

Dimensional framework of urban resilience: systematic evaluation in Latin American territories

Marco dimensional de resiliencia urbana:
evaluación sistemática en territorios
latinoamericanos

Marco dimensional da resiliência urbana:
avaliação sistemática em territórios
latino-americanos

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Abstract: This article proposes a conceptual and methodological framework for the systematic evaluation of transformative urban resilience in Latin American territories. Through a structured literature review and the analysis of five case studies from Mexico, Argentina, Peru, Colombia, and Chile, five key dimensions are identified: social, governance, physical, environmental, and economic. The study presents a comparative matrix of dimensions that enables the measurement and comparison of resilience across territories with varying levels of vulnerability and adaptive capacity. Findings emphasize the central role of the social dimension, the need for participatory approaches, and the importance of territorial justice as a foundation for resilient and inclusive public policies.

Keywords: urban resilience; multidimensional evaluation; sustainability; territorial justice.

Resumen: Este artículo propone un marco conceptual y metodológico para la evaluación sistemática de la resiliencia urbana transformadora en territorios latinoamericanos. A través de una revisión bibliográfica y el análisis de cinco estudios de caso en México, Argentina, Perú, Colombia y Chile, se identifican cinco dimensiones clave: social, gobernanza, física, ambiental y económica. El estudio presenta una matriz comparativa de dimensiones que permite medir y comparar la resiliencia entre territorios con distintos niveles de vulnerabilidad y capacidad de adaptación. Los hallazgos subrayan el rol articulador de la dimensión social, la necesidad de enfoques participativos, y la importancia de la justicia territorial como base para políticas públicas resilientes e inclusivas.

Palabras Clave: resiliencia urbana; evaluación multidimensional; sostenibilidad; justicia territorial.

Resumo: Este artigo propõe um marco conceitual e metodológico para a avaliação sistemática da resiliência urbana transformadora em territórios latino-americanos. A partir de uma revisão bibliográfica estruturada e da análise de cinco estudos de caso no México, Argentina, Peru, Colômbia e Chile, são identificadas cinco dimensões principais: social, governança, física, ambiental e econômica. O estudo apresenta uma matriz comparativa de dimensões que permite medir e comparar a resiliência em territórios com diferentes níveis de vulnerabilidade e capacidade adaptativa. Os resultados destacam o papel central da dimensão social, a necessidade de enfoques participativos e a importância da justiça territorial como base para políticas públicas resilientes e inclusivas.

Palavras-chave: resiliência urbana; avaliação multidimensional; sustentabilidade; justiça territorial.

1. Introduction

Over the last decade, the definition of resilience has gained increasing relevance in the field of urban design, especially in the context of global commitments to sustainability. Since the adoption of Sustainable Development Goal No. 11 in 2015 – which proposes to “make cities inclusive, safe, resilient and sustainable” (United Nations, n.d.) – and its inclusion in the 2016 New Urban Agenda (United Nations, 2017), resilience has become consolidated within urban life and the urban fabric, both academically and practically, by proposing transformation and adaptability strategies to address the challenges of twenty-first-century cities.

Resilience becomes an essential attribute for addressing the rapid growth of cities and their vulnerabilities (Kim & Lim, 2016; UN-Habitat, 2017; Sharifi & Yamagata, 2014). For this reason, it is important to consider social factors such as social cohesion and citizen participation, which shape collective response and adaptation capacity in challenging environments (Petrescu et al., 2016; Feinberg et al., 2023; Parés et al., 2023).

Datola (2023) defines urban resilience as the capacity of cities to face difficulties, adapt, and continue growing through the continuous improvement of their structural and social characteristics. It is likewise relevant to address the shift in its conceptual definition, since it has moved from a static perspective – centered on a return to normality – toward a dynamic or transformative perspective that understands cities as complex socio-ecological systems in permanent change (Holling, 1973; Meerow & Newell, 2015; Yamagata & Maruyama, 2016). This perspective not only generates the capacity to respond to adverse effects, but also to reorganize, learn, and adapt continuously, consolidating urban sustainability over time, in line with the Effectiveness of Environmental Urban Policies to Improve Resources Efficiency – EURE project (Interreg Europe, 2025).

From a systemic perspective, urban resilience is embedded in urban fabrics that include socio-ecological and socio-technical networks, so that, through the immediate preservation or restoration of their vital functions in the face of disturbances, they can adapt to change and transform the factors that limit such adaptation (Meerow et al., 2016). According to Pahl-Wostl (2009), this emphasis on adaptability should be presented as a fundamental pillar of governance systems, which would entail transforming traditional institutional structures and positioning urban resilience as a dynamic and collective process.

This new multidimensional and dynamic character of resilience establishes a different and challenging analytical framework, since there is no consensus on it. In this regard, Datola (2023) comprehensively considers five dimensions: physical, social, economic, environmental, and governance. By contrast, socio-ecological resilience theory considers only the social, spatial, and ecological dimensions. The City Resilience Framework (2024), for its part, defines four dimensions: health and well-being; econo-

my and society; infrastructure and environment; and governance and local planning.

Another case is the evaluation of community resilience. In this regard, Rótolo and Zulaica (2021) propose the development of a Socio-environmental Vulnerability Index (SVI) using semi-structured interviews with community actors. Zevallos (2023), in turn, presents a contextualized and participatory approach based on the concept of socioeconomic vulnerability as a key political component for measuring resilience in high-Andean regions.

From a social approach, resilience becomes community-based when self-organized communities are transformed into social support networks with strong bonds of trust, social participation, and mobilization capacity (Parés et al., 2018), thereby promoting collective learning and institutional reconfiguration (Feinberg et al., 2023). Petrescu et al. (2016), for their part, present resilience based on urban commons, emphasizing the political dimension through co-production and collective governance. Another perspective that expands the conception of resilience is multidimensional resilience theory, as it holistically integrates several dimensions: structural, environmental, economic, social, institutional, and cultural (Meerow et al., 2016; Pahl-Wostl, 2009).

Finally, based on the bibliometric analysis by Pu and Qiu (2016), two approaches were identified: ecological and socio-ecological resilience – with greater presence in urban development – and psychological resilience. This reveals an evolution of the concept itself that entails moving away from the linear, static, and parameterized logics of modern urbanism in order to adopt, from a transdisciplinary sphere, change as a fundamental constant for contemporary urban design.

This review illustrates current gaps in the measurement of urban resilience and in the design of practical tools for sustainable urban planning, especially in Latin America. The region is characterized by rapid, disordered, and unplanned urbanization, as well as by social and geographic diversity, which conditions it to face situations of high urban vulnerability to threats such as climate change and socioeconomic inequality, together with limited capacity to respond to crises. For this reason, resilience emerges as an opportunity for Latin America to transform itself and become a more humane and greener territory.

For the purposes of this research, the study combines a literature review with the analysis of selected case studies in Latin American urban contexts. The objective is to identify operational dimensions and subdimensions that allow transformative urban resilience to be evaluated comprehensively and comparatively, integrating social, governance, physical, environmental, and economic approaches.

2. Methodology

This research applied a structured literature review of studies on urban and community resilience published between 2014 and 2025. The study area is understood as the corpus of selected scientific literature developed in diverse contexts worldwide, in which theoretical, methodological, and applied frameworks around resilience were elaborated. The comparative study made it possible to analyze how quantifiable dimensions of resilience have been developed and implemented in diverse urban and rural contexts, identifying convergent and differential elements as well as innovative approaches according to region.

The selection of sources responded to criteria of thematic relevance, scientific currency, geographic diversity, and contextual applicability, ensuring a representative analysis of the theoretical and practical frameworks currently available.

In a complementary manner, exploratory case studies conducted in Latin American cities were selected, allowing the application of instruments that measured resilience with diverse results to be presented. The combination of literature review and analysis of specific cases strengthened the design of an applicable multidimensional evaluation framework that is sensitive to Latin American realities.

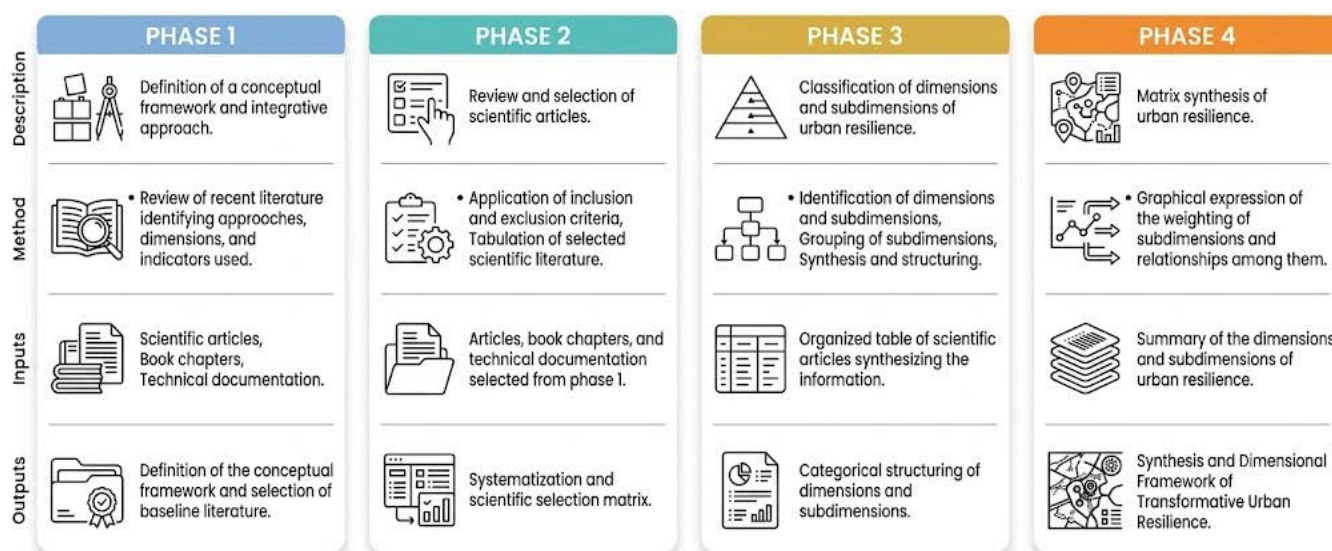
2.1. Methodological phases

The research was carried out in four phases (Figure 1):

- 1) Definition of a conceptual framework and integrative approach,
- 2) Review and selection of scientific articles,
- 3) Classification of dimensions and subdimensions of urban resilience, and
- 4) Matrix synthesis of urban resilience.

Figure 1

Summary of the methodological phases.



2.1.1. Phase 1 – Definition of a conceptual framework and integrative approach

As a first phase, a conceptual framework was established based on a review of relevant and current academic literature. Key scientific articles were reviewed, identifying different resilience approaches, main schools of thought on resilience, and relevant authors.

2.1.2. Phase 2 – Review and selection of scientific articles

To ensure an updated and relevant analysis, a search of scientific literature was conducted in high-impact indexed repositories such as Scopus, Redalyc, Taylor & Francis, ScienceDirect, and high-impact technical documents, using clearly defined inclusion and exclusion criteria. The search strategy combined key terms in Spanish: “resiliencia urbana”, “ciudades resilientes”, “indicadores de resiliencia”, “resiliencia cívica”; and in English: “urban resilience”, “resilient cities”, “resilient indicators”, and “civic resilience”. The initial number of references was not recorded because quality was prioritized over quantity, valuing studies that address urban resilience with a transformative and/or multidimensional approach applied to the territory analyzed, rather than exclusively climatic, environmental, or natural-risk management approaches.

The inclusion criteria applied in the review were:

- Scientific articles and case studies published in the last 10 years (2016-2025).
- Studies that include measurable indicators of urban resilience.
- Peer-reviewed publications, ensuring methodological rigor and academic validity.

Conversely, the following were excluded:

- Studies prior to 2016, except those considered fundamental to the theoretical framework.
- Articles without full-text access or without clear indicator information.
- Research unrelated to the urban sphere.
- Non-academic publications or grey literature.

The selection of articles followed a two-stage procedure: review of titles, abstracts, and keywords to eliminate studies not relevant to this research, and full reading of the preselected texts to ensure that they met the defined criteria. To systematize the information, an Excel table (data extraction form) was used, recording key aspects such as author, title, year of publication, abstract, keywords, methodology, instrument, and population or sample.

2.1.3. Phase 3 – Classification of dimensions and subdimensions of urban resilience

Based on the selected scientific articles, the dimensions and subdimensions of urban resilience were identified and classified. To this end, a content analysis was applied based on the suitability, recurrence, and similarity of resilience dimensions and subdimensions in the selected studies.

- Identification of subdimensions: A comparative analysis of the conceptual frameworks used in the reviewed studies was conducted, identifying the most frequently used urban resilience subdimensions.
- Grouping of subdimensions: The resilience subdimensions were organized by thematic categories, observing their recurrence across different studies.

2.1.4. Phase 4 – Matrix synthesis of urban resilience

The final part of the research consisted of standardizing and synthesizing the information obtained in order to facilitate its understanding and applicability for future research.

Through a graphic synthesis and structuring process, an organizational scheme was developed to enable a measurable evaluation of urban resilience, prioritizing those dimensions that were most consistent and applicable in different urban contexts. For the corresponding internal validation, five case studies were selected using three criteria: theoretical relevance, geographic diversity, and data accessibility. These criteria ensure comparability among different sociocultural, climatic, and regulatory contexts, and ensure that each project contains sufficient technical documentation to identify the resilience approach, types of interventions, and basic quantitative and qualitative indicators, when available.

- Theoretical relevance: All selected cases test existing theories, making it possible to capture heterogeneity and variation in urban phenomena.
- Geographic diversity: The selection includes cases from different Latin American cities in South America and North America, covering demographic, economic, or political variations and revealing common patterns or differences in similar processes.
- Data accessibility: Priority was given to cases with accessible data, minimizing logistical obstacles.

Based on these criteria, the following cases were selected: the city of Reynosa in Mexico; the city of Mar del Plata in Argentina; the city of Medellín in Colombia; the city of Puno in Peru; and the city of Peñalolén in Chile.

3. Results

This section presents the results obtained through the methodology developed.

3.1. Definition of the conceptual framework and selection of the base literature

A conceptual framework was developed based on the review of specialized literature and the cases studied, from which it was found that transformative urban resilience is considered the capacity of cities to transform and adapt in the face of threats, and that the interaction among social, physical, environmental, economic, and governance factors is key. In the review of key scientific articles, different resilience approaches were identified (Table 1), such as socio-ecological, transformative, socio-environmental, community-based, and multidimensional approaches.

Table 1 Definitions of resilience.

Author	Definition of resilience	Approach
Wang et al. (2018)	Combines physical, social, environmental, and management strategies to resist, recover, and transform in the face of challenges, while promoting a safe and sustainable environment for residents.	Socio-ecological and adaptive
Abdul-Rahman et.al. (2022)	The integrated, multidimensional, and adaptive capacity of communities to anticipate, resist, and recover from adverse events while developing sustainable and participatory strategies to mitigate future risks.	Community-based
Datola (2023)	The multidimensional capacity of urban systems to adapt, respond, and evolve in the face of disturbances and changes, not only recovering their essential functions but also improving their initial conditions.	Transformative
City Resilience Framework (2024)	The capacity of cities (including individuals, communities, institutions, businesses, and systems) to survive, adapt, and thrive in the face of any type of chronic stress or acute shock they experience.	Transformative
Parés et al. (2018)	Operates in each community according to at least three context-specific and interdependent factors: the built environment, social capital, and civic capacity, strongly influenced by the pre-crisis context and by socially generated vulnerability conditions.	Neighborhood-based
Feinberg et al. (2023)	The capacity of a more or less formal group of individuals forming a self-organized community to mitigate the effects of future environmental, socioeconomic, and health crises through experimental or disruptive social processes, whose unpredictability fosters collective learning and continuous cycles of change regarding space, infrastructure, and actors.	Social

Rótolo y Zulaica (2021)	A city's capacity to adapt to needs and crises.	Socio-environmental
Zevallos (2023)	The capacity of a community or society to resist, adapt, and recover effectively from a threat while preserving its essential structures and functions.	Socioeconomic
Inzulza et al. (2024)	The capacity of an urban system to resist, adapt, and recover from risks by integrating three key dimensions: social, physical, and environmental.	Multidimensional

Eleven scientific articles with different methodological approaches whose dimensions and subdimensions were quantifiable were selected (Table 2).

Table 2 Selected scientific articles.

Author(s)	Research topic
Petrescu et al. (2016)	They explore co-production and collective governance
Wang et al. (2018)	They identify characteristics of resilient urban communities through a case-study method.
Parés et al. (2018)	They address the role of civic capacity in community resilience.
Villada (2020)	Construction of an Urban Resilience Index in the face of climate variability and climate change.
Rótolo y Zulaica (2021)	They synthesize different aspects that influence vulnerability in the development of an index and use a qualitative approach to analyze urban resilience.
Abdul-Rahman et al. (2022)	Comparative study of critical success factors for community resilience assessment in developed and developing countries.
Datola (2023)	Proposes an integral framework for evaluating urban resilience in urban planning.
Feinberg et al. (2023)	They highlight social capital and social cohesion in self-organized communities.
Zevallos (2023)	High-Andean regions and their socioeconomic vulnerability: the case of the urban area of Puno.
<i>City Resilience Framework</i> (2024)	Key reference for structuring urban resilience in four key dimensions.
Inzulza et al. (2024)	Multidimensional urban resilience in risk contexts: strategies for the “Quiero Mi Barrio” Program based on the “Olga Leiva Neighborhood” case in Peñalolén

3.2. Matrix of systematization and scientific selection

Based on the selected scientific articles, the dimensions and subdimensions of urban resilience were identified and classified. Figure 2 shows an article-review matrix containing the comparative analysis of the dimensions and subdimensions of urban resilience; in this table, information was cross-checked by highlighting coincidences and similarities among the subdimensions found in the selected scientific articles (the detailed matrix, with legible cells, is presented in the Supplementary Material). A vertical sum of the coincidences was performed, and those subdimensions used less frequently in the selected articles were discarded.

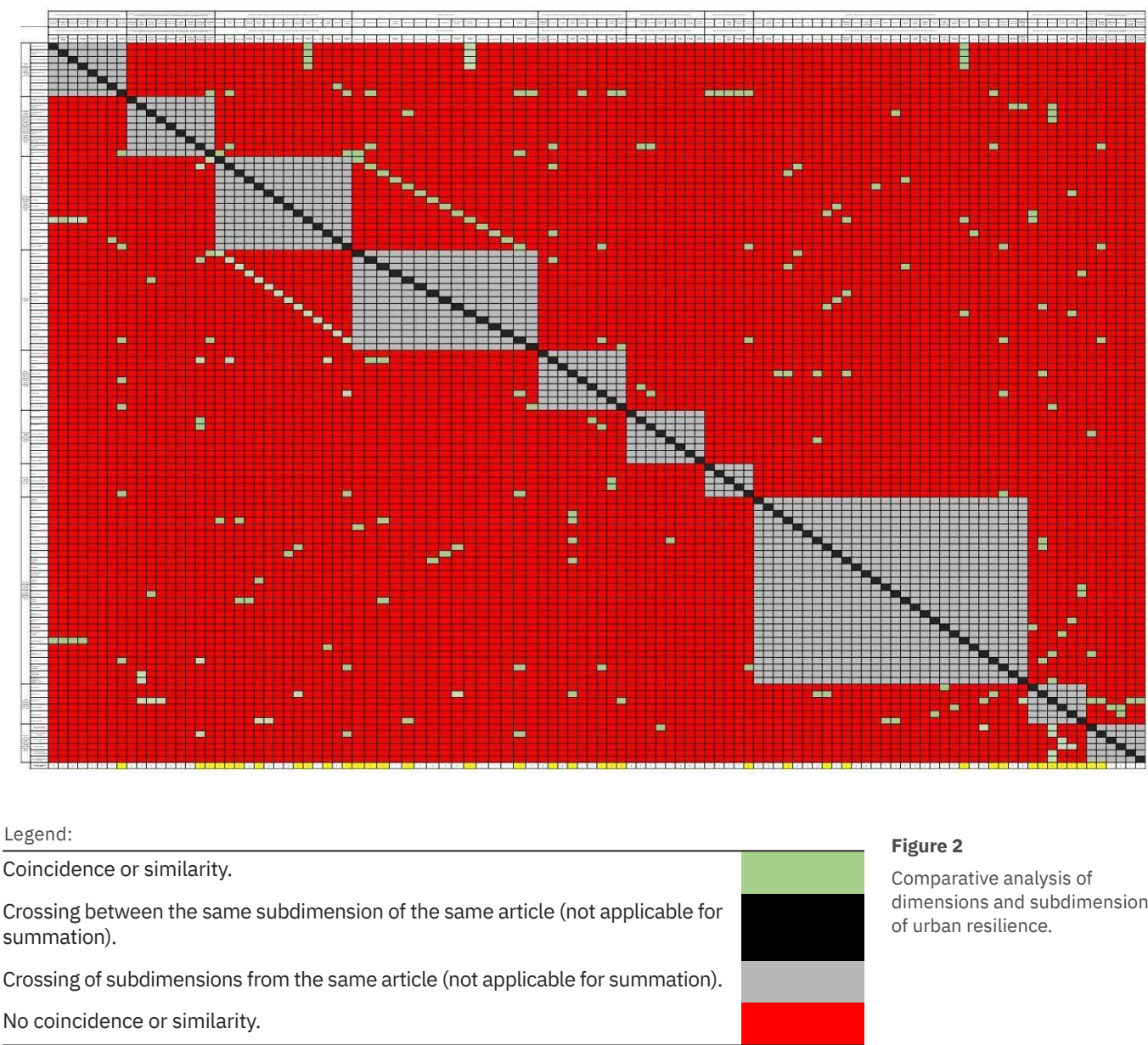


Figure 2
Comparative analysis of dimensions and subdimensions of urban resilience.

3.3. Categorical structuring of dimensions and subdimensions

Through a systematic recategorization that included reordering criteria (Table 3), as well as the definition of nomenclatures and terminological adjustments (Table 4), total and partial coincidences among the analyzed dimensions were identified. Consequently, it was necessary to apply criteria for the refinement and reorganization of subdimensions, especially in cases where redundant definitions, possibilities of integration among categories, or discrepancies between the conceptual definition of the subdimension and the dimension to which it had originally been associated were present.

Table 3 Reordering and recategorization criteria for the transformative urban resilience matrix.

Reordering criteria	Dimensions for systematic evaluation in Latin American territories	
The subdimension definition is repeated or can be integrated into another	CRITERION + DIMENSION TO WHICH IT REFERS: C(1)D(#)	Remove
The subdimension corresponds to another dimension	CRITERION + DIMENSION TO WHICH IT REFERS: C(2)D(#)	Move

Finally, Table 4 presents the results of the process of reordering and re-organizing the subdimensions within each analyzed dimension. The results show a high recurrence of subdimensions linked to social and governance factors, such as collaboration, cooperation, and partnerships, which are consolidated as predominant and determining elements in the scientific articles reviewed.

Table 4 Application of the reordering criteria for transformative urban resilience.

Dimension	Subdimension	Nomenclature	Action	Terminology adjustment
SOCIAL (S)	1. Collaboration among actors (companies, government, NGOs, population)	C(2)D(G)	Move	Cooperation and partnerships
	2. Assessment of community social networks	C(1)D(S4)	Remove	-
	3. Inclusiveness in the community resilience process	C(1)D(S5 and 10)	Remove	-
	4. Citizen participation	RETAINED		-
	5. Social inclusion	RETAINED		-
	6. Social connectivity	C(1)D(S1)	Remove	-
	7. Social activism	C(1)D(S1)	Remove	-
	8. Social relations	C(1)D(S5)	Remove	-
	9. Volunteer participation	C(1)D(S1)	Remove	-
	10. Social cohesion	RETAINED		-
	11. Community empowerment	C(1)D(S10)	Remove	-
	12. Social exposure	C(1)D(S15)	Remove	-
	13. Social fragility	C(1)D(S15)	Remove	-
	14. Social resilience (community training)	C(1)D(S10 and 15)	Remove	-
	15. Risk knowledge	RETAINED		Risk management
	16. Participation and organization	C(1)D(S4)	Remove	-
PHYSICAL (F)	1. Resilient infrastructure	RETAINED		Integral infrastructure
	2. Sustainable mobility	RETAINED		Mobility and connectivity
	3. Connectivity	C(1)D(F2)	Remove	-
	4. Facilities and services	C(1)D(F1)	Remove	-

ENVIRONMENTAL (A)	1. Water quality	C(1)A(5)	Remove	-
	2. Biodiversity and ecosystem services	RETAINED		-
	3. Green infrastructure	C(1)A(2)	Remove	-
	4. Environmental risk assessment	C(1)S(15)	Remove	-
	5. Water-resource management	RETAINED		Water resources
ECONOMIC (E)	1. Evaluación de riesgos económicos	RETAINED		Economic stability
	2. Resiliencia financiera	C(1)E(5)	Remove	-
	3. Exposición económica	C(1)E(1)	Remove	-
	4. Fragilidad económica	C(1)E(1)	Remove	-
	5. Resiliencia económica	C(1)E(1)	Remove	-
GOVERNANCE (G)	1. Cooperación y alianzas (Promotores vecinales)	RETAINED		
	2. Cooperación y alianzas (Agentes de gobierno)	RETAINED		
	3. Cooperación y alianzas (Agentes privados)	RETAINED		

SOURCE: Based on Petrescu et al., 2016; Parés et al., 2018; Wang et al., 2018; Villada, 2020; Rótolo and Zulaica, 2021; Abdul-Rahman et al., 2022; Inzulza et al., 2022; Datola, 2023; Feinberg et al., 2023; Zevallos, 2023; City Resilience Framework, 2024.

3.4. Synthesis and dimensional framework of transformative urban resilience

Consequently, it was found that urban resilience has transformative capacity and must be addressed from a multidimensional and comprehensive perspective that includes the following five dimensions (Table 5): social (S), governance (G), physical (F), environmental (A), and economic (E), each with associated subdimensions. These dimensions are grounded in the transformative approach proposed by Datola (2023), who presents resilience as a multidimensional capacity of urban systems to adapt, respond, and evolve in the face of change. In line with this perspective, the authors of this research consider that these dimensions make it possible to comprehensively address the complex urban processes that take place in inhabited territories.

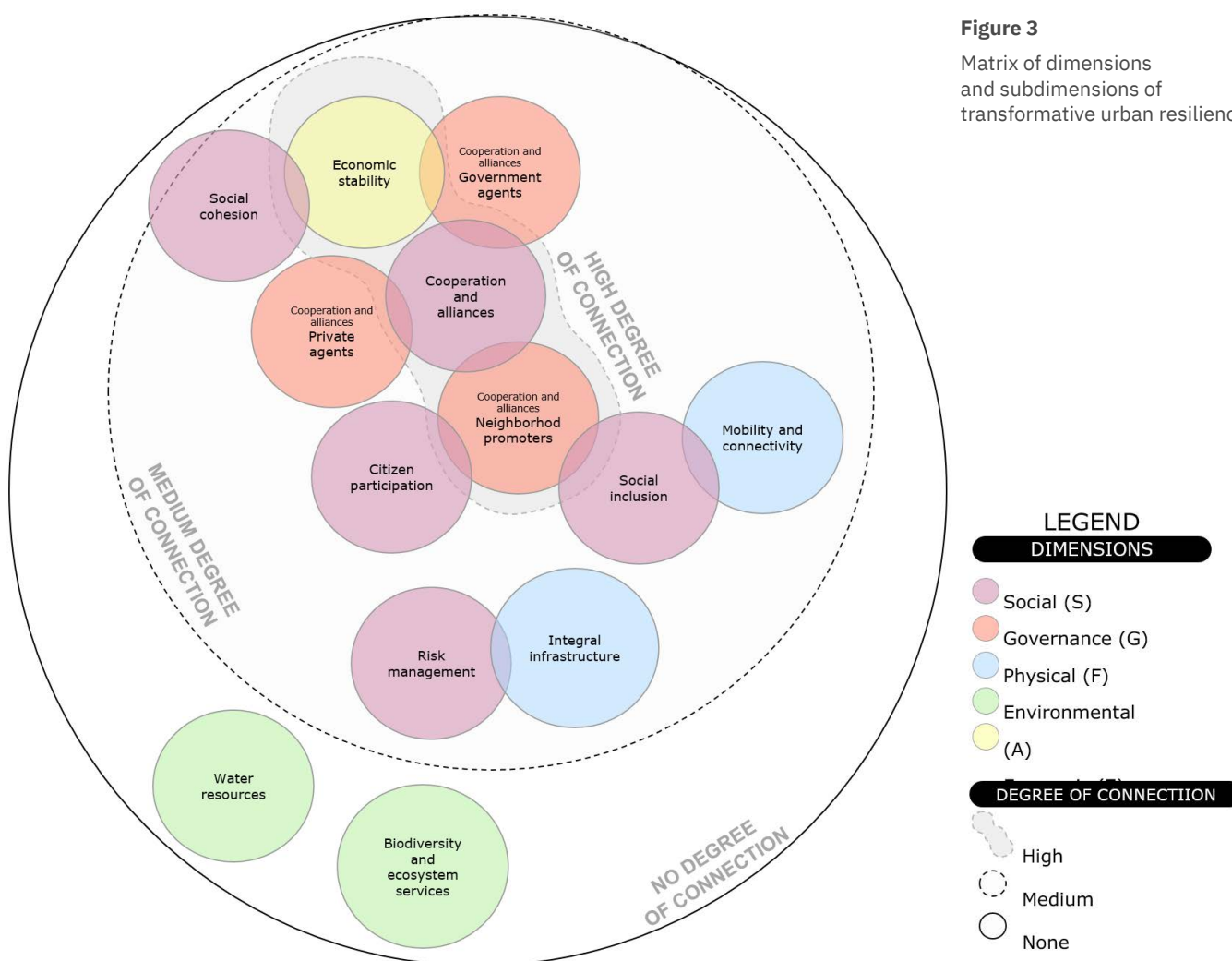
The interaction among the dimensions strengthens cities' response to diverse challenges. The study found that, although all areas are relevant, the social dimension plays a central coordinating role as a connecting axis among governance, infrastructure, and environmental sustainability (Figure 3).

Table 5 Dimensions and subdimensions of transformative urban resilience.

DIMENSION	SUBDIMENSION
SOCIAL (S)	Cooperation and partnerships
	Citizen participation
	Social inclusion
	Social cohesion
	Risk management
GOVERNANCE (G)	Cooperation and partnerships (neighborhood promoters)
	Cooperation and partnerships (government agents)
	Cooperation and partnerships (private agents)
PHYSICAL (F)	Integral infrastructure
	Mobility and connectivity
ENVIRONMENTAL (A)	Biodiversity and ecosystem services
	Water resources
ECONOMIC (E)	Economic stability

Figure 3

Matrix of dimensions and subdimensions of transformative urban resilience.



In this regard, this synthesis makes it possible to establish that transformative urban resilience is a broad and complex concept, with interrelated dimensions that are fundamental for achieving sustainable and equitable communities. As a second identified point, social subdimensions predominate, as will be specified in the discussion section of this document. There is a clear interrelationship among social, governance, physical, environmental, and economic factors, indicating a complementary connection among diverse components.

3.5. Case studies in Latin America addressing resilience through a multidimensional and interdisciplinary approach

The review of the case studies enabled an internal validation of the framework of dimensions and subdimensions proposed for transformative urban resilience, evidencing the relevance of a multidimensional and interdisciplinary approach in the analysis of Latin American territories. Based on the description and understanding of each experience, a recurrent presence of aspects linked to the social, environmental, physical, economic, and governance dimensions was identified, especially highlighting the relevance of social factors such as community participation, social cohesion, cooperation, and institutional articulation. Rather than developing a comparative quantitative or qualitative measurement of transformative urban resilience, the case analysis made it possible to recognize how certain dimensions acquire greater relevance according to the specific problems and capacities of each territory, thereby helping to reinforce and support the conceptual structure proposed in the research.

In Latin America, multiple cities face scenarios of high urban vulnerability and limited response capacity to climate, social, and environmental crises. In the case of Reynosa (Mexico), despite the application of internationally recognized methodologies such as the United Nations Ten Essentials for Disaster Risk Reduction – UNISDR, the results indicated a low level of resilience in critical aspects such as urban design, institutional capacity, and disaster response (Reyes, 2020). Conversely, in some neighborhoods of Mar del Plata (Argentina), resilience is measured through vulnerability, showing high levels of vulnerability because there is a disconnection between policies and the community's resilient capacities (Rótolo & Zulaica, 2021).

In Medellín (Colombia), a low level of urban resilience is also identified through the Urban Resilience Index (URI), evidencing strengths in the institutional, environmental, and economic dimensions, but weaknesses in the social and physical dimensions (Villada, 2020). Another study is that of Puno (Peru), where high socioeconomic vulnerability and a need to strengthen risk management were evidenced (Zevallos, 2023). Nevertheless, the Olga Leiva neighborhood (Peñalolén, Chile) is presented as a case with significant progress in urban resilience, thanks to a public

neighborhood-improvement program with a multidimensional approach that highlights work with the community in all phases of the process (Inzulza et al., 2024).

These cases show the need for an integral framework that makes it possible to evaluate community resilience from an interdisciplinary perspective, incorporating several urban dimensions. Although structural challenges persist, the advances in Peñalolén and Medellín show that urban resilience is not only an analytical concept, but also a dynamic process with concrete impacts. The analysis of international experiences made it possible to identify key subdimensions and methodological approaches that respond to the complexities of Latin American territories and contribute to the construction of transformative strategies for more resilient cities.

3.5.1. Reynosa with a view to becoming a sustainable and resilient community

This is the case of Reynosa (Tamaulipas, Mexico), where there is concern about “reducing the vulnerability of the population as well as that of ecosystems” and infrastructure (Reyes, 2020, p. 48), and whose Municipal Development Plan is aligned with Goal 11 of the 2030 Agenda. Therefore, Reyes (2020) applies the self-assessment tool known as the Ten Essentials, developed by the UNISDR Office, based on the Rockefeller Foundation guide to obtain the Urban Resilience Index (CRI) and the urban resilience profile developed by Mexico’s Secretariat of Agrarian, Territorial and Urban Development – SEDATU.

This methodology consists of 10 thematic axes that can be adapted to the situation of any city in the world (Reyes, 2020). They have a numerical weighting through which a quantitative degree of resilience is assigned according to intervals of resilience levels from the UNISDR guide in order to obtain an overall degree of resilience.

The analysis found that urban resilience in Reynosa is low. The most critical aspects were social, economic, and physical aspects, as well as effective disaster response. It should be noted that, according to the National Risk Atlas (2008, as cited in Reyes, 2020), Reynosa has a high resilience index due to its adaptation to climate change, and the National Institute of Ecology and Climate Change (2017, as cited in Reyes, 2020) indicates that its response and adaptive capacity are moderate. According to Reyes (2020), both results are not related to the new characteristics presented by the municipality.

3.5.2. Palermo Park and Las Heras: peri-urban neighborhoods of Mar del Plata, Argentina

There are also the neighborhoods located along the urban edge of the city of Mar del Plata (Buenos Aires, Argentina), where a methodological procedure was applied based on the Socio-environmental Vulnerability Index

(SVI) and semi-structured interviews to address aspects of resilience. In this case, the city of Mar del Plata is a city with a strong tourism profile, but it has also grown spontaneously and in a disordered manner, presenting social and environmental problems (Zulaica & Ferraro, 2010, as cited in Rótolo & Zulaica, 2021).

Among the indicators used in the construction of the socio-environmental vulnerability index are the percentages of the population with unsatisfied basic needs, the population by age, household characteristics, and service facilities. The interviews were structured around the following main axes: general information about the interviewee and their relationship with the neighborhood; physical characteristics of the neighborhoods; problems and weaknesses observed in the neighborhoods; strengths possessed by the neighborhoods; and projects and activities planned for the year in which the study was conducted.

The evaluation of socio-environmental vulnerability reveals critical situations, especially in the Parque Palermo settlement. Although it has been observed that the communities in both neighborhoods possess resilience capacity, this has not been reflected in urban management. The results showed the key approach that urban resilience can reduce vulnerability in the long term. The characteristics of urban resilience should be considered in the planning of urban projects, rather than only when problems manifest in neighborhoods (Rótolo & Zulaica, 2021). Community participation must be strengthened, since making a city resilient involves a sustainable network of physical systems (built and natural) and human communities that possess transformative capacity in response to urban threats.

3.5.3. The case of Medellín as an adaptive model, Colombia

In Medellín, Colombia, an Urban Resilience Index (URI) was developed to evaluate the city's capacity in the face of climate variability and climate change. This index is based on five key dimensions: social, environmental, economic, physical, and institutional, aligned with the approach of the Intergovernmental Panel on Climate Change – IPCC (2014, as cited in Villada, 2020).

A participatory method based on expert panels was applied to select and weight 28 key variables. The methodology included data collection and normalization using Geographic Information Systems (GIS) and statistical models. The results indicated that Medellín obtained a low level of resilience (45.5%), with significant deficiencies in infrastructure, social cohesion, and the economy, reflecting a limited capacity to respond and adapt to climate challenges.

The findings show the structural and social fragility of Medellín, with the social, economic, and physical dimensions registering the lowest scores and affecting its overall resilience (Villada, 2020). Despite some advances in governance and environmental sustainability, these have not been suffi-

cient to offset its critical vulnerabilities. The study establishes a model for measuring urban resilience, offering a replicable methodology that guides comprehensive strengthening policies.

3.5.4. Resilience and vulnerability in the urban area of Puno: socioeconomic analysis in high-Andean contexts, Peru

The highland city of Puno, located at 3,810 meters above sea level, presents complex socioeconomic vulnerability as a result of its disordered urban growth along Lake Titicaca. This geographic situation increases the probability of adverse events associated with natural hazards such as floods and landslides. Through the integrated application of the Analytic Hierarchy Process (AHP) and Geographic Information Systems (GIS), Zevallos (2023) developed a study that mapped various vulnerability factors. The methodology evaluated 14 indicators distributed across three dimensions: exposure, fragility, and resilience, using socioeconomic variables such as poverty, basic services, demography, and housing conditions, complemented by interviews on urban perception.

The results reveal a critical scenario: 68% of Puno's urban population faces high significant vulnerability to natural hazards such as floods, erosion, rockfalls, landslides, and unstable soils. Social resilience, linked to knowledge about disasters and risk management, and economic resilience, associated with job stability and income, are key to the population's adaptation.

Following the approach of Arvin et al. (2023, as cited in Zevallos, 2023), the study quantifies resilience as a fundamental component of vulnerability, revealing the importance of evaluating urban capacities in the face of natural threats for sustainable development.

3.5.5. The “Quiero Mi Barrio” Program based on the “Olga Leiva Neighborhood” case, Chile

In the Olga Leiva neighborhood (Peñalolén, Chile), the “Quiero Mi Barrio” Program promotes urban resilience in the face of seismic risk from the San Ramón Fault. In coordination with the Sendai Framework (2015, as cited in Inzulza et al., 2024) and the National Policy for Disaster Risk Reduction (PNRRD 2020-2030) (2020, as cited in Inzulza et al., 2024), social, physical, and environmental dimensions are considered. Therefore, participatory methodologies were applied as key urban strategies (Inzulza et al., 2024).

The study used a qualitative approach, employing secondary-source analysis and semi-structured interviews as techniques. Urban resilience was evaluated in its social, physical, and environmental dimensions using the digital program Atlas.ti. The analysis was structured in three phases: Diagnosis, Implementation, and Closure (Inzulza et al., 2024). The applied instruments were key tools for integrating risk understanding, participa-

tion and communication, and sustainable recovery at each stage of the process, at the neighborhood scale.

This strengthened resilience through the program's social dimension by integrating the community throughout the entire process, from application to participatory design and monitoring. Resilience with a multidimensional approach strengthens territorial adaptation and makes it possible to generate replicable models in other state programs (Inzulza et al., 2024). Likewise, participatory urban planning improves social cohesion and disaster preparedness, ensuring that risk knowledge and citizen education support sustainable recovery and preventive territorial management.

Ultimately, the cases of Reynosa, Medellín, Puno, and Mar del Plata show how the lack of articulation among these dimensions – especially the social, environmental, and governance dimensions – weakens recovery and adaptation processes. By contrast, the Peñalolén (Chile) experience shows that an integral and participatory strategy can generate resilient urban transformations, even in vulnerable contexts.

4. Discussion

Transformative urban resilience is a highly complex variable that requires analysis from a holistic, structured, and effective perspective. The review of existing studies shows that analysis cannot focus solely on technical or infrastructural components; rather, it should consider social, environmental, institutional, and economic aspects that directly affect cities' adaptive capacity in risk situations.

The findings reveal the relevance of the social aspect as an essential axis of urban resilience. It appears with some frequency in the categories of dimensions and subdimensions studied, which evidences its importance in the theoretical framework under analysis and also highlights its role in community cohesion and citizen participation. For example, in the study by Inzulza et al. (2024), the Olga Leiva neighborhood, located in the commune of Peñalolén, Chile, is a case that demonstrates this perspective. A multidimensional resilience model was applied, through which integrated strategies and the active participation of residents improved response capacity in the face of threats.

However, it is necessary to emphasize that, in the Latin American context, social components acquire even greater importance due to the conditions of historical inequality, structural poverty, and exclusion that affect many communities (Abdul-Rahman et al., 2022). Within this framework, alternative forms of self-management and cooperation become particularly relevant. Feinberg et al. (2023) emphasize that social capital and community cohesion are essential elements for effective resilience in critical situations. Along the same lines, Parés et al. (2018) stress that neighborhood resilience depends on civic capacity; that is, on residents' ability to orga-

nize and respond collectively to common problems. Similarly, Petrescu et al. (2016) argue that active participation and networking are determining factors in the consolidation of resilient processes. This view is reinforced by the contributions of Abdul-Rahman et al. (2022), who advocate participatory approaches that make it possible to design resilient actions based on an integral understanding of vulnerability and community capacities. In this sense, resilience should focus on recovery capacity in order to include processes of territorial justice, active inclusion, and citizen participation.

Although the social and institutional dimensions are fundamental, the important role played by the environment and context as facilitators of urban resilience should not be ignored. Thus, Wang et al. (2018) highlighted the importance of flexible and multifunctional planning of infrastructure and public spaces to enable diverse activities and facilitate disaster response, denoting the relationship among physical infrastructure, public services, and social cohesion in the creation of resilient communities.

The proper management of water and biodiversity should also be considered essential for reducing environmental risks in territories exposed to extreme phenomena. Datola's (2023) transformative proposal highlights the protection of urban ecosystems and responsible environmental management as key aspects. In rapidly growing Latin American cities, it is important to move toward urban development models that prioritize territorial sustainability and the strengthening of ecosystem services, which are often relegated to the background.

Based on this study, it can be affirmed that resilience cannot be measured only with isolated indicators; rather, these should be viewed as the result of complex interactions among different social actors and diverse dimensions. Based on the above, the methodological approach used, which integrates both academic literature and case studies, made it possible to detect patterns and develop a comparative table. This strategy reinforced the robustness of the analytical framework and also enabled an interpretation of the particular characteristics of each city studied.

The results showed that urban resilience should be understood as an active and continuous process. In Latin America, where inequality and exclusion are realities, resilience should measure response capacity. The City Resilience Framework (2024) identifies key points for application, where structural robustness, adaptive capacity, institutional reflection, and intersectoral coordination are necessary to effectively confront challenges. In some case studies, such as Reynosa (Mexico) and Medellín (Colombia), a socio-ecological approach was applied to evaluate resilience, making it possible to identify critical weaknesses and update available information, thereby generating participatory strategies for the public and private sectors.

Urban resilience must be understood as more than a simple capacity to respond to crises. It is an evolving process that requires constant learning and continuous adaptation to new realities. In this regard, the IPCC (2014,

as cited in Villada, 2020) emphasizes that cities must preserve their identity while developing better mechanisms to adapt and transform. Studies such as those by Rótoló and Zulaica (2021) on Mar del Plata (Argentina) and Zevallos (2023) on the city of Puno (Peru) indicate that socio-environmental vulnerability, resulting from both exclusion and economic precariousness, is a significant barrier to strengthening resilience, since it reduces response and adaptation capacity in the face of adverse events.

Ultimately, urban resilience must be conceived as a dynamic and multidimensional process that, in order to ensure the long-term sustainability of cities, requires the articulated treatment of social, environmental, economic, institutional, and physical aspects. This view coincides with the conclusions of Villada (2020), who states that a resilient city must not only guarantee adequate infrastructure and services, but also protect the natural environment and improve the quality of life of its inhabitants. Within this framework, social justice, environmental sustainability, and inclusive governance are not merely aspirations, but indispensable conditions for addressing current urban crises and building truly resilient territories. Even so, important challenges persist, such as the lack of updated data, the difficulty of measuring social variables, and the need to adapt evaluation instruments to local realities. These limitations reinforce the need to continue developing methodological tools that are sensitive to Latin America's territorial diversity.

5. Conclusions

Developing a measurable, holistic, and contextualized framework contributes to evaluating the transformative urban resilience demanded by contemporary urban spaces. However, the study showed that the social and governance dimensions are often ignored or insufficiently considered, despite the fact that both are fundamental for articulating the collective capacity of communities. In this regard, a reordering of key dimensions was proposed – social (S), governance (G), physical (F), environmental (A), and economic (E) – that more accurately reflects their dynamic interaction and their relevance to urban sustainability and equity.

As identified throughout the research, the social dimension stands out for its coordinating role, while governance emerges as a fundamental basis for participatory, cooperative, and territorially integrated decision-making. In turn, the physical, environmental, and economic dimensions complement one another, ensuring the necessary conditions to sustain resilience processes over time.

The categorization process used made it possible to develop a dimensional framework of transformative urban resilience, enabling its future instrumentalization and application in evaluations that are more precise and sensitive to the realities of Latin American territories. Likewise, this

framework can help guide integrated, inclusive, and territorially contextualized public policies.

The use of measurable categories, validated by the literature and evidenced in case studies, not only contributes to improving evaluation mechanisms but also promotes the active participation of different social actors in the design of urban transformation strategies.

The case studies analyzed – Mexico, Argentina, Peru, Colombia, and Chile – clearly illustrate this assertion. Whereas in Mexico, Argentina, Peru, and Medellín low resilience was attributed to partial interventions, the Chilean case demonstrated significant improvement by integrating multiple dimensions in an articulated and participatory manner. These contrasts confirm that transformative urban resilience cannot be fragmented or merely technical: it must be grounded in a systemic, human-centered vision guided by principles of territorial justice.

Similarly, when considering the interrelationship between the governance and social dimensions, it can be concluded that the social dimension plays a central role in the analysis of urban resilience, since it maintains close links with subdimensions belonging to other dimensions. Social inclusion, active participation, and community cohesion should not be conceived as desirable consequences, but as indispensable conditions for building truly resilient, just, and sustainable cities.

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