latest

improvements include testing and simulation-based cool coating and optimized building geometry. Analyses based on ASHRAE climate zone found that cool envelope is the most effective strategy for high temperature

climates (climate 2A); however, both ventilation and shading schemes effectively cool buildings rapidly during heatwaves and alleviate interior temperature rise (Al-Assaad et al., 2025; Ma et al., 2025).

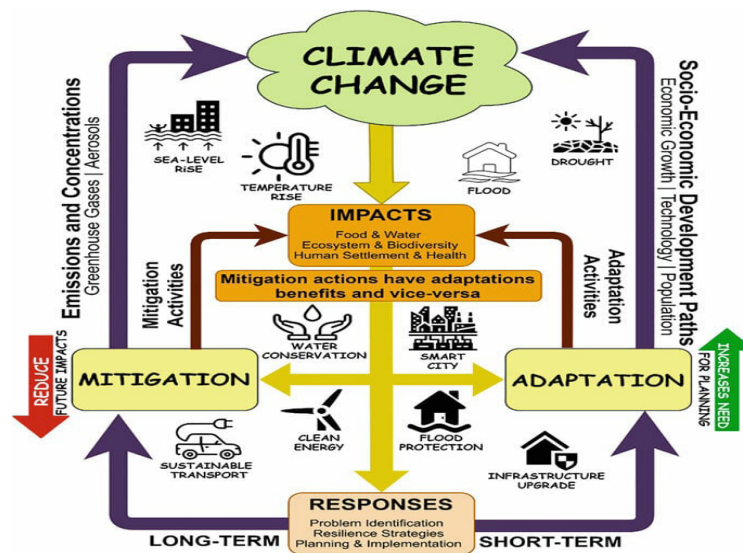


Fig1. Framework of climate adaptation strategies in housing

Sources: Patel et al. (2022)

As illustrated in Figure 1, successful adaptation follows a cyclical framework beginning with hazard identification, followed by context-specific planning, implementation of resilient construction techniques, and continuous monitoring with post-event recovery to inform future iterations.

NATURE-BASED ADAPTATION APPROACHES

Nature-based solutions (NbS) integrate living systems such as green roofs, bioswales, permeable surfaces, wetland restoration, and urban tree canopies to manage stormwater, reduce urban heat, and stabilize soils. Mechanistically, vegetation and soils absorb and evapotranspire water, provide shading and cooling through evapotranspiration, and enhance infiltration to mitigate flooding and erosion. These complement gray infrastructures by offering multifunctional benefits including biodiversity, carbon sequestration, and recreational value (Ma et al., 2025).

Traditional approaches often embed homes within natural landscapes for passive protection. Contemporary NbS scale these with engineered green infrastructure and performance monitoring. In urban and informal settings, NbS prove particularly cost-effective over time, though they require space and initial establishment periods. Integration with housing yields co-benefits for

heat and flood resilience while advancing sustainable development goals (Chohan et al., 2024).

SMART TECHNOLOGIES AND EARLY WARNING SYSTEMS

Smart technologies enhance resilience through sensors, IoT networks, AI-driven forecasting, and automated building systems that monitor environmental conditions and adjust responses (e.g., dynamic shading or ventilation). Early warning systems (EWS) provide timely alerts via integrated data platforms, enabling evacuation or protective actions before hazards peak. Mechanistically, these combine real-time data collection, predictive modeling, and community dissemination for proactive rather than reactive adaptation (Ma et al., 2025). Traditional warning relies on community observation and local knowledge. Modern systems add precision through digital integration, though challenges include digital divides and power reliability. When combined with resilient construction, they significantly reduce losses and support rapid recovery, aligning with sustainability through optimized resource use and minimized disaster impacts (Saifudeen, 2024).

DISASTER-RESISTANT HOUSING DESIGNS AND ENGINEERING APPROACHES

Disaster-resistant housing designs apply core engineering principles to withstand extreme events while maintaining structural integrity, safety, and habitability. These designs

integrate strength, ductility, redundancy, and energy dissipation to absorb and resist forces from hazards. Modern resilient building materials and passive/active protective systems enhance performance, shifting from

conventional approaches to engineered, multi-hazard solutions that balance cost-effectiveness and practicality (Chohan *et al.*, 2025).



Fig2. Disaster-resistant housing design

Sources: Saifudeen (2024)

As shown in Figure 2, a disaster-resistant house integrates multiple protective components working together for multi-hazard performance.

EARTHQUAKE- AND HURRICANE-RESISTANT DESIGNS

Earthquake-resistant designs rely on base isolation, shear walls, moment-resisting frames, and ductile detailing to allow controlled movement and energy dissipation without catastrophic collapse. Hurricane-resistant designs emphasize continuous load paths, enhanced roof-to-wall connections (such as hurricane straps), impact-resistant windows, and aerodynamic roof shapes to reduce uplift forces. These principles combine structural redundancy with energy absorption mechanisms (Chohan *et al.*, 2025). Traditional designs often use heavy mass for stability, while modern engineering applies performance-based design codes (such as the ASCE 7) and finite element analysis for optimized solutions. These approaches prove cost-effective over the building lifecycle through reduced repair needs and insurance savings, though upfront costs are higher (Chohan *et al.* 2025).

FLOOD-RESISTANT FOUNDATIONS AND DRAINAGE SYSTEMS

Flood-resistant foundations use elevated structures on pilings, stem walls, or piers to raise the lowest habitable floor above base flood elevation. Breakaway walls below the flood level allow water passage without transferring destructive forces to the main structure. Drainage systems incorporate permeable surfaces, French drains, sump

pumps, and backflow preventers to manage water entry and pressure (Chohan *et al.*, 2025). Mechanistically, these systems reduce hydrostatic and hydrodynamic loads while facilitating rapid drying. Compared to traditional slab-on-grade foundations, elevated designs significantly lower long-term flood damage. Practical implementations in flood-prone areas demonstrate affordability when combined with local materials like ferrocement or bamboo composites.

FIRE-RESISTANT BUILDING MATERIALS

Fire-resistant materials focus on high ignition thresholds, low flame spread, and char formation to slow fire progression. Key options include mineral wool insulation, fiber cement siding, metal roofing, intumescent coatings, and treated timber. These materials resist ember ignition and radiant heat, critical in wildfire-prone zones (Saifudeen, 2024). Scientifically, non-combustible materials maintain structural integrity at high temperatures, unlike conventional wood framing. Modern solutions outperform traditional materials in ember resistance and fire containment while offering good thermal performance. Cost-effectiveness improves through reduced insurance premiums and longevity, though material costs and regional availability remain considerations.

ENERGY-EFFICIENT AND PASSIVE COOLING DESIGNS

Energy-efficient designs integrate high-performance insulation, airtight envelopes, strategic shading, and natural ventilation to maintain comfort with minimal energy input. Passive cooling leverages thermal mass, night flushing, cross-ventilation, and cool roofs to reduce

heat gain and promote heat dissipation (Saifudeen, 2024). These designs use building science principles such as psychrometrics and heat transfer modeling. They are

highly cost-effective in operation due to lower energy bills and improved resilience during power outages. Hybrid passive-active systems provide practicality across different

Table 3. Disaster-resistant materials and their applications

Material/Technology	Disaster Resistance	Advantages	Limitations
Reinforced Concrete & Steel	Earthquake, Hurricane, Flood	High strength & ductility	Higher cost, higher embodied carbon
Fiber Cement & Metal Roofing	Fire, Wind, Wildfire	Lightweight, non-combustible	Initial cost, thermal bridging
Elevated Pilings & Breakaway Walls	Flood & Storm Surge	Minimizes water damage	Site-specific, higher construction cost
Mineral Wool & Fire-Resistant Coatings	Fire & Heat	Excellent fire resistance, insulation	Material availability in some regions
Ferrocement & Bamboo Composites	Flood & Wind	Affordable, locally sourced	Requires skilled labor, durability concerns

climates while supporting sustainability goals (Chohan *et al.*, 2025).

Sources: Saifudeen, (2024)

As shown in Table 3, different materials and technologies offer targeted resistance with practical trade-offs in cost and applicability.

COMMUNITY-BASED INITIATIVES AND POLICY FRAMEWORKS

Community-based initiatives play a central role in building housing resilience by leveraging local knowledge, fostering ownership, and ensuring solutions are contextually appropriate. Participatory planning enhances social resilience through inclusive decision-making processes that integrate vulnerable groups and strengthen community cohesion (Restrepo-Mieth, 2023; Selje, 2024).

Sources: Restrepo-Mieth (2023); Selje (2024).

Table 4. Examples of community-based housing resilience programs

Country/Region	Initiative	Main Strategy	Outcomes
Bangladesh/Pakistan	Community-led flood adaptation	Elevated homes, vernacular techniques	Reduced damage, faster recovery, local ownership
New Orleans, USA	Resilient New Orleans Innovation Challenge	Tech integration in affordable housing	Lower costs, enhanced resilience
Global South	CARE International CBA programs	Local knowledge integration	Improved adaptive capacity
Australia/Indigenous	Indigenous-led NbS and planning	Traditional ecological knowledge	Biodiversity co-benefits, cultural preservation

As shown in Table 4, community-based programs demonstrate tangible outcomes when local strategies are prioritized.

COMMUNITY PARTICIPATION IN HOUSING RESILIENCE

Community participation strengthens housing resilience by empowering residents to identify risks and co-design solutions. Participatory approaches improve relevance and sustainability of interventions while building social capital (Selje, 2024). Recent studies highlight that bottom-

up civil society initiatives can drive urban transformation, increasing resilience through collective action and shared governance (Kirby *et al.*, 2025). Participation also enhances adaptive capacity by mobilizing diverse resource pools and fostering trust among stakeholders (Kirby, 2026; Adger, 2003).

ROLE OF GOVERNMENTS AND URBAN PLANNING

Governments play a critical enabling role through policy, building codes, and urban planning that mainstream

climate resilience. Effective governance integrates resilience into land-use planning and enforces standards, particularly in rapidly urbanizing areas (Seeteram *et al.*, 2026). Evidence shows that multi-level governance frameworks are essential to align local initiatives with national climate goals (Bulkeley & Betsill, 2013). Urban resilience strategies, such as Barcelona's "Superblocks," demonstrate how planning innovations can redistribute public space and reduce vulnerability (Kirby *et al.*, 2025).

INTERNATIONAL CLIMATE ADAPTATION POLICIES

International frameworks such as the Paris Agreement and UNFCCC mechanisms emphasize community-based adaptation and the integration of local and Indigenous knowledge. These policies provide guidance for national actions while promoting equity (Dorji, 2024). The IPCC Sixth Assessment Report underscores the importance of embedding adaptation into everyday governance and highlights the role of Indigenous knowledge systems in resilience-building (IPCC, 2022). UN-Habitat (2020) further stresses that sustainable urbanization must prioritize resilience to climate shocks.

PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnerships facilitate resource mobilization, innovation, and scaling of resilient housing.

They bridge financing gaps and combine public oversight with private sector efficiency (Cohen, 2024; Seeteram *et al.*, 2026). Research shows that PPPs can accelerate innovation in resilient housing technologies and foster long-term sustainability when embedded in transparent governance structures (Elmqvist *et al.*, 2019).

CHALLENGES AND LIMITATIONS

High implementation costs, limited access to resilient technologies, policy and governance gaps, social inequality and displacement risks, and technical barriers in developing countries continue to constrain the widespread adoption of climate-resilient housing (Ma *et al.*, 2025; Seeteram *et al.*, 2026). Housing system resilience is further challenged by entrenched path dependencies and financing constraints (Springer, 2025). Affordability and climate resilience remain top priorities, yet they are frequently in tension. Disaster-related damages reduce housing stock and drive up costs of construction, rehabilitation, and maintenance (Seeteram *et al.*, 2026). Scholars argue that resilience must be understood as a dynamic social process, not just disaster recovery, to address these systemic challenges (Füssel, 2007; Pelling, 2011).

As illustrated in Figure 4, the major barriers to climate-resilient housing are deeply interconnected, with



Fig4. Major barriers to climate-resilient housing

Source: Chohan *et al.* (2024)

financial and governance issues often amplifying social and technical constraints. High upfront costs represent a significant barrier, particularly for retrofits and new construction in low-income communities. Resilient features such as elevated foundations, advanced materials, and smart systems increase initial capital requirements, making them inaccessible for many households and

small developers despite long-term savings in repair and insurance costs (Cohen, 2024; Ma *et al.*, 2025).

Lack of access to resilient technologies perpetuates inequities. Reliable new materials, tested buildings systems, and know-how are either non-existent, or unaffordable in much of the world. Retrofitting of inhabited homes raises both logistical and equity challenges, particularly with

respect to lower-income residents for whom renovation may be infeasible because of a combination of financial, logistical and technical issues (Abuimara, 2026).

Policy and governance issues create further barriers. Lack of uniform building codes, lack of code enforcement, regulatory impediments, fragmented institutional mandates, all impede the mainstreaming of resilience in housing and construction. In many countries, current policies favor immediate housing supply at the expense of long-term climate adaptation, generating conflict over building code approvals, insurance programs and equitable considerations (Tietjen, 2024; Seeteram *et al.*, 2026).

Social inequality and risk of displacement. If not coupled with robust affordability controls, new climate resilient building practices may increase the likelihood of gentrification or displacement from a community. Low income neighborhoods and informal settlements, especially, and marginalized communities are often the most exposed, but also least likely to have the resources to respond and adapt. New climate resilient investment in highly-exposed areas may drive up housing prices, making homeownership unavailable to existing residents and engendering a new type of climate injustice (Cohen, 2024; Zahnow, 2025). Technical barriers are particularly acute in developing countries, where rapid urbanization, limited local manufacturing capacity, skills shortages, and reliance on imported materials compound challenges. Institutional capacity constraints, poor coordination across government levels, and competing development priorities often result in adaptation efforts that remain small-scale and insufficient to match the pace of climate risks (Mwenje, 2024; Gentle, 2024).

Critically evaluating existing approaches reveals that many current strategies focus on incremental, property-level adjustments rather than transformative, systems-wide solutions. Economic realities including high construction costs, insurance market failures, and limited access to climate finance combined with political realities such as short electoral cycles and competing fiscal priorities, create strong disincentives for bold action. In many cases, political will is insufficient to overcome path dependencies favoring conventional construction practices (Ma *et al.*, 2025; Seeteram *et al.*, 2026).

FUTURE DIRECTIONS AND RESEARCH OPPORTUNITIES

Further research in resilient housing will focus on using artificial intelligence (AI) and smart technology, green materials and the circular economy, adaptive urban planning, and renewable energy incorporation. Effective

management of complex and interdisciplinary challenges require cooperation between different fields (Ma *et al.*, 2025; Shen, 2026). AI-based forecasting, building digital twins and real-time sensing would be applied for design optimization and early maintenance. New developments on low carbon/green material and circularity present opportunities to decrease embodied emission and simultaneously improve building durability. Research gap to be focused on: applicable solutions in global south, building performance assessment under compound hazards and framework for technology and equity integration.

CONCLUSION

This research makes clear that resilience in housing must simultaneously address integrated adaptation strategies, disaster-resilient design, and effective community based solutions with conducive policies. Structural mechanisms, nature-based solutions and intelligent technologies combined with community participation and governance provide viable solutions. Engineering excellence should not be an isolated practice, but rather intrinsically linked with comprehensive policies and participatory approaches. Ultimately, investing in climate-resilient housing is critical to the pursuit of sustainable development, safeguarding of health and the development of just and liveable settlements in an era of increasing climate threats. Systemic transformation at all scales, in a way that combines the scientific with local understanding, is essential for the livability of human settlements in a changing climate.

Authors' Contributions

The authors of this research have significantly contributed to the study's conception, data collection, and manuscript development. All authors were involved in writing the manuscript or critically reviewing it for its intellectual value. They have reviewed and approved the final version for submission and publication and accept full responsibility for the content and integrity of the work.

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REFERENCES

- Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, 79(4), 387–404. <https://doi.org/10.1111/j.1944-8287.2003.tb00220.x> (doi.org in Bing)
- Al-Assaad, D., Sengupta, A., An, P., Breesch, H., Afshari, A., Amaripadath, D., & Wang, L. (2025). Resilient passive cooling strategies during heat waves: A quantitative assessment in different climates. *Building and Environment*, 274, 112698. <https://doi.org/10.1016/j.buildenv.2025.112698>
- Bhanye, J. (2025). A review study on community-based flood adaptation in informal settlements in the Global South. *Discover Sustainability*. <https://doi.org/10.1007/s43621-025-01449-6>
- Bulkeley, H., & Betsill, M. (2013). *Governance and climate change*. Routledge.
- Çal, İ. (2024). Determining vulnerability indicators of buildings for sea level rise: The case of coastal urban areas. *Sustainability*, 17(1), Article 27. <https://doi.org/10.3390/su17010027>
- Chohan, A. H., Awad, J., Che-Ani, A. I., & Awad, A. (2025). Retrofit design for climate resilient housing: Strategies for architectural adaptation to climate change. *Civil Engineering Journal*, 11(3), 1011–1033. <https://doi.org/10.28991/CEJ-2025-011-03-011>
- Chohan, A. H., Awad, J., Jung, C., & Sher, B. K. (2024). Enhancing climate resilience against flooding in housing design through synergistic strategies in Pakistan. *Future Cities and Environment*, 10, Article 25. <https://doi.org/10.5334/fce.226>
- Ebi, K. L., Vanos, J., Baldwin, J. W., Bell, J. E., Hondula, D. M., Errett, N. A., & Ziska, L. (2021). Extreme weather and climate change: Population health and health system implications. *Annual Review of Public Health*, 42, 293–315. <https://doi.org/10.1146/annurev-publhealth-012420-105026>
- Elmqvist, T., et al. (2019). Sustainability and resilience for transformation in the urban century. *Nature Sustainability*, 2(4), 267–273. <https://doi.org/10.1038/s41893-019-0250-1> (doi.org in Bing)
- Füssel, H. M. (2007). Vulnerability: A generally applicable conceptual framework for climate change research. *Global Environmental Change*, 17(2), 155–167. <https://doi.org/10.1016/j.gloenvcha.2006.05.002> (doi.org in Bing)
- Hussainzad, E. A., et al. (2024). Climate risk and vulnerability assessment in informal settlements of the Global South: A critical review. *Land*, 13(9), Article 1357. <https://doi.org/10.3390/land13091357>
- Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>
- IPCC. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Cambridge University Press.
- Kirby, N. (2026). Strengthening community resilience through participation – a conceptual exploration. *Environmental Sociology*, 12(1), 76–91. <https://doi.org/10.1080/23251042.2025.2479666>
- Kirby, N., Stasiak, D., & von Schneidemesser, D. (2025). Community resilience through bottom-up participation: When civil society drives urban transformation processes. *Community Development Journal*, 60(3), 528–547. <https://doi.org/10.1093/cdj/bsae031>
- Li, A., et al. (2025). Housing at the intersection of health and climate change. *The Lancet Public Health*. [https://doi.org/10.1016/S2468-2667\(25\)00141-0](https://doi.org/10.1016/S2468-2667(25)00141-0)
- Ma, X., Yang, C., Fatourehchi, D., & Lu, D. (2025). Climate-resilient housing research in Australia: A comprehensive review. *Buildings*, 15(21), 3885. <https://doi.org/10.3390/buildings15213885>
- Patel, S., Mall, R. K., Jaiswal, R. K., Singh, R., & Chand, R. (2022). Vulnerability assessment of wheat yield under warming climate in Northern India using multi-model projections. *International Journal of Plant Production*, 16(4), 611–626.
- Pelling, M. (2011). *Adaptation to climate change: From resilience to transformation*. Routledge.
- Radeloff, V. C., et al. (2023). Rising wildfire risk to houses in the United States. *Science*. <https://doi.org/10.1126/science.ade9223>
- Saifudeen, A. (2024). Adaptation of buildings to climate change: An overview. *Frontiers in Built Environment*. <https://doi.org/10.3389/fbuil.2024.1327747>
- Satterthwaite, D., Archer, D., Colenbrander, S., Dodman, D., Hardoy, J., Mitlin, D., & Patel, S. (2020). Building resilience to climate change in informal settlements. *One Earth*, 2(2), 143–156.
- Seeteram, N. A., et al. (2026). Challenges and opportunities in scaling climate-resilient

-
- housing solutions in the United States. *Nature Communications*.
24. Selje, T., Schmid, L., & Heinz, B. (2024). Community-Based Adaptation to Climate Change: Core Issues and Implications for Practical Implementations. *Climate*.
25. Springer. (2025). Housing system resilience: An integrative literature review. SpringerLink.
26. UN-Habitat. (2020). World Cities Report 2020: The Value of Sustainable Urbanization. Nairobi: United Nations Human Settlements Programme.

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