

# Overview of Urban Vulnerability and Resilience Frameworks



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## 1 Introduction to Urbanization and Its Challenges

In the twenty-first century, our planet is undergoing an unprecedented transformation into an urbanized world. Rapid urbanization is a global phenomenon. Its accelerated pace began in the 1950s [1] and has surged, particularly in recent decades. According to UNDESA report on World Urbanization Prospects, since 1950, there has been a nearly six-fold increase in the global urban population, soaring from 751 million to 4.2 billion in 2018. Projections indicate that this trend will continue, with the world's cities and towns expected to accommodate a significant portion of the global population growth by the year 2050. It is estimated that the current figure of approximately 4.4 billion individuals residing in cities will rise to 6.7 billion by 2050. While the growth of populations in large metropolitan areas remains significant, there will also be a substantial increase in the number of regional and mid-sized cities, ranging from 500,000 to 5 million people, by 2030 [2]. Urbanization holds the capacity to significantly influence all facets of sustainable development, intricately interlacing with its three core elements: economic, social, and environmental dimensions. Proper planning and adept management can leverage urbanization to reduce poverty and inequality, augmenting job opportunities, life quality, and accessibility to high-grade education and healthcare. However, unmanaged urbanization risks harmful consequences, including congestion, crime escalation, pollution, amplified inequality, and surging social exclusion [3]. Urban areas take the form of intricate systems that are characterized by complicated socio-economic activities that have the capacity to change the built environment. These changes involve converting rural areas into urban settings, which causes a substantial population shift from rural to urban areas and, as a result, changes the geographic distribution of inhabitants. Additionally, urbanization sparks significant changes in the prevalent professions, lives,

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traditions, and habits, leading to profound demographic and social structural changes in both urban and rural areas [4]. It is anticipated that a substantial portion of the predicted urban expansion from now until 2050 will be concentrated in three key countries: India, China, and Nigeria. Projections indicate that India may witness the addition of approximately 416 million urban residents, China around 255 million, and Nigeria about 189 million by the year 2050. These staggering figures underscore the significant role these countries will play in shaping the global urban landscape in the coming decades [5].

## **2 Critical Aspects of Urban Vulnerability and Need for Resilience Planning**

The increased rate of population in urban areas will add additional pressure and stress on existing infrastructure and overall quality of living in the cities. Further rapid urbanization can lead to additional issues and challenges such as inequality, urban sprawl, unemployment, higher living costs within the urban areas, weaker urban local bodies with poor financial capacity leading to further environmental degradation and stress on urban utilities [6]. These challenges and gaps are making the cities more vulnerable to live.

Since most of the global population now resides in urban areas, addressing calamities and their connection to urbanization has emerged as a crucial and top priority for world leaders. The unprecedented impact of the novel coronavirus disease (COVID-19) has unleashed havoc upon the economic and social fabric of societies worldwide. While larger and denser cities have traditionally been hailed as engines of growth and productivity, attracting migrants from less developed regions, the rapid spread of COVID-19 infections within urban centers has raised profound concerns regarding development, city density, economic prosperity, and vulnerability. The exponential transmission of COVID-19 within densely populated cities has posed significant questions about the sustainability of high-density urban environments. It is evident that higher population densities in cities contribute to increased vulnerabilities during pandemics like COVID-19. This understanding requires a critical reassessment of the conventional view of urban densities as “engines of progress”. It’s now apparent that they can be not only detrimental but also pose serious risks during major biological crises like COVID-19 [7].

Any natural disaster causes major losses of lives and property as well as damage to infrastructure leading to substantial economic costs. The degree of these impacts depends on many factors such as the scale of the event, the level of preparedness of Governing systems, the resilience of residing population, the available support, etc. [8]. The dynamics and patterns of urbanization exert various influences on the risk and vulnerability associated with natural disasters. These effects appear in various forms, such as increasing environmental impacts, amplifying the severity of climate change-related phenomena, and extending the susceptibility and density of the population

[9]. They are further increased by complex interactions of physical, economic, socio-cultural, and institutional circumstances [10]. Notably, in developing countries, urban populations are found to be more vulnerable to natural disasters, primarily due to the unregulated expansion of cities.

According to the report released by the Department of International Development, it is imperative to prioritize raising awareness, enhancing resilience, facilitating preparedness, and implementing effective response strategies to address the escalating vulnerability. Achieving this goal necessitates the active involvement of various stakeholders, including urban local bodies, state and national governments, civil society, and the private sector. Increasing awareness plays a crucial role in fostering understanding of risks and enhancing the potential for behavioral and policy-level changes. Furthermore, community participation and effective communication of data are essential in improving planning and preparedness efforts. To cultivate resilience, it is essential to adopt an integrated planning approach that ensures the resilience of systems to existing and future vulnerabilities [11].

Promoting the resilience of urban and rural communities worldwide has become increasingly paramount as they strive to address challenges such as poverty, climate change, inequality, fragility, social exclusion, violence, and disaster risks [12]. The establishment of sustainable communities, whether in villages, cities, or entire countries and societies, will be instrumental in eradicating poverty and fostering shared prosperity. The concept of “Sustainable Cities and Communities” is recognized and emphasized by the Urban, Disaster Risk Management, Resilience, and Land Global Practice (GPURL) of the World Bank. This concept encompasses four key dimensions:

- First and foremost, sustainable communities prioritize environmental sustainability by promoting cleanliness and efficiency.
- Secondly, these communities exhibit resilience in the face of social, economic, and natural shocks, effectively preparing for the escalating intensity and frequency of climate change-induced disasters.
- Thirdly, inclusivity is a core focus of sustainable communities, ensuring active participation and engagement of all segments of society, including marginalized and vulnerable groups, in their markets, services, and overall development.
- Lastly, sustainable communities strive for competitiveness, maintaining productivity levels and generating employment opportunities for their residents.

As per World Bank, it's important to create cities and communities that include everyone, are resilient from challenges, are economically strong, and are environmentally friendly. This is a key step to reach the Sustainable Development Goals by 2030. This way, we can eliminate serious poverty and promote wealth that everyone can enjoy at the local, regional, and national levels [12].

### 3 Urban Resilience—Conceptual Framework

The concept of urban resilience encompasses a diverse range of practices aimed at adaptation and risk reduction. The increasing interest in building resilient cities has also sparked a series of important questions. As discussed by Chelleri Lorenzo in 2014 [13], the notion of resilience, much like the holistic principles of sustainability, has faced criticisms due to clashes with prevailing business-as-usual practices, a lack of comprehensive system-wide indicators, and the scalability challenges of proposed innovations.

From a representative perspective, resilience generally pertains to the ability to “deal with change” by adapting to shocks and stresses [14]. The concept of resilience originated in the scientific realm during the mid-nineteenth century, as described by Alexander in 2013 [15], referring to the capacity of a material to withstand forces without incurring permanent deformation. Over time, it found application in psychology during the 1950s (relating to the ability to recover after stress), ecology in the 1970s (pertaining to the amount of disturbance a system can absorb before undergoing change), and social studies in the 1990s (highlighting the necessity and capacity to manage change through adaptation rather than passive reaction).

In the context of cities, resilience pertains to the capacity of urban areas to function effectively, ensuring that all residents, particularly those who are poor and vulnerable, not only survive but also thrive in the face of various stresses and shocks [16]. Integrated urban planning processes play a pivotal role in shaping the well-being of city inhabitants and directly influencing urban growth. Specifically, the adoption of strategic resilient planning serves as a crucial tool for sustainable development and urban resilience. This approach encompasses the following key aspects:

- Optimizing land use and ensuring the integrity of transportation systems: Integrated urban planning considers the efficient use of land and promotes a well-connected transportation network. This approach enhances the functionality and resilience of cities.
- Reducing population vulnerability to climate change: By facilitating improved access to essential resources, services, and amenities, integrated urban planning helps mitigate the vulnerability of urban populations to the impacts of climate change. This includes addressing challenges related to extreme weather events, water scarcity, and other climate-related risks.
- Fostering sensitivity toward the environment and incorporating social and economic goals: Integrated urban planning recognizes the importance of harmonizing environmental considerations with social and economic objectives. It seeks to create sustainable and resilient urban environments that balance the needs of the community, the economy, and the natural surroundings.



By integrating these principles into urban planning decisions, cities can effectively promote resilience, low carbon development, and the overall well-being of their inhabitants [17].

According to the TERI Report on Climate Resilient and Sustainable Urban Development, urban systems exhibit dynamic characteristics, experiencing periods of balance or normalcy as well as periods of stress caused by various factors such as climate, socio-economic conditions, and demographics. Sustainability is defined as the capacity of a system to sustain its optimal structure and function over time. On the other hand, resilience goes beyond maintaining optimal conditions; it encompasses the ability to adapt to new changes and withstand periods of stress, transitioning to new states while preserving critical functions that were previously provided. In this sense, resilience and sustainability share common ground, as resilience overlaps with the principles of sustainability [18] Refer to Table 1.

According to Folke [19], to address the relationship between change, persistence, and sustainability a socio-ecological system vision shall be adopted by further conceptualizing resilience and transforming across scales. Table 2 provides a clear depiction of the convergence of various resilience approaches, including recovery, adaptation, and transformation, in terms of their impacts and services over a specific time. The visual representation of a ball in a basin serves as a metaphorical explanation for each approach, illustrating the concepts of returning to equilibrium (bounce back), expanding the system’s tolerance range, and undergoing regime change [20].

The interconnection between ecosystems and urban areas represents a bidirectional relationship characterized by intricate dynamics. Ecosystems play a pivotal


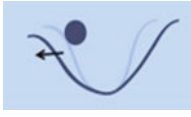
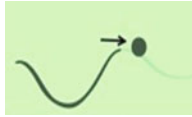
**Table 1** Conceptual understanding of sustainability and resilience

	Sustainability	Resilience
		
Definition	A system’s ability to maintain its optimal form and function throughout time	Ability to accommodate new alterations and stress situations while preserving the set of important services previously given
	Integrated urban planning	Adaptation
	Disaster risk reduction	Mitigation
	Urban services	
	Green buildings	
	Sustainable transport	
State of urban system = Services + Planning + Governance		
Stress due to impact of Climate, Socio-economic, Demographic		

*Source* TERI report on Climate Resilient and Sustainable Urban Development [18]

*Analysis* Climate-resilient and sustainable urban development entails the strategic planning and design of cities with the dual objective of reducing their negative environmental impact and strengthening their ability to cope with and endure the consequences of climate change. This approach to urban development strives to create cities that are environmentally sustainable and equipped to withstand the challenges posed by climate change

**Table 2** Three (partially overlapping) stages of resilience related to short-, medium- and

Action	Recovery	Adaptation	Transformation
			
Explanation	Recovery relates to either ensuring the supply of essential infrastructure services or disaster recovery	A reactive modification technique that reduces a system’s vulnerability to disturbances and hazards, including climate change	Transformation refers to physical or qualitative changes in form, structure, function, or meaning
Social-ecological system	Resilience/robustness	Resilience	Resilience
Socio-technical system	Resilience	Robustness	Transition

Source Adapted [20] “Findings and final remarks”, in L Chelleri and M Olazabal (editors) 0.2012 *Analysis* In general, the table indicates that different sorts of systems necessitate different types of behaviors to achieve resilience. Resilience and robustness are crucial for social-ecological system recovery and adaptation, while transformation is important for total resilience building. Resilience is crucial for action in socio-technical systems, but robustness and transition are important for recovery and adaptation. Finally, creating resilience necessitates a comprehensive and integrated approach that considers the distinct characteristics of various systems as well as the many sorts of stresses that they are expected to undergo

role in bestowing numerous physical and environmental advantages upon cities and their inhabitants, thereby bolstering the resilience of urban environments. However, the rapid urbanization and haphazard development witnessed in many cities have resulted in a worrisome decline of ecosystems. This detrimental trend disrupts the delicate equilibrium and resilience of not only the affected cities but also of other interconnected urban centers. The prevailing “extractive” nature of urbanization tends to undervalue the preservation of ecosystems, thereby impacting the livelihoods of those reliant on them and compromising the overall well-being of the city itself [21]. Broadly most of the literature emphasizes that City resilience generally refers to a city’s ability to absorb shocks, adapt to change, and respond to any future shocks. However, urban resilience also echoes similar terms such as governance, sustainability, and economic development [22]. The issues discussed above indicate the necessity of understanding resilience and its application making future cities a better place to live. A detailed literature review is conducted to further explore various dimensions of resilient cities.

## 4 Literature Study and Overview of Urban Resilience Frameworks

In the scholarly article titled “Designing, Planning, and Managing Resilient Cities: A Conceptual Framework” authored by Desouza [23], two fundamental inquiries regarding resilient cities are raised:

1. What are the key aspects to which cities need to exhibit resilience?
2. How can cities, being complex systems, cultivate resilience?

The paper thoroughly explores the concept of resilience within urban contexts and presents a conceptual framework. This framework encompasses a comprehensive examination and analysis, with a focus on essential dimensions such as planning, designing, and managing for resilience. The aim is to provide a deeper understanding of resilience and its practical implementation in urban settings (Refer to Table 3).

Planning is the initial phase in the process, where the identification of new components to be integrated within a region takes place. These components may include new structures, systems, infrastructure development, or the integration of newcomers into cities. This planning phase presents an opportunity to enhance resilience by adopting flexible strategies that can adapt to evolving environmental conditions and employing planning processes that are responsive to emerging knowledge and events. Current efforts are focused on increasing public engagement in resilience planning, recognizing that planning cannot be solely for citizens but must involve citizens, enabling information and political feedback to flow in multiple directions. A crucial aspect of effective preparation lies in establishing and communicating common goals consistently. The success of “Project Production as Preparation” is contingent on the level of consensus, flexibility, and transparency among participants, as well as the coherence and clarity of inter-community communication during these processes (Fig. 1).

The subsequent phase is design. Once the plans are formulated, the design processes commence, recognizing that there may be iterations between planning and design. The reason for delineating them here is to emphasize that while flexibility is emphasized in the planning phase, the goal at the design stage is to create adaptable structures. Planning processes can encounter obstacles such as stakeholder inflexibility or financial constraints that limit available responses. Whether creating tangible objects like buildings or conceptual constructs like policies, a focus on adaptability ensures the production of items that can be repurposed, expanded, or modified in times of stress. Adaptable objects are more likely to absorb the impact of stressors, recover from their effects, and readily reconfigure themselves to continue functioning and generating value.

The third component is management. Management encompasses a series of decisions and actions undertaken during normal and crisis situations that influence the current and future state of various community components. For a city to be competitive, agile management is essential, requiring the city to exhibit dynamism and consistency in capitalizing on opportunities and addressing challenges. Agility entails the system’s capacity to identify climate changes, assess their impacts on the city

**Table 3** Components of resilience assessment: system exposure and response capability

Types of stress	Ways to boost resilience	Examples
Resource stress	Exposure to and robustness against chronic stress from resources such as energy, water, and food	Implementation of resource-efficient technologies and sustainable resource management practices can enhance resilience
Societal stress	Social factors exacerbating the vulnerability of the system to chronic and acute stress	Ensuring equitable access to essential resources and diversifying risk distribution strategies can enhance resilience
Acute events stress	Susceptibility to and resilience against sudden shocks from catastrophes or other acute incidents	Implementing adaptation strategies and employing risk mitigation measures can enhance resilience
Learning foresight & self-organization	Capacity of the system to anticipate stresses, acquire knowledge from them, adjust and evolve in response, and exhibit self-organization when confronted with new challenges	
Interdependency	Interconnections and vital interdependencies at the system level among resources and other stress factors	Energy-intensive water sources
Structural resilience	Redundancy Modularity Requisite diversity	
Integrative resilience	Multiscale interactions thresholds social capital	
Transformative resilience	Distributed governance foresight capacity innovation & experimentation	

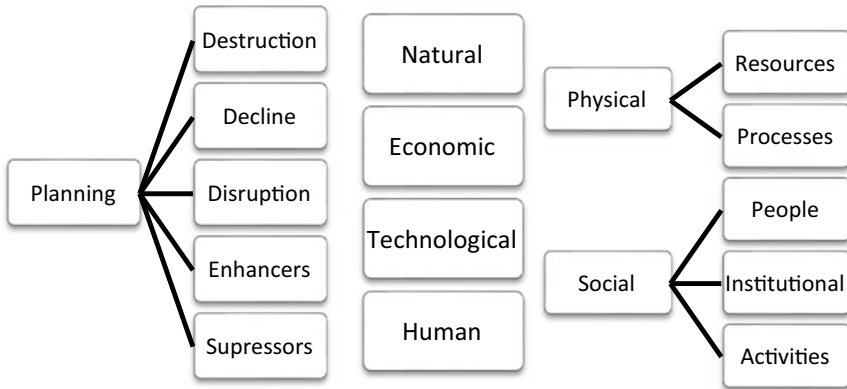
Source Albani et al. [26]. A pragmatic frame to explore resilience, 2014

*Analysis* Overall, the table emphasizes the significance of using a complete and integrated approach to increasing system resilience, considering many types of stresses, and employing multiple ways to boost resilience against each stress

and its goals, and proactively implement constructive measures to counter imminent stressors (when altering the trajectory of the stressor is not feasible). This includes considering cultural and process dynamics within the city and its physical features. Resilience, akin to sustainability, is an abstract concept, making it challenging to determine specific approaches for resilience planning [23].

Resilience planning necessitates the identification, refinement, protection, and management of resource and information flows within urban spatial and cognitive networks. To accommodate these complexities, a shift from focusing solely on planning urban products toward a more process-oriented approach is advocated, merging design with evolutionary, selective, generative, and adaptive functionality. Given the





**Fig. 1** “Designing, planning, and managing resilient cities: A conceptual framework” [23]

dynamic nature of relationships and interactions, particularly within the social realm, it becomes impossible to predict the optimal future when designing and constructing current built infrastructure, social institutions, or systems. The challenges of planning a complex system like a city extend beyond spatial considerations to encompass temporal dynamics as well. The notion of unknowability arises as a significant challenge, particularly concerning the current state of a system, as cities are open and therefore not bound by finite boundaries. Moreover, due to the intricate interplay of variables and interactions, planners face uncertainties in determining the effects of interventions. Finally, for resilience planning, it is crucial to recognize that there is no definitive and knowable future state that can be deemed optimal [24].

As per the research report “Advancing urban resilience in the face of environmental change” by S. Rajaratnam School of International Studies authored by [25], conceptualizing resilience is an essential but far from straightforward activity, and various sectors and actors have different assumptions about the concept, its characteristics and its requirements. However, it is critical that urban resilience contributes to development goals and enhances human protection by helping individuals, populations, cities, and states to adapt to environmental changes in urban areas. Identifying people and societies as beneficiaries of resilience building and human and community security as primary goals and rationales will help shape how resilience is described and sought. In other words, resilience could not be decoupled from development goals, but instead tried to strengthen them in complementary ways. Similarly, it is important to challenge the assumptions about resilience—and what it means to various stakeholders.

Urbanization brings with it shifts in natural environments, capital flows, populations, trends, individuals, livelihoods, and vital infrastructure. Such changes mean that resilience goals and approaches will inevitably be versatile, multidimensional, and dynamic, and guided by disciplines in the hard and social sciences. Given the complex nature of the situation, all stakeholders—from academics to policymakers to industry—must continue to foster resilience dialogue, both to understand future

developments and to pool their experience in urban resilience building to create a stronger knowledge base for policymakers in the area. Engaging with the above segments in the resilience planning process is crucial to mitigating these situations, which can only be accomplished by far-sighted governance and resource mobilization. Cities often function at scales beyond their ecological and political capability, making it especially difficult to promote resilience. Handling the day-to-day management and governance needs of cities is becoming more complicated, often leaving no spare capacity to tackle longer-term resilience-building efforts. Responding to these challenges requires good leadership and participatory governance. Although these structures themselves pose difficulties by bringing many conflicting interests to the fore, they remain important for the creation of resilience mechanisms that will be embraced and accepted by relevant stakeholders. Spatial planning is a key field in which good governance is required to balance, on the one hand, the needs, and interests of a multitude of stakeholders with, on the other, the need to develop urban resilience to current and imminent environmental stresses. To be successful, the proposals must consider regional awareness and interests, the geographical limits and economic factors of the city and the evolving state of the environmental systems on which the city depends. In the first place, lack of good urban planning is the key cause of many environmental hazards and daily stressors in cities around the world. When designing responses to stressors and disasters, emphasis must be put on broad-based strategies that focus not only on costly engineering and infrastructure-oriented solutions, but also on the social contexts and root causes of stressors themselves.

To develop knowledgeable, scalable, and responsive governance structures, a carefully balanced combination of top-down and bottom-up processes, including checks and balances, will need to be developed. We need to expand through urban areas and beyond to the peri-urban and rural areas in which Asia's growing cities rely. This will help to promote medium- and long-term resilience while addressing the immediate and systemic needs of the most vulnerable regions [25].

In an increasingly uncertain and unstable world, business leaders are drawn to the idea of improving the stability of their economic structures. However, implementing this concept, particularly in a way that captures the complexity emphasized by resilience and complexity studies, proves challenging. Resilience, as an emergent property of complex systems in the face of uncertainty, is difficult to measure and forecast accurately. Adaptive capacity is crucial for resilience as it allows for quick adaptation to new opportunities, effective management of interconnected systems, and improved response to changing circumstances. While resilience is a very appealing concept in theory, converting it into practical applications sets a significant challenge. Simply resorting to traditional risk management approaches is not sufficient, as they may not fully incorporate the dynamic knowledge that a resilience assessment provides. Realizing this need, the Resilience Action Initiative (RAI) has developed a simplified framework that facilitates the practical implementation of resilience. This comprehensive framework, comprising five dimensions, has been successfully tested in various settings, including industrial clusters, cities, and large regions, offering valuable insights into the complex challenges of fostering resilience.

The framework considers the external stresses on the system, its interrelationships, and the system's capacity for learning and predicting. It helps in understanding the interaction of multiple actions and has proven valuable in exploring resilience challenges. Through a series of workshops, the framework's system elements have been tested and refined, resulting in a powerful yet straightforward approach to creating a resilient system. The framework includes the following "system elements" (Refer to Table 3):

1. **Exposure to stresses:** The horizontal axis focuses on the system's exposure to stresses, which are categorized as resource, societal, and acute events stresses.
2. **Impact amplification:** One element represented on the vertical axis examines how the tight coupling of the system's exposure to different stresses can increase the impact of individual stresses.
3. **Resilience enhancement:** The other element on the vertical axis looks at how the system can increase its resilience through foresight, learning, and overall adaptive capacity.

This framework enables a simple yet powerful way to analyze and develop resilient systems, providing a comprehensive understanding of the system's resilience issues. By considering external stresses, their interrelationships, and the system's capacity for learning and adaptation, the framework offers valuable insights into building resilience in various contexts [26].

The table below appears to enumerate several elements that contribute to system resilience, with specific examples relating to various types of pressures.

Recent literature stresses the need for a philosophy of resilience that helps policymakers to cope with equity problems. Resilience cannot be presumed to be the correct policy objective in the same manner as sustainable development [27] with a better quest for sustainable development being formulated, particularly as regards governance problems and possible solutions. The role of inclusive resilience is to explain the need for these questions at the moment when they are called upon to be realistic so that resilient structures can be built which lead to changes and are socially just and then important for global challenges in the field of sustainability [28].

The four aspects—subjectivity, integration, size, and change—have near interrelationships as a foundational perspective from the study. Subjectivities demonstrate how the way people perceive themselves, how environments, personalities, and social experiences are formed. The process by which subjectivities are discussed will be substantive inclusion. Equitable resilience must also cross scales to make radical improvements to the structure feasible, particularly in circumstances where adjustment by the populations involved is considered desirable. Every challenge is important, but the awareness of all four and their relationships is necessary to foster equality in the practice of resilience. To achieve equal resilience, it is important to define social structures covering these four aspects. Systematic problems need structural remedies, and change. In addition, achieving change involves strong, equitable government, spanning diverse forms of societies and taking various levels of authority into account. The observations analyzed by the authors confirm the concept

of egalitarian resilience as considering control, subjection, or resistance issues; recognize and unite socially created vulnerabilities facing populations and individuals at all levels to prevent ineffective measures, whether based on disastrous reaction or growth.

Equitable resilience in action requires all four factors to be addressed by the approaches used to prove that individuals and institutions endorse or motivate others that are intended to benefit from ideologies, practices, or modes of legislation. Resilience and recognition of the potential to support and strengthen existing power-and-resource relationships [29]. The study indicates that a systemic study of subjectivities, the impact on the equity of inclusion, scale and the capacity for change is needed in coping with essential resilience. When resilience in policy and action becomes more widespread, exposure becomes more relevant to the needs for fair resilience. By extending resilience beyond the emphasis on utilities, defense and facilities, resilience would risk increasing instability and introducing new threats for timescale and spatial-distributed communities. Clearly placed, this means creating a durability that is beyond modification and addresses structural change. To foster fair resilience, government and professionals engaged with social, economic, and political transition policies will have to participate [30]. While this is a new and significant challenge, it's necessary and urgent. Equitable sustainability must be built into a program strategy, and it goes beyond merely taking parity into account while operating and distributing growth results, which brings them into the complexities of social systems even more thoroughly. In these middle-level social systems precisely defined concepts of scientifically measurable empirical resilience are flatter and priority needs to be directed to achieving equal resilience [31].

As global interest in resilience continues to grow, particularly in relation to climate change adaptation and other activities, it is imperative that concrete actions are taken to translate our knowledge of resilience into tangible improvements. The language used in disaster relief and humanitarian intervention must incorporate resilience, and infrastructure funding plans may also need to consider resilience requirements. Professionals in the field have a crucial role in ensuring that “resilience” goes beyond being a mere buzzword in mission statements and action plans and becomes a systematic perspective on how societies adapt to adversity.

Enhancing the capacity of populations to cope with severe weather conditions involves not only easily observable changes but also psychological and socio-ecological considerations. It is essential to engage local stakeholders from the outset through inclusive meetings and obtaining their buy-in, to ensure their full participation in the strategy, implementation, and evaluation processes. Practitioners can learn objective and creative approaches to achieve this through the insights provided by group resilience perspectives and accessible tools offered by organizations like the Resilience Alliance.

While these efforts may require additional time, energy, and complexity in development aid contracts, they are crucial for ensuring that initiatives aimed at promoting stability truly benefit the people they are intended to support and have lasting impacts

beyond their duration [32]. Several key concepts are integral to the process of transforming cities into sustainable entities. Firstly, it is essential to emphasize the integration of knowledge in decision-making to effectively address the new social challenges of the twenty-first century. This integration represents a true reinvention of science, and the most effective way to achieve it is through practical application, learning, and testing. Secondly, public policy and successful decision-making play a crucial role in the sustainability agenda by mitigating the accumulation of systemic risks and avoiding potential “perfect storms”. Risk and disaster managers have long been at the forefront of local sustainable development efforts, making it rational and realistic to frame city sustainability within the context of risk management. Thirdly, the comprehensive urbanization process holds the potential to determine the success or failure of the global pursuit of sustainable development. However, the current lack of a global critical mass of eco-city innovations poses a challenge. To address this, there is a pressing need to accelerate research and facilitate knowledge sharing through the study of existing case studies. The urgency of the sustainability transition necessitates finding ways to expedite these processes and learn from ongoing initiatives [33]. The paper published by Liu and others [34] mainly provides an operational framework to advance the quantitative evaluation of urban resilience and to further inform the urban social-ecological system’s planning practice. This study investigates the relationship between land-based indicators and the capacity for resilience in urban environments, focusing on the spatial characteristics of urban resilience and its growth. It explores the interconnection between the structure, configuration, and dynamics of the urban landscape and the resilience of cities. The study establishes a close correlation between these factors, providing valuable insights into the understanding and assessment of urban resilience [35]. The urban landscape can be viewed as a complex system that encompasses the interactions between humans and the natural environment, providing valuable insights into the nature of urban systems. A well-planned distribution of ecosystems within this landscape plays a crucial role in mitigating risks and facilitating the swift recovery of the urban economy. Moreover, optimizing the sharing of the social-ecological environment, which includes land and encompasses social factors such as social institutions and social capital, along with the ecological landscape represented by natural or semi-artificial land, allows for the optimization of both social and ecological environments [36]. Furthermore, the adoption of urban landscapes facilitates the assessment, comprehension, and simulation of urban resilience by leveraging landscape ecology tools and methodologies. These tools, such as landscape metrics, enable the intuitive articulation of landscape characteristics. As a result, urban environments serve as effective platforms for shaping resilience capacity through human interventions. In essence, urban environments, which embody and are shaped by social-ecological interactions, offer a means of quantifying and operationalizing urban resilience that is both accessible and efficient [34]. As observed by Olazabal and Chelleri [20]. While cities have often been associated with negative environmental and social impacts such as pollution, segregation, and poverty, it is important to acknowledge that they also possess the potential and opportunities to become catalysts for positive change and transformation. Numerous researchers have emphasized that cities can serve as hubs for innovation,

offering prospects for finding novel solutions and driving resilience. By harnessing their inherent capabilities, cities can pave the way for sustainable development and contribute to a more resilient future [20] found in a recent urban resilience workshop, that it is important to transform them gradually for the purpose of enhancing cities’ resilience in lifestyles, services, infrastructure, workplace accessibility and institutional and business models. The transformation is spatial and social so that urban planners, politicians, and citizens must cooperate and engage [37]; in his paper Jabreen has established a new conceptual framework for resilient cities (Resilient City Planning Framework) that discusses the most important question of what cities and their urban populations can do to ensure that they become more resilient in the future (Refer to Table 4).

The Resilient City Planning Framework (RCPF) is characterized as a theoretical network encompassing interconnected concepts that offer a comprehensive comprehension of urban resilience. Within the Resilient City Planning System, there exist four guiding principles. Each principle comprises specific components that determine and evaluate their contribution to the overall system, as outlined in this paper. The cumulative contribution of observable components shapes the Urban Resilience system. While several measurement methods may already exist for certain components, future research should prioritize a comprehensive approach to measure all components. The resilient city framework, serving as a complex and non-deterministic phenomenon, represents a framework for urban resilience and community resilience, acknowledging the existence of structural complexities and uncertainties. The planning process involves a wide range of stakeholders due to its impact on multiple economic, social, spatial, and physical factors. It is important to note that the proposed RCPF is not a dynamic and versatile structure but can be modified in accordance with the fundamental concepts of the framework. According

**Table 4** Resilient city planning framework

Resilience city transaction				
Component	Vulnerability analysis matrix	Uncertainty oriented planning	Urban governance	Prevention
1	Uncertainty	Adaptation	Equity	Mitigation
2	Informality	Planning	Integrative	Restructuring
3	Demography	Sustainable form	Economics	Alternative energy
4	Spatiality			

Source Jabreen [37]

*Analysis* Overall, the table demonstrates that developing urban resilience necessitates a multidimensional and integrated approach that includes risk assessments, uncertainty-oriented design, effective urban governance, and proactive prevention measures. Each component is related with various types of transactions that are required for resilience building. Cities may become more resilient and better suited to handle future shocks and pressures by employing an integrated approach that addresses each of these components and its accompanying transactions

## 5 Conclusions and Observations

From the above review of literature, various dimensions of Urban—Sustainability, Vulnerability, and Resilience were studied and can be summarized as follows:

- The world’s urban population has experienced a significant increase, growing six-fold since 1950. Urbanization is intricately linked to sustainable development in economic, societal, and environmental dimensions. Carefully planned and managed urbanization can enhance employment opportunities and quality of life, reducing poverty and inequality. However, inadequate planning can result in congestion, higher crime rates, pollution, and inequality.
- The growing urban population poses additional pressure and stress on existing infrastructure and overall quality of life in cities. The emergence of the COVID-19 pandemic has caused unforeseen disruptions worldwide, highlighting the significance of calamities and their relationship with urbanization. With most of the global population residing in cities, addressing vulnerabilities during pandemics like COVID-19 becomes crucial. Reevaluating the sustainability aspect of urban densities becomes imperative, as high densities can become counterproductive and even life-threatening during biological disasters.
- Natural disasters have the potential to cause significant loss of lives, property, and infrastructure damage. Developing nations with unplanned urban growth are particularly vulnerable to these disasters. Various stakeholders, including urban local bodies, state and national governments, civil society, and the private sector, play crucial roles in mitigating these risks. Raising awareness, enhancing resilience, facilitating preparedness, and effective response planning are essential in addressing the current challenges and ensuring a more resilient future.
- The concept of “Sustainable Cities and Communities” includes key dimensions such as environmental sustainability, cleanliness, and efficiency, as highlighted by the World Bank’s Urban, Disaster Risk Management, Resilience and Land Global Practice (GPURL).
- Urban and rural communities worldwide are increasingly recognizing the need to address challenges and enhance resilience to poverty, inequality, social exclusion, violence, fragility, climate change, and disaster risks.
- City resilience refers to the capacity of cities, including the well-being of the poor and vulnerable, to function and thrive despite encountering various stresses and shocks. The relationship between ecosystems and cities is interconnected and influences the resilience of cities. Unplanned urban development poses threats to ecosystems, impacting the overall balance and resilience of cities [38].
- A conceptual framework proposed by [23] emphasizes planning, designing, and managing for resilience, providing a comprehensive discussion and analysis of important dimensions related to urban resilience.
- Resilience planning involves identifying, refining, protecting, and managing internal and external resource and information flows. Marshall [24] suggests a shift from planning the products of urbanism to focusing on processes, merging design

with evolutionary, selective, generative, and adaptive functionality. Unknowability, particularly the current state of a city as an open and evolving entity, poses the greatest challenge.

- Urbanization brings about shifts in natural environments, capital flows, populations, livelihoods, and infrastructure. Cities often face governance and management complexities beyond their ecological and political capacity, making resilience goals and approaches versatile, multidimensional, and dynamic.
- Business leaders find improving the stability of economic structures appealing, as resilience emerges in complex systems in the face of uncertain events. Adaptive capacity, enabling rapid leveraging of opportunities, managing interrelated systems, and responding to signals of change, is a key aspect of resilience.
- Resilience should not be automatically assumed as the correct policy objective, like sustainable development. A better understanding of governance problems and solutions is crucial for sustainable development and the pursuit of socially just changes. Subjectivity, integration, size, and change are interconnected aspects that form the foundational perspective of the study.
- The Resilient City Framework, a framework for urban and community resilience, involves multiple stakeholders and encompasses economic, social, spatial, and physical factors. It is important to note that the proposed Resilient City Planning System is not a static structure but can be modified based on the fundamental concepts of the framework.
- Building inclusive, resilient, competitive, and sustainable cities and communities is vital for achieving the Sustainable Development Goals by 2030, eliminating extreme poverty, and promoting shared prosperity at the local, regional, and national levels.

In conclusion, research on urban resilience framework highlights the critical importance of sustainable and resilient cities and communities. The rapid urbanization experienced since 1950 brings both opportunities and challenges. Properly planned and managed urbanization can enhance employment opportunities and quality of life, reducing poverty and inequality. However, inadequate planning can lead to congestion, crime, pollution, and inequality. The increase in urban population adds pressure on existing infrastructure, particularly evident in the wake of unforeseen events like the COVID-19 pandemic. Natural disasters pose significant risks, particularly in developing nations with unplanned urban growth. Awareness, resilience building, preparedness, and effective responses are vital for managing these risks. The interplay between ecosystems and cities influences urban resilience, with ecosystem preservation often undervalued.



## 6 Recommendations

Various conceptual frameworks provide insights into planning, designing, and managing for resilience, emphasizing adaptive capacity and the need for process-oriented approaches. Achieving inclusive resilience requires addressing governance issues and ensuring socially just transformations. The Resilient City Framework highlights the interconnectedness of governance, physical, economic, and social systems in defining resilient cities. Ultimately, building inclusive, competitive, and sustainable cities and communities is essential for achieving the Sustainable Development Goals, eliminating poverty, and fostering shared prosperity at all levels. Through comprehensive research and collaborative efforts, we can develop strategies and policies to create resilient urban environments that can thrive in the face of uncertainties and challenges, ensuring a sustainable and prosperous future for generations to come. Following are the suggestions and recommendations for developing more robust urban resilience frameworks for our future cities:

- **Holistic Assessment:** Develop assessment frameworks that evaluate not only physical infrastructure but also social, economic, and institutional dimensions of resilience. Consider both acute shocks and chronic stresses.
- **Localized Strategies:** Tailor resilience strategies to the unique characteristics of each city, accounting for its geographical, cultural, and socio-economic context. Avoid a one-size-fits-all approach.
- **Education and Awareness:** Invest in public education and awareness campaigns to foster a culture of resilience. Informed citizens are more likely to engage in preparedness and mitigation efforts.
- **Inclusive Planning:** Ensure marginalized and vulnerable populations are included in resilience planning. Addressing inequality is integral to enhancing overall urban resilience.
- **Long-Term Vision:** Resilience frameworks should extend beyond short-term goals and consider long-term sustainability. Incorporate scenarios for future challenges like climate change impacts.
- **Collaborative Research:** Encourage interdisciplinary research that combines expertise from urban planning, engineering, social sciences, ecology, and other relevant fields to develop comprehensive solutions.
- **Monitoring and Evaluation:** Establish robust monitoring and evaluation mechanisms to track the progress and effectiveness of resilience strategies. Flexibility in adapting strategies based on real-time data is crucial.
- **Capacity Building:** Invest in training programs to enhance the skills and knowledge of urban planners, policymakers, and stakeholders involved in resilience initiatives.

## References

1. Gilbert A (1993) Third world cities: the changing national settlement system. *Urban Stud* 30(4/5):721–740. [www.jstor.org/stable/43195971](http://www.jstor.org/stable/43195971)
2. United Nations, Department of Economic and Social Affairs, Population Division (UNDESA) (2019) World Urbanization Prospects: the 2018 Revision (ST/ESA/SER.A/420). UNDESA, UN
3. UNDESA (2020) Urbanization: expanding opportunities, but deeper divides. <https://www.un.org/dev/UNDESA>; Urbanization: expanding opportunities, but deeper divides. <https://www.un.org/development/desa/en/news/social/urbanization-expanding-opportunities-but-deeper-divides.html>. Accessed 15 May 2020
4. Montgomery RM et al (2004) *Cities transformed: demographic change and its implications in the developing world*. Earthscan, London
5. Ghosh I (2019) 70 years of urban growth in 1 infographic. *weforum*. <https://www.weforum.org/agenda/2019/09/mapped-the-dramatic-global-rise-of-urbanization-1950-2020>
6. Zhang QX (2016) The trends, promises and challenges of urbanisation in the world. *Habitat Int* 54(3):241–252
7. Desai D (2020) Urban densities and the covid-19 pandemic: upending the sustainability myth of global megacities. Observer Research Foundation, ORF Occasional Paper No. 244
8. Bankoff GFHD (2004) *Mapping vulnerability: disasters, development, and people*. Routledge
9. Lankao PR, Qin H (2011) Conceptualizing urban vulnerability to global climate and environmental change. *Curr Opin Environ Sustain* 3(3):142–149
10. Gencer E (2013) The interplay between urban development, vulnerability, and risk management. *Springer Briefs in Environment, Security, Development and Peace*
11. Department for International Development (DFID) (2016) Revised protocol-Urbanisation and natural disaster. <https://eppi.ioe.ac.uk/CMS/Portals/0/PDF%20reviews%20and%20summaries/Revised%20protocol-Urbanisation%20and%20Natural%20Disaster.pdf>
12. World Bank (2020) Sustainable cities and communities. <https://www.worldbank.org/en/topic/sustainable-communities>
13. Chelleri L (2014) The urban resilience fallacy: gaps between theory and practice. <https://uecvviewpoints.wordpress.com/2016/10/11/the-urban-resilience-fallacy-gaps-between-theory-and-practice/>
14. Walker B, Salt D (2006) *Resilience thinking: sustaining ecosystems and people in a changing world*. Island Press
15. Alexander D (2013) Resilience and disaster risk reduction: an etymological journey. *Nat Hazards Syst Sci* 13:2007–2716
16. Rockefeller Foundation (2014) Akshay Urja climate proofing Indian cities: a policy perspective. <http://www.indiaenvironmentportal.org.in>
17. Nagargoje S, C. S (2019) Resilient cities: strategies & concepts from global best practices. In: EVF'19, 6th international conference on energy & city of the future—EVF'19, MIT Pune
18. Report TERI (2020) Climate resilient and sustainable Urban Development. <http://www.indiaenvironmentportal.org.in/files/sustainable-urban-development-background-paper.pdf>
19. Folke C (2006) Resilience: the emergence of a perspective for social–ecological systems analyses. *Glob Environ Chang* 16(3):253–267
20. Chelleri L, Olazabal M (2012) Multidisciplinary perspectives on Urban Resilience: a workshop report, Basque Centre for Climate Change (BC3), 78 pages, 67–75
21. Gupta AK, Singh S, Wajih SA, Mani N, Singh AK (2017) Urban resilience and sustainability through Peri-Urban ecosystems: integrating climate change adaptation and disaster risk reduction. Gorakhpur Environmental Action Group, Gorakhpur, UP
22. Tompkins E, Hurlston-McKenzie LA (2012) Public-private partnerships in the provision of environmental governance. In: Boyd E, Folke C (eds) *Features of adaptive governance: networks, hybrids and multilevel transformations in coupled SES*. Cambridge, p 2

23. Turner KFT, Desouza DM (2013) Designing, planning, and managing resilient cities: a conceptual framework. *Cities* 35:89–99
24. Marshall S (2012) Planning, design and the complexity of cities. In: Portugali J et al (eds) *Complexity theories of cities have come of age*. Springer, Berlin, Heidelberg, pp 191–205
25. Ewing JAG, Ewing AG (2013) Sustaining resilience. S. Rajaratnam School of International Studies. [www.jstor.org/stable/resrep17172](http://www.jstor.org/stable/resrep17172)
26. Albani MR et al (2014) A pragmatic frame to explore resilience. In: Kupers R (ed) *Turbulence: a corporate perspective for resilience*. Amsterdam University Press, pp 37–47
27. Elmqvist T (2017) Development: sustainability and resilience differ. *Nature* 546(7658):352
28. Chelleri L, Waters JJ, Olazabal M, Minucci G (2015) Resilience trade-offs: addressing multiple scales and temporal aspects of urban resilience. *Environ Urbaniz* 27:181–198
29. Ensor JE, Park SE, Attwood SJ, Kaminski AM, Johnson JE (2016) Can community-based adaptation increase resilience? *Climate Dev* 10(2):134–151
30. Ensor JFJ, Ensor DM (2018) Bringing rights into resilience: revealing complexities of climate risks and social conflict. *Disasters* 42(4):S287–S305
31. Ensor JM, N. F. J, M. N (2019) Four key elements for putting resilience into practice. Stockholm Environment Institute. [www.jstor.org/stable/resrep22984](http://www.jstor.org/stable/resrep22984)
32. Glandon DM (2015) Measuring resilience is not enough; we must apply the research. Researchers and practitioners need a common language to make this happen. *Ecol Soc* 20(2):27
33. Ciumasu I (2013) Dynamic decision trees for building resilience into future eco-cities. *Technol Forecast Soc Chang* 80(9):1804–1814
34. Xie Z, Liu C, Wang S (2019) Landscape-based assessment of Urban resilience and its evolution: a case study of the Central City of Shenyang. *Sustainability* 11. <https://doi.org/10.3390/su11102964>
35. Ahern J (2013) Urban landscape sustainability and resilience: the promise and challenges of integrating ecology with urban planning and design. *Landsc Ecol* 28:1203–1212
36. Cote M, Nightingale A (2012) Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. *Prog Hum Geogr* 36:475–489
37. Jabareen Y (2012) Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities*. <https://isiarticles.com/bundles/Article/pre/pdf/255.pdf>
38. Foundation CRI (2014) Akshay Urja climate proofing Indian cities: a policy perspective. <http://www.indiaenvironmentportal.org.in>