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ADAPTIVE HOUSING PLANNING STRATEGIES FOR STRENGTHENING URBAN POOR COMMUNITIES IN POST-PANDEMIC CITIES

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ABSTRACT

This paper argues that adaptive housing planning is crucial for strengthening the resilience of urban poor communities in post-pandemic cities. The analysis focuses on how such planning addresses housing vulnerabilities exposed by COVID-19 and promotes equitable development. Synthesising recent literature, the review centres on participatory governance, sustainable design, and innovative policy and financing tailored to urban poor populations. Using resilience frameworks such as Holling's Resilience Theory, the Adaptive Capacity Framework, and the Social-Ecological Systems approach, the paper shows how adaptive housing operates at the intersection of infrastructure, socio-economic, and environmental factors. Results suggest that adaptive housing not only addresses immediate post-pandemic housing needs but also builds long-term resilience, inclusivity, and quality of life. The paper calls for increased collaboration among policymakers, urban planners, and researchers to expand context-sensitive adaptive housing strategies within broader resilience and poverty alleviation agendas.

Keywords: Post-Pandemic Adaptive Housing Strategies, Community Resilience, Planning Strategies, Inclusive Urban Development

1.0 INTRODUCTION

Rapid urbanisation has magnified housing challenges in developing countries, especially for low-income communities. The global urban population grew from 746 million in 1950 to about 4.7 billion in 2023; nearly 70% of people could live in cities by 2050 (United Nations, 2023; World Bank, 2023). This demographic shift exacerbates pressure on housing systems, with the urban poor often limited to informal housing lacking essential services. These conditions reinforce poverty and social exclusion, creating an urgent need for adaptive, inclusive housing strategies (UN-Habitat, 2024; Anderson et al., 2024; WHO, 2023). With urban poverty rising, a growing share of those in extreme poverty will live in cities by 2035. These trends complicate progress toward the Sustainable Development Goals (SDGs), including those on poverty eradication and sustainable cities. Equitable access to resilient housing now anchors global urban development agendas (Kufeoglu, 2022).

These structural inequalities became clear during the COVID-19 pandemic. The crisis exposed the critical link between housing conditions, public health, and urban resilience. Housing fragility in low-income settlements, where overcrowding and poor sanitation are common, greatly increases infection risks. These issues showed that housing quality directly affects public health outcomes. Inadequate housing is not just a social problem, but also a pressing public health concern (Varshney et al., 2022). Beyond the immediate health impacts, the pandemic highlighted the need for resilience and long-term sustainability in housing strategies to prepare cities for future disruptions (Escorcia Hernández et al., 2023; Callenberg et al., 2024).

In response to these challenges, adaptive, low-cost housing has emerged as a promising planning approach to enhance resilience in vulnerable urban communities. Such housing emphasises flexibility, incremental development, and responsiveness to evolving socio-economic and environmental conditions. Integrating social, environmental, and health considerations into development supports inclusive, sustainable urban growth (Askar et al., 2021; Akinsulire et al., 2024a). Incremental development and participatory planning empower residents in design and decision-making, strengthening local ownership and resilience (UN-Habitat, 2022). Implementing these strategies requires supportive governance and planning frameworks. Policy tools like inclusive zoning, land-use reforms, and financial innovations (such as micro-housing loans and community land trusts) enable participatory development (Asadzadeh et al., 2023; Mrani et al., 2025). Participatory governance and community-based planning provide platforms for residents to influence priorities and embed resilience in urban policies (Ahmadi Dehrashid et al., 2026; Castañeda Rodriguez et al., 2026). Although often seen as drivers of growth and innovation, cities' vulnerability to shocks—revealed by the COVID-19 pandemic—has increased attention on the importance of urban planning and design in enhancing resilience, particularly for marginalised groups (WHO, 2020; Capolongo et al., 2020; Wade, 2020). Housing quality and spatial organisation directly affect health, social stability, and adaptability in crises (Lak et al., 2020; Callenberg et al., 2024).

This study investigates the dimensions and characteristics of adaptive low-cost housing strategies that can strengthen resilience in urban poor communities. It uses resilience as an analytical framework to examine how housing interventions support post-pandemic recovery and long-term community stability. The research explores how adaptive housing addresses physical and social aspects of resilience in low-income urban areas, with direct impacts on well-being and vulnerability. This paper synthesises existing scholarship within broader urban planning and governance frameworks. Connecting resilience theory with housing planning provides a conceptual synthesis highlighting strategies to improve housing adaptability and community resilience in vulnerable urban settings. The findings aim to guide planners, policymakers, and researchers in developing more inclusive and resilient post-pandemic housing policies. This systematic literature review (SLR) and conceptual synthesis consolidates and critically interprets current knowledge to identify key strategies, gaps, and implementation pathways, rather than generating primary data.

2.0 METHODOLOGY

This study uses a systematic literature review (SLR) to examine adaptive housing strategies that enhance resilience among urban poor communities post-pandemic. The review follows systematic protocols to ensure transparency and methodological rigour (Page et al., 2021). A structured search was performed across Scopus, Web of Science, and Google Scholar, which together cover interdisciplinary urban studies and housing research. The search combined keywords related to housing adaptability, resilience, and pandemic contexts with Boolean operators. Terms included "adaptive housing," "housing resilience," "urban poor housing," "post-pandemic housing," and "COVID-19 housing strategies." The search covered publications from 2000 to 2026, capturing foundational works and recent scholarship. Initially, 1,500 records were found. After removing duplicates and irrelevant entries, 250 articles were shortlisted based on title and abstract, of which 150 met the preliminary criteria and were reviewed in detail. An additional 15 studies were found through snowball sampling. After final eligibility checks, 110 publications were retained for analysis.

To ensure analytical consistency, clear inclusion and exclusion criteria were applied. Eligible studies consisted of peer-reviewed journal articles and scholarly book chapters published in English that addressed themes related to adaptive housing, urban resilience, housing affordability, or post-pandemic urban recovery. Studies focusing exclusively on rural housing, non-urban contexts, or unrelated architectural topics were excluded. Conference proceedings, opinion pieces, and non-peer-reviewed materials were also removed to maintain academic rigour. Three sequential filtering stages were implemented: (1) primary screening, identifying studies addressing housing challenges in urban poor communities; (2) thematic screening, selecting literature discussing adaptability, flexibility, or resilience; and (3) analytical screening, retaining studies that explicitly examined adaptive strategies for low-cost or resilient housing systems.

For each selected study, key information was systematically extracted using a structured data-extraction framework. The extracted variables included author(s), publication year, geographical context, research methodology, key housing strategies, resilience dimensions addressed, and policy implications. This structured approach enabled the identification of patterns and thematic relationships across the literature while reducing potential selection bias (Page et al., 2021). To further enhance reliability, the screening and selection processes were independently reviewed by two researchers, and discrepancies were resolved through discussion to ensure consistency in study inclusion. The analysis employed an inductive thematic analysis, allowing themes to emerge

directly from the literature rather than being imposed a priori. Each selected study was carefully reviewed, and recurring concepts related to housing adaptability, resilience strategies, and policy interventions were coded. These codes were iteratively refined and grouped into broader analytical categories. Through multiple rounds of comparison and consolidation, the coding process produced several core thematic clusters that represent the dominant adaptive housing strategies discussed in the literature.

The thematic synthesis ultimately produced a conceptual framework identifying five interrelated domains of adaptive housing strategies: policy development, community participation, sustainable design, technological innovation, and financial mechanisms. These domains represent the most frequently cited mechanisms through which housing systems can strengthen resilience in vulnerable urban communities. The framework, therefore, provides an analytical structure for understanding how adaptive housing interventions operate across social, institutional, and physical dimensions.

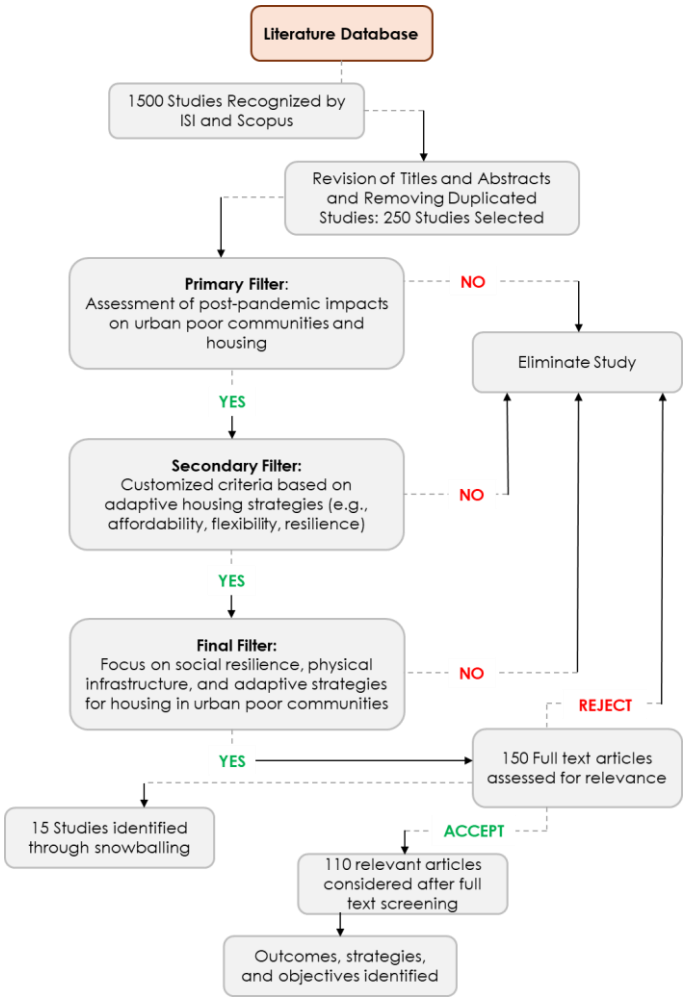

Fig. 1: Flowchart Illustrating the Literature Selection Process for Evaluation and Review

3.0 LITERATURE REVIEW

Understanding the complexities of urban poverty and housing requires a careful examination of the key concepts that underpin adaptive housing and resilience. At the outset, adaptive housing is defined by its capacity to foster sustainable living conditions for vulnerable populations, thereby positioning it as a practical response to entrenched inequalities in urban environments. Building on this foundation, the discussion turns to the COVID-19 pandemic, which disrupted everyday life and amplified the vulnerabilities of low-income urban communities, underscoring the urgent need for housing strategies that withstand systemic shocks.

To address these challenges, resilience frameworks in housing are introduced as theoretical lenses that help explain how built environments can adapt to crises while supporting social and physical well-being. These frameworks provide a basis for understanding adaptive strategies, linking conceptual discussions to practical

design and policy responses. The review then examines previous adaptive housing initiatives, drawing lessons from both successes and shortcomings to inform future directions.

Taken together, these conceptual explorations establish a coherent foundation for assessing the role of adaptive housing in strengthening resilience. They underscore how theory, lived experience, and practical initiatives converge to shape housing strategies that can enhance the well-being of low-income urban populations in the post-pandemic era.

3.1 Definition and Importance of Adaptive Housing

Adaptive housing is increasingly defined as a housing approach that responds to the evolving needs of urban populations amid rapid urbanisation. Unlike conventional designs, which often exclude user participation and fail to accommodate diverse social uses, adaptive housing emphasises flexibility and inclusivity. The COVID-19 pandemic underscored this necessity, as homes were compelled to perform multiple roles beyond their original design intentions (Pelsmakers & Warwick, 2022).

Beyond pandemic pressures, adaptability emerges as essential throughout the building lifecycle, particularly in response to broader societal shifts such as digital work, migration, and demographic transitions like ageing populations. Turner's and Davis's seminal contributions remain relevant here, showing how urban poor residents negotiate trade-offs between affordability, location, and safety (Turner, 1976; Davis, 2006). In this sense, adaptability cannot be confined to spatial or physical design but must integrate social, economic, and environmental dimensions that reflect the lived realities of low-income communities (Ramalhete et al., 2015).

These multidimensional demands also extend to geographic and climatic contexts. Advocating for locally appropriate, sustainable materials is vital, since inadequate adaptability risks disrupting social cohesion by displacing households from established networks (Pelsmakers & Warwick, 2022). Conversely, facilitating long-term residence enhances community well-being and stability (Isik-Ercan et al., 2024). Thus, material choices and design strategies must simultaneously support ecological responsiveness and social continuity.

Linking adaptability with sustainability, scholars highlight how circular construction principles can prolong housing longevity while reducing demolition costs and waste (Askar et al., 2021). Although flexible designs may involve higher upfront costs, they create long-term value, provided residents perceive adaptability as a worthwhile investment (Watt et al., 2023). This reinforces the idea that adaptability is not only a technical feature but also a socio-economic negotiation shaped by affordability thresholds and household priorities.

At a broader scale, adaptive housing must also respond to systemic challenges in urban governance and environmental degradation. Policy frameworks have often failed to account for local contexts, resulting in ineffective housing provision (UN-Habitat, 2012; ASEAN, 2022). In regions such as Sub-Saharan Africa, rapid urban growth, high rates of informal settlements, and weak infrastructure intensify vulnerabilities (Hussainzad & Gou, 2024). Here, Turner's argument remains pertinent: the housing needs of rural migrants—who often settle in peripheral, underserved areas—are best understood through the trade-offs they navigate (Turner, 1976; Davis, 2006). The persistence of overcrowded slums without adequate infrastructure demonstrates that, without comprehensive policies that address housing, infrastructure, and socio-economic development simultaneously, adaptive housing will remain out of reach for the most vulnerable (Ramalhete et al., 2015).

3.2 The Impact of the COVID-19 Pandemic on Urban Communities

The COVID-19 pandemic, emerging in late 2019, rapidly escalated into a global crisis with over 753 million cases and 6.8 million deaths recorded by early 2023 (WHO, 2023). While health measures such as lockdowns and travel restrictions were necessary to curb its spread (WHO, 2020), they simultaneously exposed deep socio-economic vulnerabilities in urban contexts, including inadequate housing, entrenched health inequalities, and fragile social networks (Nicola et al., 2020; Hasan et al., 2024). These consequences reveal that pandemics act not only as health emergencies but also as stress tests of urban systems' resilience.

Although COVID-19 is unprecedented in scale, pandemics themselves are not new phenomena. They have historically been triggered by processes closely tied to urbanisation, global travel, and environmental change (Madhav et al., 2017). Past outbreaks such as smallpox, cholera, and notably the 1918 Spanish flu—which alone claimed over 20 million lives—demonstrate their capacity to reshape societies (Piret & Boivin, 2021). More recent crises, including H1N1 (2009), Ebola, and Zika, further emphasise the ongoing urgency of pandemic preparedness and highlight how recurring health shocks intersect with the dynamics of contemporary cities (Hasan et al., 2019; Jilani et al., 2024). Importantly, history shows that pandemics have also been catalysts for urban innovation. Europe's cholera epidemics, for instance, spurred advancements in public hygiene and sanitation, while large-scale interventions such as Haussmann's redesign of Paris and Ebenezer Howard's Garden City concept reflected broader shifts toward healthier urban environments. Similarly, the Modernist planning

principles that emerged in the wake of the Spanish flu emphasised the importance of green spaces, natural ventilation, and access to light—features that remain central to contemporary urban health debates. However, drawing parallels between past and present also reveals significant contrasts. The global recovery after the Spanish flu occurred in a context where only 14% of the population lived in cities, compared to 57% today. Moreover, the world of the 1920s was far less interconnected, and the absence of modern media-driven fear arguably allowed for a faster psychological and social recovery (Kozlowski et al., 2021). These differences underscore that while past pandemics provide valuable lessons, today's urban vulnerabilities—magnified by density, globalisation, and socio-economic inequalities—demand more complex and integrated responses.

3.3 Resilience Frameworks in Housing

Resilience frameworks in housing focus on communities' capacity to absorb, adapt, and recover from shocks such as pandemics, natural disasters, and economic crises. These frameworks provide conceptual and practical foundations for adaptive housing strategies, emphasising flexibility, sustainability, and community participation as central principles. By addressing both the physical and social dimensions of resilience, they enable housing systems and the communities they serve to better withstand disruptions and accelerate recovery (UN-Habitat, 2012; Kapucu et al., 2024).

Table1. Key Resilience Frameworks Applied to Housing

Framework	Core Idea	Housing Implications	Relevance to Urban Poor
Holling's Resilience Theory	Systems absorb shocks & reorganize (Holling, 1973)	Incremental, flexible housing design	Enables crisis responsiveness
Social-Ecological Systems (SES)	Interconnected social & ecological systems (Ostrom, 2009)	Governance, community action, ecological design	Fosters collective resilience
Adaptive Capacity Framework	Ability to adjust via resources, skills, networks (Folke et al., 2010)	Microfinance, skills training, disaster readiness	Strengthens coping capacity
Community-Based Resilience	Participation & local agency (Patel et al., 2017)	Co-design, community & trusts, participatory budgeting	Enhances ownership & institutional legitimacy

Central to these frameworks are adaptable housing designs that can be reconfigured to meet evolving household needs, alongside the use of sustainable building materials that reduce environmental impacts and support long-term durability. Equally important is community involvement in decision-making, which fosters stronger social cohesion, shared responsibility, and a sense of ownership. Such participation not only improves the relevance of housing solutions but also enhances collective resilience (Bucovetchi et al., 2024). Importantly, resilience in housing extends beyond the physical domain. It also entails strengthening social networks, promoting economic stability, and integrating environmental sustainability as mutually reinforcing pillars of resilience. In this way, housing frameworks position resilience as a multidimensional construct, preparing vulnerable communities to cope with uncertainty and adapt to future challenges. The following section highlights key resilience frameworks that specifically inform adaptive housing strategies:

3.3.1 Holling's Resilience Theory

Holling's Resilience Theory (1973) conceptualises resilience as a system's capacity to absorb shocks, reorganise, and continue functioning without losing its essential structure and purpose. When applied to housing, this perspective underscores the importance of designing environments that can withstand and adapt to diverse stressors (including economic instability, health crises, and climate variability) while maintaining their core utility and livability. In practical terms, Holling's theory informs strategies such as flexible housing design, mixed land use, and participatory community planning, which collectively enhance a settlement's adaptive capacity (Salinger et al., 2024). A notable example is incremental housing, in which residents can gradually expand or reconfigure their homes in response to shifting household needs and available resources. This approach not only supports long-term adaptability but also empowers residents to directly shape their living environments, thereby reinforcing both physical and social dimensions of resilience (Mota, 2021).

3.3.2 Integrated Social-Resilience Frameworks

While Holling's framework provides a foundational understanding of systemic adaptation, several complementary models, namely the Social-Ecological Systems (SES), Adaptive Capacity, and Community-Based Resilience frameworks, offer more holistic perspectives that integrate social, ecological, and institutional dimensions.

The Social-Ecological Systems (SES) Framework, developed by Ostrom (2009), emphasises the interconnectedness between built environments, social networks, governance structures, and ecological contexts. Housing resilience, within this perspective, emerges from the dynamic interaction of these elements. It stresses the importance of community cohesion, local governance, and collective action in coping with crises (Partelow, 2018). For example, the recovery process following Hurricane Katrina in New Orleans demonstrated how community-led initiatives significantly shaped rebuilding efforts (Kates et al., 2006), showing that resilience extends beyond physical structures to include social relationships and governance systems.

The Adaptive Capacity Framework (Folke et al., 2010) highlights the ability of individuals and communities to adjust to changing conditions by mobilising resources, knowledge, and social capital. This framework is particularly relevant to urban poor communities, where limited financial and institutional capacity constrains adaptive responses. Initiatives that enhance adaptive capacity—such as microfinance for home improvements, disaster preparedness training, and knowledge-sharing platforms—can strengthen long-term resilience (Lin & Lee, 2024). The Philippines' Build Back Better program exemplifies this by embedding risk reduction and community participation in housing reconstruction (Cruz & Pulumbarit, 2023).

The Community-Based Resilience Framework builds upon these ideas by emphasising local participation and agency. Rather than imposing externally defined solutions, participatory housing planning allows communities to co-develop strategies that align with their cultural and social realities (Patel et al., 2017). Post-earthquake reconstruction in Haiti illustrates this principle, where community engagement produced housing that was both locally relevant and culturally resonant (Pyles, 2015; Boston et al., 2024). These participatory approaches enhance social legitimacy, shared ownership, and long-term adaptability.

Together, these frameworks converge within what Yadav and Yadav (2024) describe as an Integrated Resilience Framework, combining systemic understanding (SES), adaptive strategies (Adaptive Capacity), and participatory governance (Community-Based Resilience). This synthesis recognises that effective housing resilience requires the alignment of physical design, social cohesion, and institutional support. By integrating health, social, and environmental considerations—such as access to green spaces, adequate ventilation, and communal facilities-adaptive housing can simultaneously improve living conditions and strengthen preparedness for future crises (Heydari & Abbasianjahromi, 2024; Diana et al., 2024).

3.3.3 Synthesis and Insights

Across these frameworks, several common principles emerge. Flexibility in housing design, social participation, and integration of ecological and governance systems are consistent drivers of resilience (Druta & Fatemidokhtcharook, 2023; Lang & Roessl, 2013; Maravalle et al., 2024). However, persistent challenges remain, particularly affordability constraints, fragmented policy support, and limited institutional coordination that often exclude low-income populations from adaptive housing initiatives. Moreover, while the frameworks provide valuable conceptual tools, their practical translation into policy and local implementation remains uneven, especially in resource-limited settings. Addressing these gaps requires not only technical innovation but also governance reforms that strengthen community participation and align resilience planning with social equity objectives.

Ultimately, resilience in housing should be understood as both a physical capacity to withstand disruption and a social process of empowerment and adaptation, ensuring that vulnerable urban communities can sustain well-being in the face of uncertainty.

3.4 Previous Strategies for Adaptive Housing

Adaptive housing strategies have gained increasing recognition as critical tools for enhancing the resilience of urban poor communities, particularly during crises such as the COVID-19 pandemic. Rooted in principles of flexibility, inclusivity, and community participation, these strategies aim to provide housing solutions that evolve with residents' changing socio-economic and environmental circumstances (Kapucu et al., 2024). By merging adaptive design with participatory processes, they not only mitigate short-term vulnerabilities but also promote long-term stability, well-being, and social cohesion. This section outlines the key strategies and their practical applications through selected case studies.

3.4.1 Incremental Housing

Incremental housing is a progressive construction model that allows residents—especially those in informal or low-income communities—to build or upgrade their homes over time as financial resources permit. This approach enhances affordability and empowers residents through gradual investment and self-determination. In Belapur Housing, Navi Mumbai, India, Charles Correa's 1980s design exemplified this approach by providing low-cost starter units clustered around communal courtyards, with additional space for future expansion. This design not only facilitated community interaction but also supported incremental development aligned with household growth. Similarly, Brazil's Incremental Housing Program under the Minha Casa Minha Vida initiative provides subsidies for basic housing units that residents can expand, promoting affordability, ownership, and localised resilience (D'Ottaviano & Bossuyt, 2024).

3.4.2 Flexible Housing Designs

Flexible housing design focuses on adaptable layouts and modular structures that respond to evolving household and community needs. Such designs extend the lifespan of housing, reduce displacement, and enhance functionality during social or environmental disruptions. The Netherlands' Flex Homes initiative offers prefabricated modular units for individuals in transitional crises, such as divorce, job loss, or displacement. These units are quick to assemble, cost-efficient, and relocatable, providing both immediate relief and long-term adaptability (Druta & Fatemidokhtcharook, 2023). Likewise, Switzerland's Neuwil Development by Metron-Architekten AG integrates an open-plan layout with a central technical core, enabling occupants to reconfigure internal spaces as family structures change. This design promotes sustainability, user autonomy, and adaptive reuse (Živković et al., 2021).

3.4.3 Community-Led Housing Initiatives

Community-led housing emphasises resident participation in decision-making, ensuring that design and management processes are grounded in local priorities. Such approaches strengthen social capital, reduce dependency on external actors, and ensure culturally and contextually relevant outcomes. Vienna's Cooperative Housing Model empowers residents through collective ownership and democratic governance, ensuring affordability and long-term community stability (Lang & Roessl, 2013). Similarly, the Community Land Trusts (CLTs) model in Nashville, USA, separates land from housing ownership, preventing market-driven displacement and preserving intergenerational affordability (Engelsman et al., 2016). Both models demonstrate how shared ownership and participatory governance can institutionalise resilience within urban housing systems.

3.4.4 Resilient Infrastructure and Disaster-Resistant Housing

Resilient and disaster-resistant housing integrates structural robustness, environmental sensitivity, and risk reduction into design and infrastructure planning. These approaches are crucial for communities exposed to climate hazards and environmental stress. After Hurricane Sandy, New York City's Housing Recovery Program introduced retrofitting initiatives—such as elevated structures, flood-resistant foundations, and green stormwater systems—to improve both safety and sustainability (Salmanian et al., 2024; Salmanian & Bayat, 2023; Petkova et al., 2017). In Japan, post-2011 disaster innovations introduced seismic-flexible structural systems, elevated foundations, and energy-efficient materials, reflecting a strong cultural emphasis on preparedness and collective resilience (Farhanrika et al., 2023). These cases underscore that integrating resilience into housing not only safeguards lives but also catalyses urban regeneration.

3.4.5 Government Policy and Support Programs

Government interventions play a pivotal role in scaling adaptive housing solutions by providing financial support, technical expertise, and regulatory incentives. Such programs institutionalise resilience through inclusive planning and policy integration. In Mexico, the Programa de Mejoramiento Urbano targets informal settlements with subsidies for housing upgrades and infrastructure improvements, enhancing community participation and reducing spatial inequalities (Maravalle et al., 2024). Similarly, Canada's National Housing Strategy incorporates adaptive housing principles through its Affordable Housing Program, emphasising affordability, adaptability, and support for vulnerable groups (Farhan, 2024). These examples highlight how state-led initiatives can translate adaptive principles into equitable and sustainable outcomes.

3.4.6 Technology-Driven Solutions

Technological innovation is reshaping adaptive housing by enhancing efficiency, sustainability, and responsiveness. Through digital tools, renewable energy systems, and data-driven design, housing can better adapt to changing conditions and resource limitations. In India, IoT-based housing solutions integrate smart monitoring systems that optimise energy use and improve affordability, making adaptive living feasible even in low-income contexts (Salmanian & Ujang, 2021; Sharma et al., 2020). In Sub-Saharan Africa, solar-powered housing systems have expanded access to stable electricity, reducing vulnerability and improving adaptive capacity in off-grid areas (Ajagun et al., 2024). Collectively, these innovations illustrate how technology complements social and policy-driven strategies by embedding resilience at multiple scales of housing.

3.5 Thematic Insights and Knowledge Gaps

Across these diverse strategies, common principles emerge: incremental growth, flexibility, participation, institutional support, and technological integration (Kapucu et al., 2024; Lang & Roessl, 2013). Each approach contributes to housing resilience by addressing different dimensions—social empowerment, physical adaptability, environmental safety, and governance inclusivity (Druta & Fatemidokhtcharook, 2023; Farhan, 2024). However, their effectiveness depends on context-specific implementation and multi-sectoral coordination. For low-income urban communities, the most successful adaptive housing models combine bottom-up participation with supportive policy frameworks and accessible technology, reinforcing the premise that housing resilience is achieved not through singular design solutions but through the alignment of physical, social, and institutional capacities.

Despite these advancements, several knowledge gaps persist. Existing literature tends to focus on conceptual frameworks and pilot projects, with limited empirical evidence on the long-term effectiveness of adaptive housing strategies in high-density, low-cost urban settings (Ajagun et al., 2024; Maravalle et al., 2024). Moreover, the intersection between housing adaptability, social well-being, and public health resilience remains underexplored, especially in the post-pandemic context (Farhanrika et al., 2023). Few studies examine how adaptive housing principles can be operationalised within government-led housing programs or how residents' lived experiences and informal adaptive practices can inform future housing design. Addressing these gaps requires multidimensional planning strategies that link physical flexibility, social networks, and institutional responsiveness to enhance the resilience of urban poor communities. While these studies provide valuable conceptual and practical insights, a significant empirical validation gap remains, particularly in high-density, government-led housing contexts. Many existing contributions rely on pilot projects or theoretical models, with limited evaluation of measurable outcomes such as occupancy conditions, environmental performance, and long-term maintenance. This gap highlights the need to integrate secondary empirical evidence and to develop assessment indicators, which this study begins to address through its synthesis and contextual analysis.

4.0 Findings and Discussion: Post-Pandemic Strategies for Resilient Urban Poor Communities

The COVID-19 pandemic revealed deep vulnerabilities within urban poor communities, amplifying challenges related to housing, health, and livelihoods. The COVID-19 pandemic revealed deep vulnerabilities within urban poor communities, amplifying challenges related to housing, health, and livelihoods. Economic disruptions, heightened social isolation, and persistent health disparities underscored the urgency of developing strategies that foster resilience and adaptability in housing systems (Escorcia Hernández et al., 2023; Heydari & Abbasianjahromi, 2024). Addressing these vulnerabilities requires targeted interventions that integrate inclusivity, sustainability, and community participation while leveraging technology and supportive policies (Sato et al., 2023).

This section synthesises four interrelated domains of adaptive housing strategies, policy frameworks, community engagement, sustainable design and technological innovation, and financial mechanisms, each contributing distinct yet complementary pathways toward resilience. Table 2 summarises the main domains, mechanisms, and examples identified in the reviewed literature.

Table 2. Comparative Summary of Post-Pandemic Adaptive Housing Strategies

Strategy Domain	Key Mechanisms	Illustrative Examples	Contribution to Resilience
Policy and Governance	Flexible zoning, inclusionary housing, and integrated urban planning	San Francisco inclusionary zoning (Wang & Balachandran, 2021); BRAC incremental housing policies	Enables mixed-income development, balances affordability and access
Community Engagement	Participatory planning, capacity building, grassroots advocacy	KDI School participatory model (Song, 2022); SDI community networks (Huchzermeyer, 2023)	Builds local ownership, strengthens social capital, and ensures contextual relevance
Sustainable Design & Technology	Modular construction, green roofs, passive design, smart monitoring	Kota Kita modular housing (Kurniasari et al., 2019); Bosco Verticale greenery (Liu, 2023)	Enhances energy efficiency, environmental quality, and adaptability
Financial Mechanisms	Microfinance, public–private partnerships, digital inclusion	Grameen Bank microloans (Nawaz et al., 2021); South Africa SHUP PPP (Akinsulire et al., 2024b); India's PMJDY digital banking (Gupta, 2023)	Expands access to funding, supports self-help improvements, and stabilizes livelihoods

4.1 Policy and Governance

Building resilience requires integrated governance frameworks that embed adaptive housing principles into broader urban systems. The pandemic exposed weaknesses in conventional planning that often separate housing policy from social welfare. Adaptive governance links spatial planning, financial assistance, and digital management tools, ensuring responsive decision-making and transparency (Kapucu et al., 2024).

Flexible zoning reforms, for example, permit incremental and mixed-use developments that better reflect the socioeconomic realities of urban poor households. Inclusionary zoning (such as that used in San Francisco) prevents exclusionary redevelopment and secures affordable units within higher-value areas (Wang & Balachandran, 2021). These approaches highlight that adaptive housing depends not only on design innovations but also on the institutional willingness to accommodate diversity and gradual upgrading.

4.2 Community Engagement and Participation

Community participation transforms residents from beneficiaries into co-producers of resilience. Participatory mechanisms (including community mapping, design charrettes, and participatory budgeting) encourage local input and accountability (Gil et al., 2019). The KDI School model in South Korea and SDI's transnational networks demonstrate how engagement builds social capital, promotes equity, and generates housing solutions that align with local customs (Song, 2022; Huchzermeyer, 2023). Crucially, participation enhances social cohesion and trust, which are essential in responding to shocks. Even in low-resource contexts, residents benefit from capacity-building training in construction or management (Bredenoord et al., 2020). These skills reduce dependence on external aid and embed adaptability within community systems.

4.3 Sustainable Design and Technology Innovations

Sustainable design emphasises resource efficiency, climate responsiveness, and long-term adaptability. Energy-efficient materials, passive cooling, and modular construction lower maintenance costs while supporting ecological goals (Bao et al., 2023). Projects such as Kota Kita's modular housing in Indonesia and Bosco Verticale in Milan reveal how integrating greenery and modular systems enhances liveability while addressing environmental degradation (Liu, 2023). Technological innovation further supports adaptive living. Smart housing systems, such as affordable energy-monitoring devices, can reduce energy use and improve safety in dense environments (Patience & Apaokueze, 2024). However, effective deployment requires digital equity, access to devices, connectivity, and literacy to prevent deepening existing inequalities.

4.4 Financial Mechanisms and Support Systems

Financial inclusion underpins adaptive housing implementation. Microfinance programs, like the Grameen Bank's women-led initiatives, enable incremental home upgrades and entrepreneurial resilience (Nawaz et al., 2021). Government subsidies (as seen in Finland's Housing First program) provide direct affordability support to vulnerable groups (Juhila et al., 2022). Public–private partnerships extend impact through shared financing and technical expertise, as illustrated in South Africa's Sustainable Housing for the Urban Poor project (Akinsulire et al., 2024). Meanwhile, digital finance initiatives such as India's PMJDY broaden access to banking, savings, and micro-insurance for low-income households (Gupta, 2023). These instruments illustrate that financial resilience is as critical as spatial or social resilience: without affordable, accessible financing, adaptive housing cannot be sustained.

4.5 Integrative Synthesis: Interdependence of the Four Domains

The four domains function not in isolation but as a synergistic system. Policy frameworks establish enabling conditions; community participation ensures contextual fit; sustainable design translates policy intent into practice; and financial mechanisms provide continuity. For instance, participatory budgeting (a governance tool) strengthens financial accountability, while modular design (a physical strategy) becomes viable only when supported by inclusive financing. This interdependence suggests that post-pandemic resilience relies on cross-sector collaboration rather than fragmented interventions. Adaptive housing thus emerges as both a design philosophy and a governance paradigm, bridging technical, social, and financial systems to foster sustainable urban recovery.

5.0 DISCUSSIONS

The reviewed literature identifies adaptive housing as a critical lever for strengthening resilience among urban poor communities in the aftermath of COVID-19. Beyond technical improvement, adaptive housing redefines how cities conceptualise vulnerability, linking physical design, social empowerment, and institutional reform. The pandemic underscored that resilience must be multidimensional, encompassing physical adequacy, financial flexibility, social inclusion, and ecological sustainability.

5.1. Revisiting the Analytical Framework

The findings align with five interrelated domains, policy, community, design, technology, and finance, identified in the methodological framework. Together, these domains shape a comprehensive resilience ecosystem. Policy reforms create institutional legitimacy; community participation embeds local relevance; sustainable and technological design ensures environmental responsiveness; and financial mechanisms guarantee continuity. Their convergence demonstrates that adaptive capacity is strongest when governance, design, and social capital are mutually reinforcing (Toyoda, 2021). This integrated model advances existing literature by reframing adaptive housing not as an isolated technical fix but as a systems-based governance approach to urban poverty reduction and public-health resilience.

5.2. Interpretation of Global Strategies

Global examples illustrate that adaptive housing succeeds when participatory structures and flexible financing are embedded in national policy. Incremental housing in Latin America and modular schemes in Asia exemplify bottom-up resilience, while social-housing retrofits in Europe demonstrate institutional adaptation. However, these cases also reveal tensions: balancing rapid urban redevelopment with affordability; maintaining cultural integrity while standardising designs; and reconciling sustainability targets with cost constraints. Thus, adaptive housing's greatest contribution lies in its capacity to evolve (technically, socially, and institutionally), rather than in any single architectural or financial model.

5.3. Challenges and Limitations

Despite its promise, adaptive housing faces significant obstacles:

- Policy capture and tokenism: Participatory initiatives may be co-opted by political elites, resulting in symbolic rather than substantive inclusion (Kamalipour & Dovey, 2020).
- Financial and institutional barriers: Limited budgets and fragmented responsibilities impede long-term maintenance and scalability.
- Digital inequality: Smart technologies remain inaccessible to many low-income households, risking a new form of exclusion.
- Socio-cultural resistance: Standardised housing designs often neglect local customs, reducing acceptance and long-term occupancy rates.

Acknowledging these challenges underscores that adaptive housing requires not only design innovation but also political commitment, capacity building, and equitable access to technology and finance.

5.4. Regional Context: Malaysia

In the Malaysian context, adaptive housing principles must be understood in relation to the structural and governance realities of the People's Housing Programme (PPR), as critically examined by the Khazanah Research Institute. Its report, Decent Shelter for the Urban Poor (2023), positions PPR as the country's primary social housing instrument while questioning its capacity to deliver not only basic shelter but also pathways for social mobility. Empirical evidence from Kuala Lumpur and Penang indicates that, although PPR has succeeded in formalising housing provision for former squatters, it often reproduces new forms of deprivation, including overcrowding, inadequate ventilation, poor maintenance, and limited communal spaces. These spatial and managerial deficiencies are compounded by socio-economic vulnerability, with a majority of residents remaining below the poverty line and engaged in precarious employment. Consequently, PPR developments—despite their central urban locations—frequently experience infrastructure deterioration, weak long-term management, and increasing social and health risks.

This diagnosis reframes the limitations of PPR from purely architectural shortcomings to systemic issues of governance, adaptability, and socio-economic integration. In this regard, earlier critiques of rigid design templates and constrained communal provision align with KRI's conclusion that PPR is often treated as a completed physical asset rather than a dynamic housing system requiring continuous management and adaptation. Therefore, enhancing resilience necessitates a shift from static delivery models toward adaptive, process-oriented frameworks.

KRI's proposed framework reinforces this transition through three interrelated strategies: adaptive household management (e.g., dynamic eligibility registries and structured exit pathways), adaptive stock management (e.g., diversification of unit typologies, universal design integration, and lifecycle-based upgrading), and systemic integration with the private housing sector via national-level data infrastructures. These recommendations directly complement design-oriented approaches such as incremental housing, participatory maintenance schemes, and digital community management systems, extending adaptability beyond the unit scale to institutional and policy dimensions.

Accordingly, recent policy dialogues—such as Kuala Lumpur City Hall's inclusive-neighbourhood initiatives—signal an emerging paradigm in which resilience is co-produced with residents rather than delivered through top-down mechanisms. Embedding such adaptive principles within Malaysia's National Affordable Housing Policy would therefore align national housing strategies with both KRI's evidence-based recommendations and broader global shifts toward resilient, inclusive, and transition-oriented urban housing systems.

5.5. Advanced Knowledge and Practice

This synthesis contributes to the growing body of research on urban resilience by emphasising adaptability as a social process in which governance, design, and community engagement intersect. It advances understanding in three ways:

1. Conceptually, by positioning adaptive housing as a multidimensional resilience strategy.
2. Empirically, by consolidating global practices and their relevance to Malaysia's low-income housing context.
3. Practically, by identifying cross-domain linkages that inform policy integration and participatory planning.

In conclusion, adaptive housing offers a transformative framework for post-pandemic recovery, grounded in equity, flexibility, and sustainability. Its success depends on how effectively urban governance systems integrate policy coherence, community empowerment, sustainable technology, and financial inclusion to ensure that resilience is not merely built, but continually renewed.

6.0 CONCLUSION

Based on the synthesis of the reviewed literature, adaptive housing can be operationalised through a structured implementation process linking policy, design, community, and financial mechanisms. The process begins with identifying key housing vulnerabilities, including physical deficiencies, socio-economic constraints, and governance limitations. This is followed by the selection and integration of appropriate adaptive strategies across the four domains

identified in this study. Implementation requires coordinated action among stakeholders, ensuring that design interventions, policy instruments, and financial support systems are aligned with local needs. Finally, continuous monitoring using measurable performance indicators—such as occupancy density, environmental quality, and resident satisfaction—enables evaluation and iterative improvement of housing outcomes. This framework provides a practical bridge between conceptual strategies and real-world applications.

This review underscores that adaptive housing represents more than a technical response to urban poverty; it is a multidimensional strategy for strengthening resilience in the face of ongoing and future crises. As the discussion highlighted, adaptability must be understood across physical, social, economic, and environmental dimensions. Flexible designs and incremental upgrading allow housing to evolve with household and financial changes, while community-driven processes ensure cultural relevance and inclusivity. Grounding adaptive housing within resilience frameworks such as Holling's Resilience Theory, the Social-Ecological Systems Framework, and the Adaptive Capacity Framework further emphasises its role as part of broader socio-ecological systems, capable of absorbing shocks while enabling long-term sustainability.

Global experiences, from Latin America's incremental housing to Switzerland's adaptable social housing and Japan's disaster-resilient models, demonstrate the practical value of adaptive approaches. At the same time, technological innovations such as modular construction, renewable energy systems, and passive cooling strategies expand opportunities for sustainable housing solutions. Yet, as discussed, these advances must be carefully aligned with local contexts, financial realities, and participatory governance to avoid exclusion or inequity.

Ultimately, adaptive housing provides a viable pathway to address housing inadequacies, strengthen community resilience, and advance post-pandemic recovery. Achieving this potential requires integrated planning that combines supportive policy frameworks, technological and design innovation, and meaningful resident participation. For rapidly urbanising regions such as Malaysia, embedding adaptive strategies into housing policies and urban planning is not optional but imperative, ensuring that housing functions not only as shelter but as a foundation for resilience, equity, and dignity in uncertain futures.

The findings highlight the need for policymakers to adopt integrated, resilience-oriented approaches to urban housing. Urban development strategies should prioritise adaptive and flexible housing designs that accommodate evolving household needs and demographic shifts. Policies must also promote community engagement through participatory planning, ensuring that residents' local knowledge and cultural practices shape housing solutions. Financial mechanisms, including subsidies, microfinance, and public-private partnerships, are crucial for supporting incremental upgrades and ensuring long-term affordability for low-income households. Furthermore, technological innovations—such as modular construction, energy-efficient systems, and climate-responsive materials—should be implemented in ways that are accessible, contextually appropriate, and environmentally sustainable. Ultimately, effective coordination across governance levels is crucial for aligning urban planning, social services, and infrastructure development with adaptive housing objectives. By integrating these measures, governments can enhance the resilience, equity, and sustainability of housing for urban poor communities, while preparing cities to respond effectively to future crises.

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