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SHKUROPADSKA Diana
https://orcid.org/0000-0002-6883-711X

PhD (Economics), Associate Professor
at the Department of Economics
and Competition Policy
State University of Trade and Economics

19, Kyoto St., Kyiv, 02156, Ukraine
diana.shkuropadska2016@knute.edu.ua

ШКУРОПАДСЬКА Діана
https://orcid.org/0000-0002-6883-711X

доктор філософії, доцент кафедри
економічної теорії та конкурентної політики
Державного торговельно-економічного
університету

вул. Кіото, 19, м. Київ, 02156, Україна
diana.shkuropadska2016@knute.edu.ua

LEBEDEVA Larysa
https://orcid.org/0000-0001-8632-5460

PhD (Economics), Associate Professor,
Associate Professor at the Department
of Economics and Competition Policy
State University of Trade and Economics

19, Kyoto St., Kyiv, 02156, Ukraine
l.lebedeva@knute.edu.ua

ЛЕБЕДЕВА Лариса
https://orcid.org/0000-0001-8632-5460

к. е. н., доцент, доцент кафедри
економічної теорії та конкурентної політики
Державного торговельно-економічного
університету

вул. Кіото, 19, м. Київ, 02156, Україна
l.lebedeva@knute.edu.ua

THE GLOBAL DIMENSION OF URBAN VULNERABILITY AND RESILIENCE

Urban resilience is a multidimensional category, critically important for the sustainable functioning of cities under contemporary challenges, including climate change, armed conflicts, technological disruptions, and demographic processes. A hypothesis has been formulated that the resilience of cities is determined by the level of economic development, the state of critical infrastructure, the effectiveness of socio-institutional governance, and environmental adaptability, with a balanced combination of these factors ensuring a higher capacity of the city to withstand crises and recover from them. The aim of the article is to identify and assess the factors that ensure urban resilience under contemporary challenges. To achieve the goal, general scientific and specific methods were used: systematization and generalization, statistical analysis, and comparison. Four key areas of urban resilience were considered: infrastructure, environmental, socio-institutional, and economic. Cities are increasingly using "smart management" and digital

ГЛОБАЛЬНИЙ ВИМІР ВРАЗЛИВОСТІ ТА СТІЙКОСТІ МІСТ

Міська стійкість є багатовимірною категорією, критично важливою для сталого функціонування міст у сучасних умовах, через наявну зміну клімату, збройні конфлікти, технологічні збої та демографічні процеси. Сформульовано гіпотезу, що стійкість міст визначається рівнем розвитку економіки, критичної інфраструктури, соціально-інституційного управління та екологічною адаптивністю, причому збалансоване поєднання цих чинників забезпечує вищу здатність міста протистояти кризам і відновлюватися після них. Метою статті є ідентифікація й оцінка чинників забезпечення стійкості міста в умовах сучасних викликів. Для досягнення мети використано загальнонаукові та специфічні методи: систематизації й узагальнення, статистичний аналіз і порівняння. Розглянуто чотири ключові напрями міської стійкості: інфраструктурну, екологічну, соціально-інституційну та економічну. Міста дедалі частіше використовують "розумне управління", цифрові сервіси, підвищуючи ефективність функціонування й адаптивність. Водночас цифрова вразливість,

services, enhancing operational efficiency and adaptability. At the same time, digital vulnerability, cyberattacks, and risks to vulnerable population groups significantly complicate the situation. Aging infrastructure limits cities' ability to provide essential services during emergencies. Environmental challenges increase urban vulnerability. Social inequality and limited access to services reduce collective resilience, especially among the elderly, people with disabilities, internally displaced persons, and low-income populations. According to the research results, the key role for the resilience of cities belongs to management and strategic planning. Ineffective governance, the absence of a long-term development strategy, weak coordination, and limited citizen participation weaken cities' ability to respond to crises and mobilize resources. The analysed 2023 City Resilience Index indicated that North American and Western European cities, particularly New York, London, and Los Angeles, demonstrate high resilience, whereas Global South cities, such as Lagos, Dhaka, and Cairo, face structural limitations. It is possible to enhance urban resilience through infrastructure modernization, climate adaptation, strengthening social cohesion, citizen engagement, and economic diversification.

Keywords: urban resilience, critical infrastructure, digital vulnerability, social inequality, environmental resilience, city governance.

кібератаки та ризики для вразливих груп населення значно ускладнюють ситуацію. Застаріла інфраструктура обмежує здатність міст надавати критично важливі послуги під час надзвичайних ситуацій. Екологічні виклики посилюють вразливість міст. Соціальна нерівність і обмежений доступ до послуг знижують колективну стійкість, особливо серед літніх людей, осіб з інвалідністю, внутрішньо переміщених осіб та малозабезпечених верств населення. За результатами дослідження, ключова роль для стійкості міст належить управлінню та стратегічному плануванню. Неефективне управління, відсутність довгострокової стратегії розвитку, слабка координація й обмежена участь громадян послаблюють здатність міст реагувати на кризи та мобілізовувати ресурси. Проаналізований індекс стійкості міст 2023 р. засвідчив, що міста Північної Америки та Західної Європи, зокрема Нью-Йорк, Лондон і Лос-Анджелес, демонструють високу стійкість, тоді як міста Глобального Півдня, такі як Лагос, Дакка та Каїр, мають структурні обмеження. Підвищити міську стійкість можливо засобами модернізації інфраструктури, кліматичної адаптації, зміцнення соціальної згуртованості, залучення громадян і диверсифікації економіки.

Ключові слова: міська стійкість, критична інфраструктура, цифрова вразливість, соціальна нерівність, екологічна стійкість, управління містом.

JEL Classification: R58, L96, I30, Q54.

Introduction

In the 21st century, cities have become the main hubs of social, economic, and innovative development, while at the same time serving as epicenters of vulnerability to contemporary global challenges. Climate change, increasing urbanization, armed conflicts, pandemics, energy crises, cyber threats, and the deterioration of critical infrastructure intensify the pressure on urban governance systems.

The 2030 Agenda for Sustainable Development was adopted by all UN member states in 2015. It sets out 17 Sustainable Development Goals (SDGs) that cover a wide range of issues, from poverty reduction to environmental protection. One of the key priorities is the development of cities as centers of economic activity and innovation, which require balanced planning and effective governance (UN-Habitat, n. d.).

At the European level, these global objectives were further specified in the Leipzig Charter (2007) (European Commission, 2007), and the New Leipzig Charter (2020) (European Commission, 2020, December 8). Both documents emphasize the importance of sustainable urban development with active citizen participation in decision-making, multilevel governance, and an integrated approach that combines social, economic, and environmental dimensions of urban growth. These principles contribute to shaping more sustainable, inclusive, and vibrant urban environments.

In this context, the issue of urban resilience becomes particularly significant, as it encompasses not only the physical protection of cities from external shocks but also the ability of urban systems to adapt, maintain

functionality, and ensure the well-being of residents in the long run. It is precisely the integration of sustainability principles at all levels of urban governance that allows us to speak about a sustainable, adaptive, and just city of the future.

Overall, urban resilience describes the measurable capacity of urban systems to function continuously under shocks or stresses, as well as to adapt and transform in order to ensure sustainable development (Belaïd et al., 2025).

In other words, a city must analyze potential risks, develop response strategies, and act proactively to prepare for threats of both natural and anthropogenic origin – whether sudden or gradual, predictable or unforeseen. Accordingly, this enables not only the protection of human lives and the uninterrupted functioning of critical infrastructure, but also the preservation of historical and cultural heritage, the promotion of sustainable development, and the creation of an investment-attractive urban environment (Kuzyshyn, 2025, March 14).

In contemporary academic literature, urban resilience is defined through a variety of approaches. The understanding of resilience has gradually shifted – from the national to the local scale, from central governments to municipalities, and from security institutions to individual citizens-highlighting and fostering the constructive self-organization of diverse stakeholders in response to crises and unfavorable conditions (Hagmann & Cavelty, 2012; Zalizniuk et al., 2025).

The notion of urban resilience itself, as defined by Meerow et al. (2016), describes the ability of socio-economic, socio-ecological, and socio-technical elements of an urban system to sustain or swiftly restore desired functions when disrupted, to adjust to evolving conditions, and to transform structures that constrain present or future adaptive capacity.

Furthermore, resilience outlines the threshold at which cities can absorb or endure change before they are compelled to reorganize around a different set of processes and institutional arrangements (Alberti et al., 2003).

Generally, urban resilience is viewed as a component of sustainability. Enhancing a system's resilience contributes to its overall sustainability; however, improving sustainability alone does not always strengthen resilience. Both sustainability and resilience are essential for addressing natural and human-induced risks and for shaping urban planning decisions in cities (Pirlone et al., 2020; Kochskämper et al., 2024; Wieszczeczynska et al., 2024).

Resilient cities need to anticipate a wide range of potential challenges, such as climate change and rapid population growth. This requires forward-looking planning and preparing the urban environment to effectively respond to these pressures over the next 10, 20, or even 50 years (Robert, 2025, January 19).

In order to stay resilient to contemporary challenges cities should utilise smart cities technologies. Future resilient cities will depend on accurate predictive tools, real-time monitoring, and cost-efficient emergency response mechanisms. The combination of advanced technologies with socioeconomic measures, such as equity, sustainable environmental practices, effective governance, and citizen engagement, offers greater potential for building resilience (Almulhim, 2025).

The hypothesis of this article is that the resilience of cities is determined by the level of economic development, the state of critical infrastructure, the effectiveness of socio-institutional governance, and environmental adaptability, with a balanced combination of these factors ensuring a greater capacity of cities to withstand crises and recover from them.

The aim of the article is to identify and assess the factors that ensure urban resilience under contemporary challenges.

To achieve the research aim, a combination of general scientific and specific methods was applied: methods of systematization and generalization were used to identify challenges to urban resilience and potential risks for stable development. Statistical analysis and the comparative method were used to evaluate the level of urban resilience.

The structure of the article is as follows: first, the key challenges to urban resilience are analyzed; next, the level of city resilience is assessed using the Economist Impact methodology; finally, measures to strengthen urban resilience are highlighted.

1. Challenges to Urban Resilience

A city is a "system of systems", and each of these subsystems (e.g., communication, water supply, energy, healthcare, and others) may potentially have different owners and stakeholders. Resilience must be ensured both within each of these systems and across them, and thus it can only be achieved through effective cooperation.

According to the *Sendai Framework for Disaster Risk Reduction*, resilience is defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management" (UNDRR, 2015). In the context of cities, this increasingly refers to the ability to withstand and recover from acute shocks (natural and technological disasters), such as floods, earthquakes, hurricanes, wildfires, chemical spills, or disruptions of energy supply, as well as from chronic stressors in the longer term, such as groundwater depletion or deforestation. The main challenges to urban resilience are shown in th *Table 1*.

Table 1

The Main Challenges to Urban Resilience

Challenges	Description
Natural disasters	Rising temperatures, droughts, floods, storms; vulnerability of urban infrastructure to extreme weather events; air, water, and soil pollution
Armed conflicts and insecurity	Destruction of critical infrastructure (transport, energy, water supply); forced displacement of the population; threat of missile and drone attacks
Energy insecurity	Dependence on centralized systems (thermal power plants, electricity grids); underdevelopment of renewable energy sources; vulnerability during energy crises

End of Table 1

Challenges	Description
Migration and demographic change	Urbanization, overpopulation, pressure on housing and social services; aging population; integration of internally displaced persons (IDPs) and migrants
Infrastructure deterioration	Outdated engineering infrastructure that does not meet modern requirements; low energy efficiency of buildings; lack of backup (redundant) systems
Social inequality and vulnerability	Unequal access to basic services (healthcare, education, housing); unemployment, rising poverty; stigmatization of vulnerable groups
Digital insecurity	Cyber threats to urban management systems; uneven access to digital services; dependence on information and communication technologies
Ineffective governance and planning	Lack of crisis response systems; insufficient community participation in decision-making; corruption and inefficient use of resources

Source: compiled by the authors.

Resilience to natural disasters refers to a city's capacity to anticipate risks it may face, to mitigate them, and to respond effectively to natural hazards when they occur (Feofilovs & Romagnoli, 2021). This minimizes the likelihood of loss of life or damage to livelihoods, property, infrastructure, economic activity, and the environment in both the short and long term. However, it should be taken into account that chronic stressors can influence the likelihood or severity of acute shocks, as well as undermine a city's ability to respond and adapt. For example, deforestation increases the probability of sudden flooding, while socially vulnerable communities may be unable to rebuild their homes and businesses after a major earthquake (UNDRR, 2023, November).

In addition to natural disasters, anthropogenic challenges have an increasingly destructive impact on the urban environment, particularly *armed conflicts* that cause massive destruction. Armed conflicts primarily threaten the physical existence of critical infrastructure, including electricity, water supply, transport, communications, healthcare facilities, and educational institutions (Laakkonen, 2020). Destruction of these systems not only paralyzes the daily functioning of a city but also creates a humanitarian catastrophe, as seen in Mariupol, Gaza, and Aleppo. Beyond physical destruction, armed attacks cause profound social shocks: cities lose human capital, lives are lost, the number of internally displaced persons increases, external migration grows, and social disintegration emerges. This, in turn, significantly weakens social cohesion, which is a key foundation of urban resilience. A frequent consequence of armed conflict is energy insecurity, as attacks on critical infrastructure, disruption of supply chains, and shortages of energy resources destabilize vital urban systems.

Energy security is one of the key prerequisites for the sustainable functioning of urban spaces. In the 21st century, as cities increasingly rely on electricity to sustain critical infrastructure, energy insecurity has emerged as a serious challenge to their resilience. The causes of energy instability may

vary: damage to energy infrastructure as a result of military actions (such as the shelling of power facilities in Ukrainian cities), shortages of energy resources, import dependence, outdated energy supply systems, insufficient diversification of energy sources, climate anomalies, or cyberattacks on energy facilities (Nikolaiets et al., 2023). In conditions of prolonged crises, energy insecurity leads to declining quality of life, higher utility costs, and reduced safety, which in turn fuels migration flows and exacerbates demographic imbalances in cities.

As population hubs, cities are the first to experience the consequences of *mass displacement, population aging*, or, conversely, rapid demographic growth. One of the most significant challenges is forced migration caused by armed conflicts or socio-economic instability. A large number of internally displaced persons (IDPs) put enormous pressure on urban infrastructure, social services, housing stock, healthcare, and education systems. Cities that were unprepared for such an inflow of people often face resource overload, uncontrolled urban sprawl, and rising social tensions between local residents and newcomers.

Another important aspect is *demographic aging*, characteristic of many European cities, including those in Ukraine. A shrinking share of the working-age population combined with the growing number of elderly people alters the needs of cities. Low birth rates and the outflow of youth weaken the economic potential of cities, reduce human capital, and complicate recovery after crises (Shkuropadska et al., 2024).

On the other hand, uneven population growth in certain cities, driven by urbanization or unregulated migration, results in chaotic urban expansion, rising housing costs, pressure on natural resources, challenges for transport infrastructure, and a deterioration in quality of life. Overall, intensified migration flows and demographic change create additional pressure on urban systems, further complicating the task of ensuring resilience.

One of the key factors affecting urban resilience in the 21st century is *infrastructure deterioration*. A significant number of cities, particularly in countries with transition economies, continue to operate on engineering networks and facilities built decades ago, often without proper maintenance or modernization. Deteriorated infrastructure substantially limits a city's capacity to adapt to contemporary challenges, respond to crises, and ensure an adequate quality of life for its residents (Abbas & Ameen, 2019).

Infrastructure deterioration is most evident in the areas of water supply and sanitation, electricity grids, district heating, roads, bridges, public transport, and housing stock. Outdated systems often operate at the edge of their capacity, show high accident rates, and lose a significant share of resources (such as water or heat) during delivery to consumers (Eskandari & Zarabadi, 2017). Under conditions of extreme weather, energy crises, or armed conflict, such infrastructure is among the first to fail, paralyzing the functioning of urban spaces. Moreover, deteriorated infrastructure places additional pressure on municipal budgets, since repairs to outdated networks often cost

more than their modernization. The issue is particularly acute in socially vulnerable neighborhoods, where limited access to quality services deepens existing social inequalities and lowers the overall well-being of residents.

In the urban environment, social inequality and vulnerability represent some of the most serious challenges to resilience, as they directly affect the city's ability to function stably, respond to crises, and provide safe and equitable living conditions for all residents (Lewis, 2023, May 12). Social inequality manifests itself in unequal access to housing, education, healthcare, transport, information, and justice. While some districts enjoy modern infrastructure, safety, and comfort, others are characterized by poverty, environmental degradation, and neglect. This spatial-social segregation produces "two-speed cities" (e.g., Cape Town, São Paulo, Detroit), where part of the population actively develops while the other becomes increasingly marginalized.

Vulnerable groups, including people with disabilities, the elderly, single parents, internally displaced persons (IDPs), the homeless, and ethnic minorities, constitute a separate category. Their capacity to adapt to changes and withstand crises is significantly lower due to limited access to social protection, employment, healthcare, information, or community support (Roy et al., 2024). Importantly, social inequality reduces the collective resilience of a city. In critical moments, communities with strong cohesion and solidarity are able to mobilize resources more quickly, provide mutual support, and respond more effectively to threats. By contrast, where social divides prevail, cooperation becomes more difficult, weakening crisis response.

Social inequality is also reflected in the *digital dimension* (Baraka, 2024). Low-income groups often face limited access to digital technologies, the internet, and the necessary skills to use them, which exacerbates digital insecurity and excludes them from urban development processes.

In the era of rapid digital technology development, cities are increasingly implementing intelligent management systems, digital services for residents, e-governance, and "smart infrastructure" tools (Chang et al., 2023). However, alongside these positive transformations, a new challenge emerges – *digital insecurity*. It is becoming a significant risk factor for urban resilience, especially under conditions of military threats, hybrid aggression, cyberattacks, or technological disruptions.

Digital insecurity refers to the vulnerability of urban digital infrastructure to impacts that may disrupt the functioning of critical services, cause data loss, interrupt communications, or restrict access to essential information (Kolotouchkina et al., 2024). Energy supply, transportation, security, communications, healthcare, and educational infrastructure systems are particularly exposed. Their malfunction may trigger a "domino effect", paralyzing the functioning of the entire city, generating public panic, and reducing the effectiveness of crisis response (e.g., the cyberattack on Atlanta in 2018) (Avast Business, n. d.).

Beyond technical risks, digital insecurity also has a social dimension. In many cities, there exists so-called *digital inequality*, when a significant

share of residents, especially the elderly, persons with disabilities, low-income groups, or internally displaced persons, lack access to digital devices, the internet, or skills to use online services. In crisis situations, this greatly complicates their ability to receive assistance, access information, or use administrative services.

Another challenge to urban resilience is *inefficient governance and weak strategic planning*, which manifests in many aspects: the absence of long-term strategies, chaotic decision-making, lack of coordination among government bodies, inconsistency of actions across departments, distrust between authorities and communities, corruption, and lack of budget transparency. As a result, cities become more vulnerable to crises, lack reserves for response, and use resources inefficiently (Dinets et al., 2021).

Planning that is not based on data, forecasts, or the actual needs of residents leads to poor-quality urban development, infrastructure overload, disruption of transport logistics, and shortage of social facilities. For example, the construction of residential complexes without adequate roads, schools, or hospitals creates structural problems that later become extremely difficult and costly to fix (e.g., Mumbai, Cairo). In critical situations, this prevents cities from responding rapidly to emergencies and restoring their functioning.

Particularly dangerous is the *lack of crisis planning*. A significant number of cities do not have clear response protocols for military threats, natural disasters, or technological accidents. The absence of risk monitoring systems, scenario modeling, and contingency solutions significantly weakens a city's ability to withstand unexpected challenges (Melnykova, 2020).

Furthermore, inefficient governance limits citizen participation in decision-making (Vodotyka et al., 2020, April 27). Without feedback from residents, authorities often fail to understand actual local problems, which leads to conflicts, protests, and loss of trust. This gap between authorities and communities reduces social cohesion. Ineffective governance also hampers the mobilization of external resources such as investments, international aid, and technologies. Investors and donors rely on transparency, predictability, and strategic vision. The absence of these characteristics makes them bypass cities with ineffective governance (e.g., Caracas, Dhaka, Lagos).

2. Assessment of Urban Resilience

Urban resilience in today's world is one of the key factors determining the successful functioning and development of cities under contemporary challenges. In 2023, the study by Economist Impact was conducted, the results of which are presented in the *Resilient Cities Index* (*Table 2*). The index covers 25 megacities and evaluates them across four main components: critical infrastructure, environment, socio-institutional capacity, and economic capacity. The research is intended to empower policymakers,

city planners, and communities to design targeted strategies that ensure cities not only survive but also thrive amid challenges (Benyon & Benwell, 2023, November 22).

Table 2

The Resilient Cities Index in 2023, %

Cities	Resilient Cities Index	Critical Infrastructure	Environment	Socio-Institutional	Economic
New York	84.9	91.1	93.1	72.9	81.8
Los Angeles	84.4	88.0	91.3	78.3	78.6
London	83.2	82.4	89.1	79.7	81.2
Singapore	82.0	90.8	81.8	79.4	73.2
Paris	81.3	84.1	90.9	79.1	67.4
Melbourne	80.9	88.3	93.3	73.9	63.4
Amsterdam	79.9	84.9	80.0	84.0	66.5
Tokyo	79.6	84.3	83.6	79.9	67.0
Barcelona	79.0	87.2	84.7	79.6	58.3
Munich	78.6	83.6	86.9	77.5	61.4
Hong Kong	77.0	86.9	75.0	74.0	70.0
Warsaw	75.4	79.9	83.6	79.8	51.6
Dubai	69.5	93.8	52.0	71.9	55.1
Shanghai	69.4	91.4	75.1	55.9	49.5
Santiago	66.1	74.0	83.4	47.1	58.6
Istanbul	65.9	65.4	83.5	62.4	47.6
São Paulo	62.7	67.1	82.2	43.1	57.9
Mexico City	62.7	56.6	87.1	53.7	59.9
Cape Town	62.1	51.3	84.5	56.6	54.7
Bangkok	58.0	64.8	64	47.3	55.1
New Delhi	53.3	59.5	48.0	54.4	50.1
Jakarta	51.6	50.6	56.7	59.3	47.7
Cairo	44.7	56.3	47.3	37.2	35.2
Dhaka	43.0	43.1	50.3	40.6	36.4
Lagos	39.6	31.1	60.7	29.3	37.4

Source: compiled by the authors basing on Economist Impact (2023).

New York ranked first in the index (84.9%), recognized as the global city with the highest capacity to adapt to the risks and uncertainties of the new century. Other top-ranked cities include Los Angeles (84.4%) and London (83.2%). These cities demonstrated balanced development in infrastructure systems, environmental protection, institutional effectiveness, and economic stability. The highest-ranked Asian city is Singapore (82.0%), followed by Tokyo (79.6%). Melbourne (80.9%) is the highest-ranked Australian city. In contrast, the lowest resilience levels were observed in Lagos (39.6%), Dhaka (43.0%), and Cairo (44.7%), primarily due to poor critical infrastructure, weak institutional governance, and economic vulnerability.

In the critical infrastructure category, Dubai led with the highest score (93.8%), reflecting effective investments in urban planning, transportation, and utility systems. High scores were also recorded for New York (91.1%) and Shanghai (91.4%). Meanwhile, Lagos (31.1%) and Cape Town (51.3%) lagged significantly, highlighting a critical need for infrastructure modernization. It should be noted that unstable internet connection, which

limits access to digital services, lowered the overall resilience score in this domain. At the same time, digital technologies and advanced data analytics can forecast risks, optimize existing systems, and increase public awareness. Although digitalization carries certain risks, particularly for critical infrastructure, it has motivated most cities to implement preventive measures. However, most cities in developing economies lack adequate regulatory frameworks, long-term strategies, and incentives for sustainable infrastructure development.

Regarding *environmental resilience*, Melbourne (93.3%), New York (93.1%), and Paris (90.9%) performed best. These cities actively implement "green" policies aimed at improving air and water quality and promoting sustainable transportation. In contrast, New Delhi (48.0%) and Cairo (47.3%) face serious environmental challenges. The study emphasized that developing cities urgently need to enhance resilience to climate change impacts. Cities such as Bangkok, Cairo, Dubai, Jakarta, and New Delhi were encouraged to adopt heat mitigation plans. Several Asian cities, including Bangkok, Hong Kong, Jakarta, and Dhaka, were identified as extremely flood-prone. Currently, around 1.8 billion people live in flood-prone areas. Asia is particularly vulnerable, as urban temperature growth rates in the region exceed global averages. Efforts to achieve environmental resilience are increasingly based on innovative approaches, including nature-based solutions for flood and heat adaptation. Such solutions include green infrastructure (green roofs, mangrove planting) and blue infrastructure, such as wetland restoration. Cities are also decarbonizing by adopting renewable energy and negative-emission technologies, including carbon capture, storage, and removal. Scaling these technologies is likely to pose a challenge for developing cities with limited resources.

Social and institutional resilience is another key factor. Amsterdam scored highest (84.0%), reflecting high institutional trust, social cohesion, and safety. London, Tokyo, and Warsaw also ranked among the leaders. In contrast, Lagos (29.3%) and São Paulo (43.1%) showed high social vulnerability. Most cities scored poorly in the social-institutional dimension, mainly due to high income inequality and low health and well-being indicators. Only nine cities had comprehensive plans for supporting vulnerable populations. Nevertheless, many cities actively cultivate a culture of disaster preparedness, earning high marks in this regard.

Regarding *economic resilience*, New York (81.8%), London (81.2%), and Los Angeles (78.6%) performed best. Economic diversification, the development of small and medium-sized enterprises, innovation, and high employment levels drive their stability. Meanwhile, Cairo (35.2%) and Dhaka (36.4%) face significant economic development challenges, limiting their ability to withstand crises. Overall, cities in the ranking showed the lowest average scores in the economic segment, which negatively affected even those with high scores in other areas. A key aspect of economic

resilience is a city's ability to support innovations that address a wide range of issues, from traffic congestion to water scarcity. Unfortunately, most cities received low scores for startup ecosystem development.

In general, North American and Western European cities demonstrate the highest levels of resilience due to long-term sustainable development strategies. Asian cities such as Singapore, Tokyo, and Shanghai have high infrastructure development scores but often face social and economic challenges. Global South cities require targeted policies to enhance social and institutional resilience and adapt to climate change.

Conclusions

Urban resilience is a multidimensional concept encompassing not only physical infrastructure but also economic, environmental, and socio-institutional factors, which, in turn, supports the hypothesis put forward in this article. The analyzed data further indicate that many cities demonstrate progress in developing "smart" critical infrastructure, enhancing urban greenery, implementing climate adaptation measures, supporting vulnerable population groups, and promoting digitalization. Nevertheless, several challenges persist, including low socio-institutional stability, underdeveloped startup ecosystems in certain cities, and insufficiently effective regulatory frameworks in developing economies.

Ensuring urban resilience requires addressing four key dimensions: infrastructure resilience, environmental resilience, socio-institutional resilience, and economic resilience. Within each dimension, specific measures have been identified to enhance cities' adaptive capacity during crises and to promote sustainable development:

Infrastructure Resilience. Priority actions include modernization and protection of critical infrastructure, particularly in the energy, transport, and water supply sectors. Establishing backup systems, such as alternative energy and water sources, is essential to reduce vulnerability during emergencies. Implementation of smart city technologies is also crucial for efficient infrastructure management. To ensure physical safety, it is necessary to provide underground shelters, protective structures, and to reinforce buildings.

Environmental Resilience. This dimension encompasses measures for greening urban areas and expanding green spaces, which help mitigate heat stress and improve air quality. Waste management and the development of recycling systems are necessary to reduce environmental pressures. Protection of water resources, modernization of drainage systems, and the adoption of climate adaptation solutions, such as rainwater harvesting and urban cooling technologies, are also critical components.

Socio-Institutional Resilience. Strengthening urban resilience requires the development of local governance and enhanced public participation in decision-making processes. Establishing emergency response centers and mobile units to operate during crises is advisable. Supporting vulnerable population groups and fostering social cohesion are key priorities. Equally important are educational initiatives, including public training, drills, and simulations to enhance preparedness for emergency situations.

Economic Resilience. Urban resilience is closely linked to economic diversification, particularly through the support of small and medium-sized enterprises and the promotion of entrepreneurship during crises via subsidies, concessional loans, and grants. Attracting investment in innovation and digitalization is a strategic priority. The development of local production chains and the strengthening of local labor markets are also crucial for ensuring the city's economic self-sufficiency.

Future research should focus on evaluating the impact of armed conflicts on the resilience of urban systems, particularly in the areas of critical infrastructure, social protection, economic stability, and governance. The ways to mitigate the effects of armed conflicts on the cities functioning, especially the analysis of policies of local authorities would be of particular interest. Also, it is essential to investigate the role of local communities and civil society in strengthening adaptive capacities of cities to crisis situations.

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