Chapter 1
Resilience-Oriented Urban Planning

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1.1 Introduction

Cities across the world are increasingly exposed to a wide variety of risks. Many of these risks are environmental (e.g. extreme weather events, water shortage and pressure on other natural resources, biodiversity loss, failure of climate change mitigation and adaptation, etc.) (WEF 2017). Climate change and environment-related risks are tightly interconnected with other risks and, since 2011, have often been ranked among the top five global risks in terms of both impact and likelihood (WEF 2017). Many cities, especially coastal cities, are susceptible to climate change and environment-related risks and hazards (Boyd and Juhola 2015). The frequency and intensity of these risks is expected to increase as climate change continues. Climate change and its impacts may have significant ramifications for the effective management of cities which are engines of economic growth (accounting for over 80% of global GDP) and are expected to host about 66% of global population by 2050 (WB 2015). Based on low estimates, current global average annual losses in cities are about USD 314 billion. Unless cities around the world take appropriate actions to enhance their resilience, this figure may rise to USD 415 billion and even higher (if losses from knock-on effects such as mass human migrations, conflicts, pollution, epidemics, economic collapse, etc. are also considered) by 2030 (WB 2015).

The concept of resilience is increasingly used as an organizing principle to frame scientific and political discourses on cities. Its importance has been emphasized in United Nations (UN) documents related to cities. In the newly adopted New Urban Agenda a wide range of stakeholders, across multiple scales, make commitments to

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develop policies, programs, plans, and actions for building urban resilience (Habitat_III 2016). The importance of building urban resilience is also echoed in the UN Sustainable Development Goals (SDGs): SDG 11 asserts that cities should adopt plans to build their resilience in line with the Sendai Framework for Disaster Risk Reduction 2015–2030; SDG 9 is focused on developing resilient infrastructure to support sustainable development (UNSDG 2015).

Integrating resilience thinking into urban planning and design is essential for building urban resilience. The significance of achieving such integration is emphasized in many policy documents such as the Hyogo Framework for Action 2005–2015, and the Sendai Framework for Disaster Risk Reduction 2015–2030. For several decades, resilience has been a popular subject in field such as physics, ecology, and psychology. It is, however, a comparatively new concept in the field of urban planning and design and was introduced about two decades ago (Sharifi and Yamagata 2016). Since the turn of the century, resilience has received increasing attention within the field of urban planning and design. This can be attributed to the fact that, as mentioned above, cities around the world are, more than ever, facing the impacts of a board range of hazards.

Despite efforts to integrate resilience thinking into urban planning [e.g. see (Wilkinson 2012a, b)], there is still no consensus on the implications of resilience thinking for urban planning theory and practice (Sharifi et al. 2017). This chapter aims to shed more light on this issue by analyzing literature on urban resilience and discussing how resilience can be used to provide the planning theory and practice with new conceptual grounds. It elaborates on the main components and principles of the resilience concept that should be incorporated into the theory and practice of urban planning and discusses paradigm shifts that should occur during the integration process.

This chapter is organized as follows: Next section provides a brief literature review on the resilience concept and its underlying principles. In Sect. 1.3 implications of these principles for urban planning are discussed. Section 1.4 concludes the chapter by providing suggestions for future research.

1.2 Resilience and Its Underlying Principles

Resilience is a polysemic concept that has been interpreted in a variety of ways within and across disciplines (Norris et al. 2008). Groups with different research and policy interests provide different interpretations of the resilience concept and use it to frame and conceptualize their own agenda. Some may use resilience in the context of climate change adaptation and mitigation, while others utilize it in the context of human development, disaster risk reduction, and international development (Lu and Stead 2013). As mentioned earlier, the concept of resilience has its roots in disciplines such as physics and psychology. Originally, it was used to measure the capacity of systems, objects, or individuals to survive disruptions by maintaining acceptable levels of functionality and returning to pre-disruption levels of functioning in a timely manner (Sharifi and Yamagata 2016). This could be considered as an equilibrium approach to defining resilience and was the dominant approach until concepts such as ecological resilience and adaptive resilience were introduced in the second half of the twentieth century (Gunderson and Holling 2002). The single-equilibrium theory was challenged by the emergence of these new concepts that introduced multiple-equilibrium and non-equilibrium approaches to resilience.

Planning scholars have mainly borrowed the concept of resilience from ecology. Three major approaches to defining urban resilience can be distinguished in the literature. These are, namely, engineering resilience, ecological resilience, and adaptive resilience. Engineering resilience theories emphasize minimizing vulnerability to disasters by enhancing resistance and robustness of the physical infrastructure. Based on this interpretation of resilience, disruptions and disasters can, to a large extent, be predicted and prevented. In other words, cities and their infrastructures should be fail-safe (Ahern 2011; Sharifi and Yamagata 2016). If stressors exceed the safety thresholds and the system (or parts of it) experience failure, engineering resilience will enable rapid recovery to pre-disruption conditions (equilibrium). Reliance on engineering methods for building urban resilience may, however, give planners and decision makers a false sense of security.

Extending the theory of adaptive cycle (that was originally developed to understand ecosystem complexities and dynamics) to the urban system (as a social-ecological system), it can be argued that cities and infrastructures regularly go through the four phases of ‘exploitation’(r), ‘conservation’ (k), ‘release’(Ω), and ‘reorganization’(α) (see Fig. 1.1) (Gunderson and Holling 2002). Transition from the exploitation to the conservation phase takes place over a considerably long time period during which changes occur slowly and the system is relatively predictable. However, shift from the release to the reorganization phase often represents a short period of chaotic change and high uncertainty. This alternation between long periods of normal functioning, slow change, and relative stability and briefer periods of chaotic change (due to cumulative accumulation of small-scale events that can lead to major transformations over time) and sudden increase in unpredictability might result in occasional exceedance of critical limits of (urban) systems (Gunderson and Holling 2002). Under such circumstances, overreliance on engineering resilience and system robustness may result in irreversible changes and cause significant loss in system performance.

Ecological resilience entails a more dynamic and flexible approach that recognizes inadequacy of resistance and robustness characteristics for building urban resilience. It promotes building safety margins into the design of the system in order to absorb initial shocks, retain functionality, and minimize overall losses. An ecologically-resilient system may experience transition to new equilibrium states during the recovery process. However, the basic structure and function of the system remains unchanged (Sharifi and Yamagata 2016).

Driven by the growing understanding that future changes are hard to predict, disasters are not always preventable, and urban systems should learn how to live with risk; a more recent approach has emerged and gained widespread popularity in

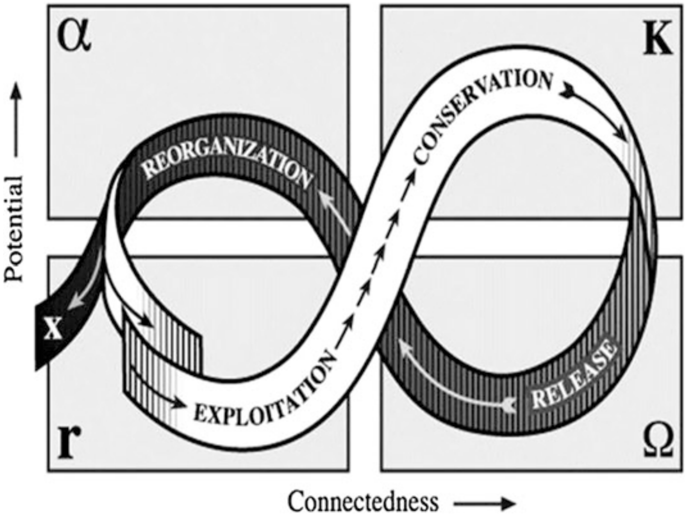

Fig. 1.1 A representation of the adaptive cycle theory. *Source* http://www.resalliance.org/adaptive-cycle

recent years. Highly influenced by the above mentioned 'adaptive cycle' concept, adaptive resilience[1] conceptualizes urban systems as complex and dynamic socio-ecological systems. A nested set of adaptive cycles can be used to model the performance of urban systems over time and across space. Adaptive resilience facilitates appropriate interactions between slow and fast variables. This allows the system to smoothly alternate between long periods of stability and short periods of chaotic change, without losing its integrity and functionality. Social-ecological memory, self-organization, and learning from the past are essential characteristics for achieving adaptive resilience. Overall, adaptive resilience strengthens short-term coping and long-term adaptation capacities and enables the system to sustain functionality over time. Since urban system is nested in a hierarchy of adaptive cycles, it does not necessarily return to (new or old) equilibrium states following adverse events. Adaptive resilience enables building "safe-to-fail" systems that not only bounce back from disasters, but also bounce forward and constantly enhance their performance and adaptive capacity (Ahern 2011; Gunderson and Holling 2002; Sharifi and Yamagata 2016).

The 'adaptive resilience' concept recognizes system complexities and dynamics and lends itself to describing and understanding resilience of urban systems as complex and dynamic social-ecological systems. Inspired by the concept of adaptive resilience, this study defines urban resilience as the *ability of urban systems to continuously develop short-term coping and long-term adaptation strategies- considering,*

[1]Terms such as social-ecological resilience, transformational resilience, and adaptive resilience are sometimes used interchangeably and all refer to the same concept.

and in response to constantly changing system dynamics and complexities over a range of spatial and temporal scales-to mitigate hazards, withstand and absorb shocks, rapidly bounce back to baseline functioning, and more effectively adapt to disruptive events by bouncing forward to better system configurations.

Achieving urban resilience requires incorporation of essential principles and characteristics such as robustness, stability, diversity, redundancy, flexibility, resourcefulness, coordination capacity, modularity, collaboration, agility, efficiency, creativity, equity, foresight capacity, self-organization, and adaptability into the urban system. These principles and characteristics have been defined elsewhere (Sharifi and Yamagata 2016) and will be referred to in describing the major elements of resilience-oriented urban planning in the following sections.

1.3 Integration of Resilience Thinking into Urban Planning

Several fundamental practices and measures for integrating resilience thinking into the theory and practice of urban planning are discussed in this section. These discussions include arguments on the importance and benefits of incorporating resilience into urban planning, as well as, some remarks on how such an incorporation can be achieved.

Before embarking on these discussions, it is worth noting that, traditionally, disaster risk management has always been an essential part of urban planning. However, as will be discussed in the rest of this chapter, introduction of the concept of resilience has given rise to major transformations in approaches to urban disaster risk management. Traditionally, disaster risk management was mainly focused on short- and medium- term emergency planning and mitigation efforts. Integrating resilience thinking into urban disaster risk reduction encourages taking a medium- to long- term approach which is more compatible with phenomena such as climate change that are characterized by slow and steady changes as compared to those that occur abruptly (slow vs fast variables) (Sellberg et al. 2015).

Resilience can be either against abrupt shocks that often occur due to climate variability or against slow and steady changes caused by climate change. In response to abrupt shocks, it is important to enhance resistance, robustness, and absorption capacities of the system, incorporate redundant elements in the system configuration, and develop plans to recover rapidly in case damage is occurred. Changes caused by climate change exhibit different features. Slow and steady variables that continuously change the system may cause irreversible transformations and shift the system into completely different regimes. Under such conditions, only emphasizing principles such as robustness and redundancy would not be sufficient and improvements in terms of coping, adaptation, and transformation capacities are needed (Kim and Lim 2016). Resilience-based planning and disaster management requires continuous and systematic efforts to coordinate the ongoing processes related to exploitation, conservation, release, and reorganization as the four major phases of the adaptive cycle. One point to be mentioned is that the medium- and long-term nature of climate change related phenomena may conflict with the short-term nature of electoral cycles that affect urban policies. Effective strategies, such as raising citizen awareness, need to be developed to address this temporal mismatch.

Traditional urban disaster risk management is mainly centered around vulnerability assessment and developing action plans for reducing vulnerability. Vulnerability is a static concept that provides a snapshot of system conditions and is often evaluated before the occurrence of the event. However, resilience-oriented disaster management recognizes the importance of understanding dynamics and complexities of the system and intends to explain how these dynamics and feedbacks evolve across temporal and spatial scales. Resilience can, therefore, be considered as a dynamic property that is constantly changing and indicates transformations of system vulnerabilities over time (Irwin et al. 2016).

In the following sub-sections, implications of integrating resilience thinking into urban planning are discussed. It should, however, be mentioned that not all planning stages and components are covered here and only selected fundamental points are discussed.

1.3.1 Planning Strategy and Vision

Visioning and strategy making is one of the most fundamental parts of any planning effort. Traditionally, establishing a desirable development pathway and safeguarding it has been at the center of planning efforts. Blueprint plans are developed to provide a clear vision for future growth and development and to deliver guidance for action. Although they can be suitable for achieving the former goal, fulfillment of the latter goal will be challenging. Resilience thinking questions suitability of blueprint planning on the grounds that development pathways need to be regularly updated in order to deal with the constantly changing profile of risks and uncertainties. Due to their rigidity, blueprint plans fail to capture dynamics and complexities of urban systems. Integrating resilience thinking into urban planning requires recognizing the shortcomings of blueprint planning. It is essential to acknowledge that threats cannot always be prevented due to the unpredictability of future conditions. Integrating resilience thinking into urban planning requires stepping away from the "predict and prevent" approach and moving towards understanding and accommodating complexities and uncertainties inherent in the planning for cities as dynamic and constantly evolving social-ecological systems (Reed et al. 2013). Adopting experimental approaches based on "learning by doing" principles (involving co-design and transdisciplinary approaches that engage different stakeholders in urban planning) is an effective social learning strategy for dealing with uncertainties inherent in social ecological systems and achieving adaptive planning and design (Ahern et al. 2014; Reed et al. 2013; Wilkinson 2012a).

It should be appreciated that engineering approaches that emphasize eliminating risk factors, through technological advances and physical planning approaches such as construction of coastal walls and levees, may not be sufficient for safeguarding communities. Instead of eliminating risk, avoiding exposure (e.g. through appropriate site selection) and enhancing resilience to risk should be emphasized (Syphard et al. 2013). Planning authorities should understand the possibility of risk and develop innovative and adaptive planning and design strategies so that the system can experience a safe failure ("safe to fail" instead of "fail safe") (Ahern et al. 2014). For this purpose, a paradigm shift from blueprint planning (linear and static) to adaptive planning that embraces change and involves regular and iterative processes of monitoring, assessment, and scenario making is needed.

Further benefits can also be realized by integrating assessment and monitoring into the planning process. Study conducted in Eskilstuna, Sweden shows that resilience assessment can facilitate brainstorming on uncertainties and complexities and help achieve a "dynamic systems" approach (Sellberg et al. 2015). Through developing longer-term scenarios and analyzing future changes within longer time horizons, resilience-based planning and assessment provides more opportunities for accommodating uncertainties and complexities. The system dynamics are appreciated through integrating changing thresholds into planning and assessment frameworks and taking account of social ecological interactions that occur across time and scale (Sellberg et al. 2015). In addition, assessment and certification can encourage companies and developers to aim for best practices and integrate innovative thinking into their activities.

Earlier, it was mentioned that adaptive resilience promotes a non-equilibrium perspective to system functionality and disaster recovery. This signifies a shift from the conservative mindset that promotes maintaining status quo and returning to equilibrium conditions (traditional urban disaster risk management) to perspectives that embrace change and see disaster (happening or pending) as an opportunity to enhance the overall performance of the system and achieve transformative adaptation.

1.3.2 Public Participation and Capacity Building

City is a social-ecological system where humans and environment are tightly interconnected. Stewardship of human-environment interactions and management of natural resources lie at the core of resilience concept (Wilkinson 2012a). Resilience-oriented planning acknowledges these interactions and puts people at the center of planning efforts and activities. Participation should be an integral part of the planning process, during both pre- and post-disaster periods. It should involve as many stakeholders as possible and start as early as problem definition in the planning process (co-design) (Schauppenlehner-Kloyber and Penker 2016). Public participation and citizen engagement in mitigation and risk communication efforts is a social learning practice and improves social capital which is widely believed as an essential component of urban resilience (Prior and Eriksen 2013). It is also important to promote communal actions and common practices (again important for enhancing social capital). The citizens should acknowledge that achieving urban resilience may require enhancing preparedness of all households and community members and this may require communal actions. For instance, vulnerability of one household to fire hazard may have consequences for neighboring households too (spread of fire) (Prior and Eriksen 2013).

Stakeholder engagement should also be prioritized during the post-disaster period. Getting people (and not just property owners) involved in the reconstruction process is considered as an important step to build their capacities, empower them, and enhance their resilience and adaptive capacity (Schilderman and Lyons 2011). Participation of people in the reconstruction activities also results in better overall satisfaction with living conditions following the completion of the reconstruction process (Schilderman and Lyons 2011). Furthermore, through capacity building activities, participation in the reconstruction process improves self-organization capacities and reduces community dependence on external support (Schilderman and Lyons 2011).

1.3.3 Equity and Empowerment of Poor and Marginalized Communities

Resilience planning efforts should be aimed at protecting poor and marginalized groups from the negative impacts of disasters through enhancing their economic conditions (Peyroux 2015). Rapid and unregulated urbanization in many cities in the developing world may lead to the formation and growth of informal settlements and poor communities. These communities are often more vulnerable to the impacts of disasters. There is ample evidence demonstrating that low income and marginalized groups are disproportionately affected by the impacts of climate change and other disasters. For instance earthquakes of higher magnitude have resulted in less damage and casualties in cities of developed countries such as the US and Japan as compared to earthquakes of relatively lower order of magnitude hitting cities of developing countries such as Haiti, India, and Iran (Schilderman and Lyons 2011). Many cities in the developing countries are polarized and poor. Marginalized groups in these cities cannot afford complying with required building and construction standards (Schilderman and Lyons 2011). High prices of land and properties in such cities leave the poor groups with no option but to build their settlements on highly vulnerable sites such as steep slopes and alluvial and fluvial plains. This further increases their vulnerability (Schilderman and Lyons 2011). It is, therefore, essential to integrate social justice into resilience planning activities.

To protect poor and marginalized groups from being disproportionately affected by the impacts of disasters, imposing limitations on development in disaster-prone areas is essential. This can be achieved by developing risk maps that clearly identify risk-prone areas that should be protected, preventing new developments in those areas, and developing strategies to incrementally relocate existing properties in risk-prone areas. Occurrence of disasters provides opportunities to take actions that more effectively prevent persistence of vulnerabilities by restricting return of people and businesses to disaster areas. However, if relocation is necessary, care should be taken to ensure that livelihoods of communities are not negatively impacted. Relocation should not negatively impact access of communities to ecosystem services essential for their livelihood (Villagra et al. 2016). For instance, relocating a fishing community to inland areas that are far from the sea can have significant livelihood impacts (Schilderman and Lyons 2011). Evidence from Korail, Dhaka shows that people may prefer living in risk-prone areas that provide them with better livelihood opportunities over comparatively less risky locations with unsecure livelihood opportunities (Jabeen et al. 2010). Therefore, relocation from risk-prone areas should be coupled with mechanisms to provide alternative livelihood opportunities in the short run and diversify livelihood strategies in the long run.

Disproportionate impacts on poor and marginalized groups can also be reduced by developing empowerment strategies. Meta-analysis conducted by Oberlack and Eisenack (2014) identifies income insecurity, restricted availability and accessibility to critical infrastructure, low standard housing conditions, land tenure insecurity, and lack of access to education and health services as major barriers undermining adaptive capacity of communities. Evidence from Korail, Dhaka suggests that tenure instability adversely impacts inhabitants' willingness to enhance their living conditions and levels of preparedness (Jabeen et al. 2010). Obviously, lack of tenure can erode inhabitant's coping capacity. Therefore, empowerment should include enhancing sense of ownership and developing strategies for securing land and home tenure, especially in informal areas (Jabeen et al. 2010). Empowerment should also involve municipal support for development of collective insurance and saving schemes for poor urbanites living in informal areas of developing countries. These efforts could also be complemented through development of innovative municipal insurance plans for further support of urban poor (Jabeen et al. 2010).

Social inclusion is tightly tied with social cohesion and contributes to urban resilience (Peyroux 2015). Enhanced accessibility to infrastructures, safety nets and services in the community, empowerment initiatives to enhance capacity of low-income and marginalized groups, creation of jobs and employment opportunities for diverse community groups, and engagement in the decision making process are examples of efforts that can be taken for improving social inclusion (Peyroux 2015).

1.3.4 Traditional Local Knowledge

Many cities have been inhabited for centuries. Over their histories, residents have learned how to deal with disturbing events and pass on design and construction techniques to later generations. Modern planning efforts should not deny existing planning culture. It should be considered as an asset that needs to be improved as the nature of disasters evolves over time.

The significance of utilizing traditional ecological knowledge for building resilience is emphasized in the literature (McMillen et al. 2017). Planners should understand how coping strategies and capacities of communities to adapt to climate change and variabilities have evolved over time (McMillen et al. 2017). Studying this evolution process will provide valuable lessons about how to adapt to future changes. For instance, traditional ecological knowledge can be used in selecting species suitable for the local climate (e.g. drought-tolerant species in water-stressed areas) (McMillen et al. 2017).

Other benefits can also be accrued from understanding traditional local knowledge. It strengthens social capital, enhances modularity, and contributes to local economy. For instance, awareness of local building technologies and tapping into them reduces dependence on external support and contributes to local economy (Schilderman and Lyons 2011). Respecting local building technologies and applying vernacular architecture principles in modern construction can also provide other co-benefits in terms of energy resilience and thermal comfort (Sharifi and Yamagata 2016).

1.3.5 Institutional Reforms

The structure and functionality of urban systems is characterized by complex and dynamic interrelationships and interactions between a broad spectrum of actors, institutions, sectors, infrastructures, norms, networks, and processes that operate at multiple spatial and temporal scales. Therefore, achieving urban resilience requires developing institutional mechanisms that transcend spatial, temporal, and sectoral boundaries. These institutional mechanisms should be guided by an adaptive management strategy that facilitates collaboration between different stakeholders and gets them involved in continuous processes and feedback loops of learning and adaptation (Crowe et al. 2016). According to Crowe et al. (2016), adaptive management should start with understanding the system through collecting data, generating information, and making the information accessible for different actors to better understand factors that drive change. In terms of the system operation, it is needed to reduce bureaucratic hierarchies, adopt co-design and co-production approaches, capitalize on social and community capital, and emphasize incremental approaches based on learning by doing. Adaptive management should also improve the overall efficiency of the system through instigating behavioral changes, establishing support networks between resources, and optimizing system performance.

It can be argued that devolution of power to local communities, building a culture of collaboration, developing effective communication strategies, appropriate financing of disaster risk management, establishing public-private partnerships, and enhancing institutional transparency and accountability are critical for streamlining adaptive management strategies in urban planning efforts.

Decentralization and devolution of power to local authorities is essential for enhancing local capacity. Successful adaptation and resilience building requires direct participation and input from the local community. Achieving this objective is difficult in highly centralized political systems that lack integrated management at the urban level (Villagra et al. 2016). Strong local authorities with stable and sustainable budget resources are better capable of enhancing community resilience and responding to disaster risks (Villagra et al. 2016). A paradigm shift from top-down and "command and control" approaches towards recognition of bottom-up community-based efforts is needed. Such a shift improves adaptability and flexibility of urban systems and recognizes significance of factors such as human behavior, stakeholder interactions, social networks, etc. (Prior and Eriksen 2013; Reed et al., 2013).

Promoting a culture of collaboration is one way to achieve decentralization. Different forms of collaboration, ranging from cross-sectoral collaboration, through collaboration between cities, to inter- and trans-disciplinary collaboration are needed.

A challenging, yet critical, task would be stepping away from sector-based planning toward recognizing that urban issues are often interconnected. Collaboration between different actors, sectors, and agencies is needed to better understand interdependencies, minimize conflicts and trade-offs, and maximize synergies. A case study of Rotterdam shows that collaboration across different governmental and non-governmental stakeholders, with diverse interests, is essential for enhancing urban resilience. Collaboration networks should be established to coordinate between groups with different interests. Operationalizing such coordination networks requires a shift from top-down and infrastructure-based planning to decentralized planning that acknowledges significance of various social, economic, and environmental forces (Lu and Stead 2013). Networking should not be limited within the city boundaries. It is increasingly recognized that building global networks for promotion of city-scale collaborations can be an effective way for gaining support and sharing knowledge and experiences (Lu and Stead 2013). This is specifically important for supporting cities in the Global South. Cities in the developing countries often have less adaptive capacity to combat the impacts of climate change. Since developed countries are responsible for a significant share of cumulative atmospheric Greenhouse Gas Emissions (GHGs), it is the historical responsibility of cities in the Global North to collaborate with those in the Global South through transfer of knowledge and technologies (Oberlack and Eisenack 2014). Inter- and trans-disciplinary collaboration is also needed because no single discipline is capable of appropriately capturing complexities and dynamics involved in inert-linkages between different social, environmental, and economic factors related to urban resilience. The increasing interest in addressing urban complexities from the perspective of food-water-energy-carbon nexus is a good example in this regard.

Applying appropriate communication strategies is essential for facilitating collaboration between actors with different interests and backgrounds. Drawing on urban flood risk management case studies in several cities in Denmark and the

Netherlands, Fratini et al. (2012) argue that a multitude of stakeholders, including, water professionals, urban planners, landscape architects, natural scientists, laypersons and politicians should be engaged in the planning process. These stakeholders may have different values and communication techniques should be employed to create a common vision and a common understanding among them. Appropriate communication strategies should clarify the interrelationships between various social, natural, and technological aspects of the issue and possibly develop multifunctional strategies and action plans that can benefit various groups of stakeholders and, at the same time, enhance urban resilience by improving citizen awareness and system flexibility. When communicating climate change resilience strategies and action plans (and results of vulnerability and resilience assessment) with stakeholders, it should be noted that highly technical language may not be easily understood by all community groups. Communication using a commonly understandable language is needed for promoting shared learning experiences that can improve social capital (Reed et al. 2013).

Access to financial resources is essential for maintaining the planning, absorption, recovery, and adaptation abilities of urban systems. Availability of sufficient financial resources enhances preparation efforts and can expedite the recovery process following a disaster. Maintaining financial reserves, establishing mutual aid agreements with neighboring communities and regions, establishing microfinance mechanisms in collaboration with vulnerable communities, insuring properties, issuing "catastrophe bonds" and "contingent credit contracts", developing microinsurance plans, and establishing public-private partnerships can provide authorities with resources needed during the recovery process (Johannessen et al. 2014). Urban authorities should provide opportunities and incentives for involvement of the private sector. Unlike developed countries, share of private investment in urban infrastructure management in developing countries is limited. This needs to be changed to improve resilience of cities. Public-private partnerships provide learning and innovation opportunities for both sectors and can, therefore, be regarded as social learning practices that as mentioned earlier are critical for enhancing urban resilience (Johannessen et al. 2014). Nongovernmental Organizations (NGOs) and Nonprofit Organizations (NPOs) can play an effective role in the immediate aftermath of disasters, as proved following Hurricane Katrina. These groups will also facilitate better rebuilding in the later stages. Therefore, public-private partnerships that also engage NGOs and NPOs are considered essential for disaster preparation and provide communities with increased resources available to respond to disasters (Carpenter 2015). It should be mentioned that only relying on private sector can cause problems, especially in terms of providing services to low income and marginalized groups such as slum dwellers. Private sector tends to avert financial risks and this may lead to exclusion of marginalized communities that are often in a financially precarious situation (Johannessen et al. 2014). In some informal settlements, services are provided by "small-scale independent providers(SSIPs)" which are often informal entities. Urban authorities should develop strategies for formalizing such providers and integrating and engaging them in decision making processes (Johannessen et al. 2014).

In order to ensure proper application of the above-mentioned institutional measures, enhancing transparency and accountability of urban management activities is critical. Compliance with transparency standards enhances trust in authorities, encourages stakeholder participation, reduces the possibility of corruption, and ensures proper expenditure of municipal funds.

1.3.6 Social Networks and Social Support

Early human settlements were often spatially divided into neighborhoods that were characterized by the presence of strong social networks. These networks have functioned as sources of social and economic support during adverse situations (Sharifi and Murayama 2013). As urbanization intensifies and virtual communication networks gain increasing strength, concerns about the decline of social networks in cities become salient.

Social networks provide opportunities for having access to mutual support when needed. They enable individuals, households and communities to seek support (e.g. financial aid, resources, emotional support) from other groups at the time of disaster (Jabeen et al. 2010). These networks are also vital for information flow and for sharing experiences. Social networks are often established within and/or beyond neighborhoods and include groups with shared identities (e.g. faith-based, commercial, linguistic, etc.) (Jabeen et al. 2010). In addition to the above-mentioned benefits, these multi-scale networks can improve the self-organization capacity of communities (Wilkinson 2012a).

Bolstering social networks should be prioritized in planning for urban resilience. It is especially important to employ effective strategies for preserving functionality of social networks when preparing plans for urban renovation and gentrification in historic neighborhoods. Razing old neighborhoods and districts can destroy social relationships that have been in place for a long time (Wallace and Wallace 2011). Drawing on insights from the destruction of some New York neighborhoods (Harlem, South Bronx) in the late twentieth century, Wallace and Wallace (2011) argue that post-destruction policies that promote ethnic segregation undermine resilience of communities and their capacity to respond to negative social and health-related impacts. They argue that the massive destruction projects have resulted in homogeneous neighborhoods (white or black) with small social networks that do not interact properly to establish social ties. Diversity in terms of ethnicity, socio-economic status, and age can contribute to strengthening social networks (Wallace and Wallace 2011).

Sense of place is an integral component of urban resilience and is essential for formation, maintenance, and growth of social networks. Sense of place improves urban resilience and reinforces social networks by strengthening feelings of trust and reciprocity, providing incentives for collective action, and facilitating pooling of skills and resources in the community (McMillen et al. 2017). It also improves household’s willingness to take preparation measures against potential future hazards (Prior and Eriksen 2013). Development and preservation of place attachment and sense of community should be prioritized in development of urban renovation and regeneration projects. Sharing knowledge and experiences and engagement in social learning and communal activities may be more difficult in communities with higher rates of turnover, as the process of creating social bonds and trust in neighbors may take time (Prior and Eriksen 2013).

Survey conducted in Australia (Hobart, Tasmania and Sydney) showed that sense of community and attachment to place improves social cohesion, knowledge and information sharing, and tendency to collective action which are important factors in enhancing community preparedness to wildfire hazards (Prior and Eriksen 2013). Social cohesion is essential for transferring response knowledge to community members. In cohesive societies, residents find their neighbors and community members reliable to provide them with support when needed (Prior and Eriksen 2013). Cohesive societies that feature collective action exhibit higher levels of coping capacity and are likely to better self-organize to address irregularities and uncertainties involved in disaster risk management. The propensity to get prepared to respond to disturbing events is also expected to be higher in socially cohesive communities (Prior and Eriksen 2013). Social cohesion enhances collective memory (i.e. lessons learned from previous experiences) which can facilitate a better response to future risks (Prior and Eriksen 2013). It can also be important for implementing adaptation strategies such as collective savings in the community and community-driven infrastructure management.

1.3.7 Dimensional, Spatial, and Temporal Interrelationships and Interlinkages

Conventional urban planning has achieved limited success in addressing interlinkages between different sectors and different socio-economic and environmental factors that shape cities and affect their performance. There is also a lack of understanding about the spatial and temporal dynamics of urban functions, processes, and changes.

Traditionally, plans for urban development have been prepared based on silo-based approaches and each city department has been responsible for preparing plans related to specific sectors (i.e. water, energy, housing, economy, etc.). This approach is not appropriate for understanding how different sectors are interconnected. Sustainability-oriented approaches have for long been in search of solutions to tackle this shortcoming. However, development and operationalization of such solutions has proved to be challenging. Since dealing with interconnections is inherent in resilience theory, resilience concept is useful for strengthening the shift from silo-based planning to understanding and taking account of interconnections (Sellberg et al. 2015). Integrating resilience thinking into urban planning provides opportunities for capturing the interactions between different sectors and understanding the nature and complexity of interlinkages between social, economic, and ecological factors. Achieving such integration is essential for better understanding the dynamics of urban systems and their potential future trajectories (Peyroux 2015).

A major attribute of social ecological resilience is that components of the system are interlinked and interconnected. Urban system is a social-ecological system and thus its underlying components exhibit multiple linkages across spatial and temporal scales (Wilkinson 2012a). Planning efforts for enhancing urban resilience should not be only restricted to the city boundaries. Several risks such as flashfloods have roots in upstream land use changes and human interventions in the environment (e.g. deforestation). Failure in upstream landscape planning can cause several socio-economic and health impacts and trigger secondary risks such as water-borne diseases downstream (in case of flooding events) (Johannessen et al. 2014). For instance, deforestation is believed to be one of the factors contributing to the 1988 flooding in Greater Dhaka. The flooding also impacted city's drinking water system and affected the lives of about 11 million inhabitants through water pollution and water borne diseases (Johannessen et al. 2014).

Resilience planning should also consider dynamics and feedbacks across temporal scale. Traditionally, planning efforts aimed at vulnerability assessment for disaster risk reduction have focused on providing a snapshot in time of the rapidly evolving state of cities. However, path dependencies are important and understanding the temporal continuum within which the dynamic processes and system transformations occur is indispensable (Sharifi 2016). Some simple strategies for incorporating temporal dynamism into resilience planning include longitudinal analyses to evaluate the degree of effectiveness of action plans and interventions in absorbing shocks and expediting recovery process and also using scenario-making and projection techniques for anticipating potential future changes and dynamics (Sharifi 2016).

Overall, different stakeholders across multiple scales influence dynamics of cities as social ecological systems and multi-level adaptive networks are needed to take account of interactions across temporal and geographic scales (Boyd and Juhola 2015).

1.3.8 Resilience-Oriented Land Use Planning

Land use planning should emphasize minimizing exposure to risk, facilitating timely response, and maximizing absorption capacity. To minimize risk exposure, land development should be prevented in certain locations such as ecologically sensitive and risk-prone areas (e.g. flood-prone or earthquake-prone areas). Controlling and regulating development in risk-prone areas is already well-recognized in the field of urban disaster risk management. To integrate resilience thinking into urban planning and urban disaster risk management, ecosystem protection should also be further strengthened. Urban planners should appropriately consider various services provided by the ecosystem and acknowledge that ecosystem planning and conservation can also provide buffers that can mitigate impacts of flooding, tsunami, and other disasters (Villagra et al. 2016). Specifically, urban development should not encroach on valuable ecosystems such as wetlands and greenfields and should not disrupt the natural drainage flows that are critical for flood mitigation. Protection of ecosystem services and avoidance of development in risk-prone areas may require relocation of some existing urban areas and infrastructures. However, as earlier mentioned, relocation should not negatively impact access of communities, living in those areas, to ecosystem services that are essential for their livelihood.

Density, mix of uses, connectivity, accessibility, permeability, and multi-functionality are some other basic attributes and criteria related to land use planning that influence resilience and vulnerability profiles of cities. These criteria have implications for evacuation planning, flood risk management, energy and water consumption, urban heat island effect, social justice, etc.

Choosing appropriate density thresholds has major implications for urban resilience. Increasing density up to a certain point can reduce per-capita energy consumption. It can also provide environmental benefits, as low-density development may result in the loss of valuable greenfield areas and the ecosystem services that they provide. Low-density development can also be associated with other issues such as increased commuting distances, diminished accessibility of emergency response teams and services, and increased vulnerability to natural disturbances such as wildfire. For instance, research shows that low housing density and leapfrog development (isolated development clusters) increase vulnerability to wildfire risks (as compared to infill development that increases overall housing density in inner urban areas) (Syphard et al. 2013). It should, however, be noted that high density may have adverse impacts on the response and absorption abilities of communities. Open spaces needed for evacuation and temporary sheltering may be more limited in high-density areas. High-density urban development can also increase flood risk by increasing impervious surfaces. Incorporation of green infrastructure into urban development plans will also be more challenging in high-density areas.

Green corridors are recognized as important elements for connecting people with nature and providing landscape connectivity. The latter facilitates movement of species (species traversing landscape patches) and provides ecosystem services to the urban dwellers. Urban ecosystem services can also be maintained through protection of natural habitats in the city. As mentioned above, ecosystem protection is vital for regulating temperature, mitigating extreme events such as flooding and heat waves, and protecting livelihoods of inhabitants. The connectivity criterion has also implications for street networks. Highly connected and porous urban areas facilitate better movement of people and vehicles. Street connectivity is essential for effective emergency response and safe and timely evacuation following disturbances. If coupled with well-designed pedestrian areas, street connectivity can also encourage walking which has substantial implications in terms of energy saving, mental and physical health, and social interactions. It is argued that walkable and mixed use neighborhoods provide more opportunities for strengthening social networks and enhancing social interactions among neighbors, thereby enhancing social capital and sense of attachment to the community (Carpenter 2015). In a study about resilience of communities along the Gulf Coast, it was found that intersection density has the highest effect on enhancing resilience. Other noteworthy factors include residential density, density of historic sites, and land use mix. It is argued that such urban form features can create opportunities for more social encounters and interactions and strengthen social networking among citizens which is believed to be critical for enhancing resilience (Carpenter 2015). As explained in Sect. 1.3.6, more social encounters and strengthened social networks can also contribute to building urban resilience by enhancing sense of community.

To integrate resilience thinking into urban planning, paying attention to multi-functionality of land use is critical. Diversity and redundancy attributes can be incorporated into the urban system by creating land use patterns that facilitate achieving multiple technological, social, economic, and ecological functions. For instance, open spaces and parks can be used for stormwater management and also provide other services such as evacuation space and playgrounds for children (Fratini et al. 2012). The multi-functional car parks in Rotterdam provide an underground space that includes water storage tanks or reservoirs and can be used for stormwater retention (to take some pressure off the drainage system), peak flow reduction, and temporary water storage if needed (Balsells et al. 2013). Such alternative systems can be used in case the excess water runoff exceeds the capacity of the drainage system (Balsells et al. 2013).

1.3.9 Resilient Urban Infrastructure

Critical infrastructures such as communication infrastructures, educational centers, energy and water systems, financial institutions, fire stations, health centers, and transportation networks are the backbones of modern cities. All these systems are susceptible to a diverse profile of risks, including the potential impacts of climate change. For instance, many centralized energy plants are located in low laying areas that will be affected by sea level rise; dry spells and droughts have negative impacts on the capacity of hydropower facilities; and extreme events such as hurricanes and typhoons can bring to a halt communication and transportation systems.

To achieve urban resilience, these principles and characteristics should be incorporated into infrastructure planning: robustness, diversity, redundancy, flexibility, efficiency, modularity, and innovation (creativity). Updating existing urban regulations, buildings codes, zoning codes, and design guidelines will be a first step towards incorporating these principles into infrastructure planning. Most urban infrastructures have a long lifetime. Compliance with these principles is critical to avoid lock in into inefficient and unsustainable development trajectories. Location of critical infrastructure is an important factor that has implications for the robustness criterion (Armenakis and Nirupama 2013). New infrastructures should not be built in risk-prone areas and should comply with strict building standards so that the urban system can maintain its stability under high-risk scenarios. Strategies should be developed for relocating existing buildings and properties from risk-prone areas. Existing buildings and infrastructures located in other areas should be retrofitted to meet the requirements of the most updated building codes and regulations. In addition, proper infrastructure maintenance is needed to ensure its functionality over time. Technical and financial knowledge at the local level is needed for maintaining operationality of critical infrastructure (Johannessen et al. 2014).

It should be noted that overreliance on enhancing resilience and reducing vulnerability through enhancing infrastructure robustness can create a false sense of safety. An example of such a sense of security was experienced when Hurricane Katrina hit New Orleans and there was overreliance on dams and levees built for flood risk management and coastal protection. Failure of such hard infrastructures caused unprecedented catastrophic losses in the area (Johannessen et al. 2014).

Traditionally, providers of urban services such as water, waste management, energy, and food have managed infrastructures in a centralized way. This tendency towards centralized systems is explained by the belief that management of centralized infrastructure is less complicated and more efficient (Sharifi et al. 2017). However, there is a growing recognition that decentralized infrastructure is more resilient and provides benefits in terms of diversity, redundancy, and modularity.

Decentralization of infrastructures makes it possible to utilize a diverse array of resources. For instance, various technologies such as nuclear, coal, natural gas, hydroelectric, biomass, solar photovoltaics, and wind can be used for electricity generation. Redundant infrastructure systems are needed for achieving such a diversity. This may affect the efficiency of the system, but is essential for distributing risk, improving modularity of the system, and minimizing its vulnerability to disruptions in the supply chain (Sharifi et al. 2017).

Decentralization of infrastructure is also considered an essential strategy for minimizing the knock-on effects that may spread throughout the system due to the fact that different sub-systems of the urban system are interconnected and disruption in one system can trigger disruptions in the others (Sharifi and Yamagata 2016). Decentralization of infrastructure should be considered as an opportunity for incorporating clean and renewable technologies into the urban system (e.g. developing micro-grids that are fed by solar panels and mico-turbines) (Sharifi and Yamagata 2016). Such a system needs to be co-designed and co-managed by different community stakeholders. Participation in such co-design and co-management efforts provides opportunities for creating social bonds in the community and can result in improvements in terms of social cohesion. It can also be considered as a social learning exercise that may result in societal transformation. For instance, decentralized water, food, and energy systems are important for enhancing citizen understanding of the resource cycle and origin of the resources. Decentralization of these systems may, therefore, have a positive influence on their consumption behavior (Rauland and Newman 2011).

Benefits of decentralization can be maximized by incorporating blue and green infrastructures into the urban system. Over the past few decades, a large body of literature has been published on a diverse group of green and blue infrastructures that can enhance resilience of cities against disturbing events such as flooding, drought, and heat wave (van de Ven et al. 2016). There are also tools such as "Climate Adaptation App (www.climateapp.org)" that can be used by various stakeholders to guide them on how to incorporate climate sensitive and resilient strategies into urban planning and design. In the reminder of this section, only a brief explanation of blue and green infrastructures is provided.

Green and blue infrastructures are essential for regulating urban microclimate, reducing heat island effect, and mitigating flood risk. A wide variety of green infrastructure technologies, such as green roofs, bioswales, rainwater harvesting systems, and permeable pavements can be incorporated into urban development. For instance, a combination of underground (e.g. drainage canals) and above ground (e.g. permeable surfaces) techniques should be used for flood risk management (Fratini et al. 2012). Current drainage systems have been designed to accommodate certain amounts of waste water and rainwater discharge and surcharge. These systems are designed based on the requirements of specific flooding return periods. Resilience-based planning should enhance capacity of drainage systems to meet the needs of large flood volumes with (potentially) large return periods. It should also incorporate sustainable urban drainage systems (SUDSs) and water sensitive urban design measures to enhance adaptive capacity of cities to mitigate flooding (Fratini et al. 2012). Water sensitive urban design principles and strategies such as permeable pavements (instead of sealed surfaces that increase the severity of flash flooding and reduce groundwater recharge rate), green roofs (for peak flow reduction through water retention), retention ponds, bioswales, etc., should be applied in order to get prepared for the potential impacts of changing rainfall patterns that will overwhelm the capacity of existing drainage systems. These strategies should be coupled with other actions such as solid waste management. Effective management of solid waste is necessary to avoid clogging of the drainage system in the event of extreme flooding events. Such clogging can further intensify floods and also trigger health-related risks (such as the spread of water-borne diseases) (Brown et al. 2012).

It should be noted that there are also other types of infrastructures (e.g. transportation and communication) that have not been discussed here, but need to be considered in resilience-oriented infrastructure planning.

1.4 Conclusions

Urban planning and design theories, discourses, policies, and processes are increasingly framed using the resilience concept. This signifies the increasing recognition that, unless cities build their resilience, a broad host of risks and threats including, but not limited to, extreme weather events, sea-level rise, droughts, wildfires, economic crises, and pressure on natural resources can disrupt the functionality of urban systems.

To help cities build their resilience, it is essential to integrate resilience thinking into urban planning and design. This chapter provides some fundamental discussions on how such integration could be achieved. Inspired by the theory of adaptive cycle it is argued that urban planning should not be considered as a static process. Urban systems are dynamic entities characterized by non-equilibrium dynamics and constantly go through the four phases of 'exploitation', 'conservation', 'release', and 'reorganization'.

It is argued that resilience thinking gives planning new perspectives that enable it to frame and address complexities and uncertainties inherent in the understanding and analysis of urban systems. Change, dynamism, uncertainty, adaptability and self-organization are at the core of resilience planning. This is in clear contrast with the traditional interpretation of planning as an effort to mainly resist disturbance and build 'fail-safe' cities. Integrating resilience thinking into urban planning theory and practice is necessary for taking account of uncertainties and complexities-scale and scope of which can be increased due to climate change- inherent in urban systems (Albers and Deppisch 2013). Resilience-based planning should acknowledge the dynamics of urban system, step away from static blueprint planning, and shift towards adaptive planning that involves regular and iterative processes of monitoring, assessment, and scenario making. It is also emphasized that a paradigm shift from 'command and control' approaches towards recognition of bottom-up approaches and social learning practices is essential for achieving resilience-based planning.

The chapter provides specific discussions on how to utilize resilience thinking for transforming planning culture and methodology in the following thematic areas: planning strategy and vision; public participation and capacity building; equity and empowerment of poor and marginalized communities; traditional local knowledge; institutional reforms; social networks and social support; dimensional, spatial, and temporal interrelationships and interlinkages; land use planning; and urban infrastructure. A summary of these discussions is provided in Table 1.1. It is hoped that such transformations not only improve efficiency of urban systems and reduce vulnerability, but also provide opportunities for innovation and contribute to achieving sustainable urban development.

The paper argues that key attributes and principles such as robustness, stability, diversity, redundancy, flexibility, resourcefulness, coordination capacity, modularity, collaboration, agility, efficiency, creativity, equity, foresight capacity, self-organization, and adaptability underpin the concept of resilience. Throughout the chapter, it has been discussed how planning interventions aimed at integrating resilience thinking into planning contribute to promoting these principles. Table 1.2 illustrates potential contributions of different planning themes to meeting the resilience principles. It should be emphasized that this does not intend to be an exhaustive illustration and further research is needed to be able to provide a more detailed and precise account of potential contributions of different planning actions.

It should be mentioned that not all principles can be easily applied to urban planning in every city. For instance, as cities around the world increasingly become more interconnected and interdependent through the flow of information, energy,

Table 1.1 A summary of the main features of conventional and resilience-oriented approaches to planning

Planning theme	Conventional	Resilience-oriented
Disaster risk management	- Focus on short- and medium-term emergency planning and mitigation efforts - Target fast variables, and chaotic and abrupt changes - Static vulnerability assessment	- Medium- to long-term approach - Suitable to address both abrupt and slow and steady changes - Recognize the importance of dynamics and complexities and evaluating transformations across temporal and spatial scales - Capacity to respond to constantly changing risks and to expand the response margins and capacities of the system
Planning vision and strategy	- Blueprint planning (linear and static) - Engineering approaches that emphasize eliminating risk - Equilibrium approach to disaster recovery - Predict and prevent approach	- Adaptive planning (regular and iterative processes of monitoring and scenario making) - Acknowledge the unpredictability of future conditions and difficulties in completely preventing risks - Non-equilibrium perspectives to system functionality and disaster recovery
Public participation and capacity building	- Environmental determinism - Limited public participation - Local authorities are responsible for providing services (command and control)	- People-oriented design (putting people at the center of planning efforts) - Co-design, co-production, and co-implementation - Importance of communal actions and self-organization (capacity building)
Building equity and empowering poor and marginalized communities	- Failure in upgrading conditions of low-income urban areas - Emergence and spread of wealthy enclaves in cities - Loose control over development in risk-prone areas - Limited insurance of properties in poor neighborhoods	- Integrate social justice into resilience planning efforts - Reduce urban inequalities (e.g. through affordable housing policies) - Regulate development on risk-prone areas - Ensure that relocation does not affect livelihood prospects of communities - Empower and enhance the sense of ownership - Utilize innovative municipal insurance plans (e.g. collective insurance and saving schemes)

(continued)

Table 1.1 (continued)

Planning theme	Conventional	Resilience-oriented
Learning from traditional local knowledge	- Overreliance on modern planning and design strategies - Spread of standardized building techniques	- Due attention to traditional coping capacities - Awareness of vernacular architecture and local building technologies
Institutional reforms	- Sector-based planning - Communication using a highly technical language - Top-down planning - Limited share of private investment in urban infrastructure management (esp. in developing counties)	- Interactions between sectors (interconnected and interdependencies) - Decentralized planning - Promotion of the culture of collaboration - Incremental and learning by doing approaches - Recognize the significance of behavioral changes - Transparent decision making process - Communication using a commonly understandable language - Strong public-private partnerships
Social networks and social support	- Renovation and gentrification policies affect functionality of social networks	- Community-based social networks are bolstered - Enhance place attachment and sense of community
Sectoral, spatial, and temporal interlinkages	- Failure to address interlinkages between different sectors and dimensions - Silo-based - Lack of understanding of spatial and temporal dynamics	-Not carried out in silos - Efforts to understand interconnections between different sectors - Emphasis on understanding spatial and temporal dynamics
Resilience-oriented land use planning	- Limited success in protecting ecologically-sensitive areas - Functional zoning	- Ecosystem protection - Mixed use development - Due attention to other attributes such as density, connectivity, accessibility, permeability, and multi-functionality
Resilient urban infrastructure	- Overreliance on robustness - Large, centralized infrastructure	- Recognition of other attributes such as diversity, redundancy, flexibility, efficiency, modularity, and innovation - Small-scale, decentralized infrastructure

Table 1.2 Contribution of the selected planning strategies to meeting resilience principles

	Robustness	Stability	Diversity	Redundancy	Flexibility	Resourcefulness	Coordination capacity	Modularity	Collaboration	Agility	Efficiency	Creativity	Equity	Foresight capacity	Self-organization	Adaptability
Planning vision and strategy	■	■			■			■		■	■	■		■		■
Public participation and capacity building			■			■		■	■						■	■
Building equity and empowering poor and marginalized communities		■	■										■			■
Learning from traditional local knowledge						■		■			■				■	■
Institutional reforms			■			■	■		■		■		■	■		■
Social networks and social support		■				■			■	■					■	■
Sectoral, spatial, and temporal interlinkages							■		■					■		
Resilience-oriented land use planning			■	■	■					■	■		■			■
Resilient urban infrastructure	■		■	■	■	■		■	■		■	■	■		■	■

and matter, the relevance and applicability of the modularity principle becomes more restricted (Albers and Deppisch 2013). However, some principles such as diversity are more applicable and have already been integrated into plans of many cities (Albers and Deppisch 2013). Further context-specific research is needed on the relevance, applicability, and priority of different resilience principles.

Overall, this chapter emphasizes that major paradigm shifts in conventional planning approaches are needed for integrating resilience thinking into urban planning and design. Further work needs to be done to provide more details about each planning theme that was discussed in this study (Sect. 1.3). Furthermore, it is essential to examine other planning themes and discuss how they should be evolved and transformed based on the principles of resilience thinking. Finally, challenges and constraints in integrating resilience thinking into urban planning and design should also be investigated.

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