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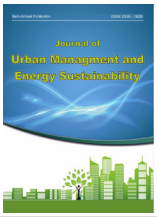

CASE STUDY RESEARCH PAPER

Explaining a sustainable urban regeneration model with an approach to improving the quality of urban space

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ABSTRACT

Urban areas are continually evolving, facing increasing pressures from environmental, social, and economic challenges. Developing a sustainable urban regeneration model that prioritizes the enhancement of urban space quality is essential for creating resilient, vibrant, and livable cities for current and future generations. The urban regeneration approach, as a dynamic process of restoration and renovation of urban fabrics, is based on the concept of sustainable developmen,. The aim of this study is to explain the main indicators affecting the concept of urban regeneration with the approach of optimizing urban spaces. This research is of a descriptive-analytical type, which aims for development, but its fundamental characteristic can be highlighted, particularly in explaining the depth of the theoretical foundations, as well as the proposed model and framework. The method of data collection involves both library and field methods, utilizing references such as the architecture departments of academic institutions and international data sources, along with field-level observations. First, after examining the theoretical foundations and the research history in two dimensions procedure and content emphasis is placed on clarifying the objective without repetition. Factors are then extracted as the result of the research framework, and the Delphi method is used to propose final indicators in the form of a model. The findings show 7 most significant factors are greenery, employment, investment, citizen engagement, amenities, stakeholder involvement and pollution control. Finally, the presented structural model underscores that sustainable urban regeneration is not the result of isolated actions but a coordinated effort across multiple domains.

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INTRODUCTION

In recent decades, addressing the challenges of modern and unsustainable urban development has become one of the main priorities of urban research (Yang et al., 2022). Cities worldwide face numerous issues such as air pollution, traffic congestion, reduction of green spaces, deterioration of old and rundown areas, and declining quality of life for residents (Zagorácz, Liang, & Várady, 2023). These problems demand innovative and sustainable approaches to urban regeneration and improvement, capable of balancing economic, social, and environmental development (Chahardowli et al., 2020). One of the key strategies in this field is urban regeneration, which aims to revitalize old neighborhoods, reduce poverty and social inequalities, and enhance urban space quality. This approach can serve as an opportunity to transform vulnerable, degraded areas into vibrant, attractive, and economically active centers, thereby improving residents' satisfaction and achieving sustainable development (Gao, Chen, Wang, & Pellegrini, 2022). Within this context, the concept of sustainability in urban development holds particular importance. Urban sustainability emphasizes creating urban spaces that meet current needs without compromising the ability of future generations to meet theirs. This requires designing and implementing strategies that integrate economic, social, and environmental aspects harmoniously (Li et al., 2024). In recent years, various models for urban regeneration have been introduced, each tailored to local conditions, economic realities, and social contexts. However, due to the complexity and diversity of urban issues, there is a need to develop more comprehensive and strategic models that can consistently and effectively influence the quality of public and private spaces (De Sousa Lima et al., 2024). Improving the quality of urban spaces depends on the intersection of green space development, public amenities, citizen interaction, and effective management. This is crucial for creating dynamic, diverse, and resilient cities capable of responding to residents' everyday needs while also being environmentally, economically, and socially sustainable (Prim, Figueiredo, & Dandolini, 2021). To achieve sustainable urban development, models must be designed not only to focus on existing spaces but also to create new opportunities for developing public and private spaces. In addition, participatory processes and collective decision-making must be organized and facilitated to strengthen citizens' roles in shaping the urban environment (Lak et al., 2021). Furthermore, modern technologies, especially digital and smart city innovations, are powerful tools for the process of urban regeneration and improving space quality. These technologies enable monitoring urban performance, enhancing services, and increasing citizen participation (Tiboni & Boglietti, 2022). In summary, aligning urban regeneration models with sustainability principles and aiming to improve space quality requires innovative frameworks, participatory approaches, and the integration of new technologies. Such approaches can transform cities into resilient and adaptable entities capable of meeting future challenges (Saha & Banerjee, 2022). Finally, studying successful case studies from different countries offers valuable lessons and insights for developing suitable, context-specific strategies. Analyzing global experiences can guide the design of comprehensive and sustainable models in the field of urban regeneration (Haase et al., 2021). Despite the increasing recognition of the importance of sustainable urban regeneration, many cities struggle to develop and implement effective models that genuinely enhance the quality of urban spaces while ensuring long-term sustainability. A significant challenge lies in balancing multiple, often conflicting, objectives such as economic revitalization, social inclusion, environmental preservation, and aesthetic improvement within complex urban contexts (Barnes, 2024). Furthermore, many regeneration initiatives tend to focus primarily on physical and infrastructural

improvements without adequately addressing social dimensions and community participation. This often leads to developments that are unsustainable in the long term and fail to meet the needs of diverse urban populations (Aspuru et al., 2022). Additionally, the lack of integrated and strategic planning can result in fragmented efforts that do not produce lasting impacts or improvements in the quality of urban spaces (Elsayed, 2021). Another critical issue is the limited adoption of innovative technologies and participatory decision-making processes in urban regeneration projects, which hampers effective stakeholder engagement and adaptive management (Caldarola, 2020). Consequently, many regeneration projects do not fully capitalize on the potential of digital tools and smart solutions to monitor progress, gather feedback, and guide sustainable development practices (Zhang, Xu, & Guo, 2022). Moreover, existing models often lack a comprehensive framework that effectively combines sustainability principles with local socio-economic and cultural contexts. This mismatch reduces their applicability and effectiveness in achieving genuine, resilient, and equitable urban regeneration, particularly in rapidly urbanizing areas (Liu, 2022). Overall, there is a pressing need for a holistic, sustainable model that integrates environmental, social, and economic considerations and actively involves citizens and stakeholders. Such a model should be capable of guiding urban regeneration efforts that truly improve the quality of urban spaces and promote long-term resilience, especially in the face of climate change and urbanization pressures (Wang, Pellegrini, & Chen, 2022). Building upon the main research focus, the next step is to develop a set of specific indicators that can effectively measure and evaluate the success of a sustainable urban regeneration model with an emphasis on improving the quality of urban spaces (Önaç & Sütçüoğlu, 2022). These indicators will serve as practical tools to assess various sustainability dimensionseconomic, social, and environmental and ensure that the regeneration efforts are aligned with overarching sustainability principles(Fallanca, 2020). By establishing clear, measurable criteria, it becomes possible to monitor progress, identify gaps, and adapt strategies accordingly, thereby enabling more informed decision-making in urban planning and regeneration processes (Jung & Awad, 2021). In addition to defining indicators, the goal is to formulate a comprehensive conceptual model that integrates these measures within a structured framework (Agapi et al., 2024). This model will illustrate the relationships between key components such as environmental quality, social participation, infrastructure development, and stakeholder engagement. The conceptual framework will serve as a guide for practitioners and policymakers to design, implement, and evaluate sustainable urban regeneration initiatives systematically (Addas, 2023; Çoniku & Manehasa, 2021). Ultimately, this model aims to provide a clear conceptual foundation that supports the development of effective strategies and policies for enhancing urban space quality within a sustainable context (Kara & Iranmanesh, 2022; Zhang & Gu, 2025; Mitkovic, Protić, & Vasilevska, 2020). A sustainable urban regeneration model integrates social, economic, environmental, and governance dimensions. Social factors—such as community involvement, housing provision, and quality of life—are especially significant, followed by environmental considerations like green space and resource conservation. Economic viability and effective policymaking also play crucial roles in ensuring long-term success and resilience of urban regeneration efforts (Zhao et al., 2023; Caselli et al., 2024; Zhuang et al., 2023; Chen et al., 2024).

Improving the quality of urban space is central to sustainable regeneration. This involves:

Enhancing accessibility and inclusivity of public spaces, promoting active mobility, and ensuring zero soil consumption and renaturalization of urban areas (Hu et al., 2024; Caselli et al., 2022). Upgrading built environments to foster social sustainability, with design elements

focused on accessibility, quality of social life, conservation of resources, and protection of disadvantaged groups (Chen et al., 2024). Redesigning public spaces and mobility infrastructure to improve pedestrian and cycle access to services, supporting healthier and more equitable urban environments (Caselli et al., 2022). Robust assessment frameworks are essential for tracking progress. Models such as the SDGs-based index (URSDGi) evaluate regeneration outcomes across multiple urban types, measuring improvements in land use efficiency, mixed land use, and overall SDG performance. However, regeneration can also introduce challenges, such as increased pressure on housing and potential reduction in green spaces, highlighting the need for balanced, context-sensitive approaches (Liu, 2022). Active community participation and inclusive governance are vital. Participatory planning processes and stakeholder engagement ensure that regeneration addresses local needs and fosters a sense of ownership, which is critical for the long-term sustainability and acceptance of urban changes (Zhao et al., 2023; Caselli et al., 2024; Hu et al., 2024). Incorporating innovative technologies, energy efficiency, and green building practices supports environmental sustainability and enhances the quality of life. Green city models serve as valuable references, demonstrating how infrastructure development and social initiatives can create comfortable, safe, and environmentally friendly urban environments (Caselli et al., 2024; Zhuang et al., 2023; Ros-García, 2022). Urban regeneration is a complex, multi-dimensional process that aims to enhance the sustainability, livability, and resilience of urban areas. A comprehensive approach to sustainable urban regeneration must integrate environmental, social, economic, and infrastructural dimensions to create vibrant and resilient cities for current and future generations. Below table presents a structured model for sustainable urban regeneration, categorizing its core components, criteria, and sub-criteria. Each component addresses critical aspects necessary for holistic urban development. Environmental sustainability focuses on improving green spaces, biodiversity, air and water quality, and mitigating urban heat island effects key factors in ensuring healthy and resilient cities. Social inclusion and community engagement emphasize equitable access to resources and active public participation, fostering social cohesion and cultural vitality. Economic revitalization highlights job creation, real estate development, and connectivity, which are vital for economic resilience and growth. Furthermore, the table underscores the importance of urban space quality and aesthetics, encompassing design, safety, and cleanliness, which influence the overall experience of city inhabitants. Infrastructure and public services are crucial for providing basic needs and supporting daily life, while participatory planning encourages stakeholder engagement and effective governance. Lastly, leveraging innovation and technology through smart city solutions and digital access is vital for modern urban management and improving service delivery. This analytical framework aims to guide policymakers, urban planners, and stakeholders toward an integrated strategy that prioritizes sustainability, inclusivity, and innovation, ultimately leading to more livable and sustainable urban environments. (Tab. 1)

MATERIALS AND METHODS

Urban regeneration

The urban regeneration approach, as a dynamic process of restoration and renovation of urban fabrics, is based on the concept of sustainable development, which aims to preserve and revive cultural and historical values while improving the quality of life of residents (Lak, Gheitasi, & Timothy, 2020). This approach relies more on the active participation of local communities in order to meet the real needs of citizens and at the same time avoid stereotypical interventions. Citizen participation is considered one of the fundamental principles of this process and plays an important role in the success of regeneration projects (Boussaa et al., 2023). Urban regeneration maintains a close relationship between

economic and social development and believes that improving the physical form should be in line with improving the social situation in order to have long-term and sustainable effects (Hosseini et al., 2024). Therefore, paying attention to social and cultural dimensions along with physical reforms is of great importance. Another important principle of regeneration is the preservation of the cultural and heritage identity of cities. This approach, based on an understanding of the cultural and historical values of the city, attempts to revive them and transmit them to future generations (Shahabadi & Sajadzadeh, 2020). In addition, the desire for the internal revitalization of historical fabrics causes these places to once again play an active role in everyday life as identity and cultural symbols and strengthen the sense of belonging of residents. From a theoretical perspective, the urban regeneration approach should be based on sustainable development; that is, preserving resources and reducing negative impacts on the environment during renovation operations (Nikfarjam et al., 2024). This approach emphasizes the optimal use of resources, designing with an economic-environmental approach, and

Table 1: Component, criteria and sub-criteria of sustainable urban regeneration model with an approach to improving the quality of urban space

Component	Criteria	Sub-criteria
Environmental Sustainability	Green Space and Biodiversity	Number and quality of parks, urban trees, biodiversity indices
	Air and Water Quality	Levels of pollutants, access to clean water
	Urban Heat Island Effect	Temperature reduction strategies, reflective surfaces
Social Inclusion and Community Engagement	Public Participation	Community involvement in decision-making, stakeholder engagement
	Social Equity	Access to amenities for diverse social groups, affordability of housing
	Cultural and Social Vitality	Preservation of local culture, social cohesion indices
Economic Revitalization	Job Creation and Economic Opportunities	Number of new jobs, support for local businesses
	Real Estate Value and Investment	Property value increase, private sector investments
	Accessibility and Connectivity	Public transport accessibility, walkability scores
Urban Space Quality and Aesthetics	Design and Aesthetics	Visual quality, architectural coherence, street furniture
	Safety and Security	Crime rate, lighting quality
	Maintenance and Cleanliness	Regular maintenance, cleanliness indices
Infrastructure and Public Services	Infrastructure Quality	Quality of roads, sewage, lighting, internet connectivity
	Availability of Public Amenities	Parks, community centers, healthcare, educational facilities
Participatory Planning and Management	Stakeholder Engagement	Degree of citizen participation, multi-stakeholder coordination
	Governance and Policy Framework	Effectiveness of urban management policies, enforcement mechanisms
Innovation and Use of Technology	Smart City Solutions	Deployment of sensors, data-driven management, digital apps
	Technological Accessibility	Digital literacy, access to digital services

improving the quality of the urban environment, all of which are aimed at creating better livability for residents. Studies show that urban regeneration plays a key role in strengthening social cohesion and reducing class gaps. This process, by improving public spaces, creating economic opportunities, and providing desirable facilities, increases social participation and a sense of belonging in urban neighborhoods (Cappello et al., 2022). These factors ultimately help to strengthen a sense of trust and social ownership. In addition to the importance of cultural content, the regeneration process should pay special attention to indicators of physical resistance and resilience. These indicators are, in fact, the ability to cope and adapt to natural disasters such as earthquakes and environmental crises (Feizizadeh et al., 2021). Therefore, resilient and sustainable design in the form of regeneration plays an important role in the sustainability of the global community. Another theoretical consideration is the impact of the regeneration process on the local economy. This approach can increase economic values and increase employment opportunities within historic and old neighborhoods (Ahmadivostakolaei et al., 2024). Economic development, while preserving cultural values, not only contributes to economic sustainability but also enables social and cultural development. These models strive to ensure that adaptive and flexible processes respond to the changing needs of society and the environment, and accordingly, design strategies should be reviewed throughout the project life cycle (Meshkini, Bozorgvar, & Alipour, 2024). Finally, it is important to know that urban regeneration is not only a physical project but also a social process that must be carried out in a participatory and coherent manner. Deepening the concepts of citizen-centeredness and smart city-based approaches play an important role in achieving this goal (Figueiredo, Prim, & Dandolini, 2021). Therefore, education, culture building and resident participation are the keys to the success of the various stages of regeneration.

Methodology

This research is of a descriptive-analytical type, which aims for development, but its fundamental characteristic can be highlighted, particularly in explaining the depth of the theoretical foundations, as well as the proposed model and framework. The method of data collection involves both library and field methods, utilizing references such as the architecture departments of academic institutions and international data sources, along with field-level observations. First, after examining the theoretical foundations and the research history in two dimensions procedure and content emphasis is placed on clarifying the objective without repetition. Factors are then extracted as the result of the research framework, and the Delphi method is used to propose final indicators in the form of a model. In the Delphi process, through successive rounds, an elite panel consisting of 15 specialists in architecture, university professors, and researchers in the field is formed. Data collection is conducted via a digital questionnaire using Google Forms, with responses received through a link. The responses are categorized based on a Likert scale, ranging from very low, low, medium, high, to very high impact. The influencing factors on the subject of the sustainable urban regeneration model with an approach to improving the quality of urban space are identified through several stages, including the calculation of the Kendall coefficient for the responses. The polling process is halted once a certain average is reached. The final indicators are then proposed as the research framework. Subsequently, the extracted indicators are explained as the main model of the research, based on the intermediate analysis of the results.

DISCUSSION AND FINDINGS

Initially, based on the structure of the component table and criteria, the extracted factors are extracted from the theoretical foundations and the theoretical framework and are compiled in the form of direct factors. (Tab. 2) (Fig. 1)

The Delphi method is a structured communication technique used to gather expert opinions and reach consensus on complex issues. In this simulation, we aim to identify the most influential factors affecting a sustainable urban regeneration model focused on improving the quality of urban space.

Establishing the Initial List of Factors

Based on the previously provided list in table, 18 potential factors were identified, categorized under various components such as environmental sustainability, social participation, economic revitalization, urban aesthetics, infrastructure, and technology.

Table 2: Factors and direct factor of sustainable urban regeneration model with an approach to improving the quality of urban space

Component	Criteria	Factor	Direct Factor
Environmental Sustainability	Green Space and Biodiversity	Development of parks and urban trees effectively	Greenery
	Air and Water Quality	Reducing pollutants and access to clean water	Pollution Control
	Urban Heat Island Effect	Use of reflective materials and temperature reduction strategies	Cooling Solutions
Social and Participatory	Public Participation	Level of citizen involvement in decision-making	Citizen Engagement
	Social Equity	Equal access to amenities and affordable housing	Equity
	Cultural and Social Vitality	Preservation of cultural identity and social cohesion	Cultural Vitality
Economic	Job Opportunities and Economic Revitalization	Creating new jobs and supporting local businesses	Employment
	Real Estate Value and Investment	Growth in property value and attracting private investment	Investment
	Accessibility and Connectivity	Improving public transportation and walkability	Connectivity
Urban Space Quality and Aesthetics	Design and Aesthetics	Enhancing urban design and architectural harmony	Design
	Safety and Security	Reducing crime rates and ensuring security in public spaces	Security
	Maintenance and Cleanliness	Regular maintenance and cleanliness of public areas	Cleanliness
Infrastructure and Public Services	Infrastructure Quality	Improving roads, waste collection, internet, and lighting	Infrastructure
	Availability of Public Amenities	Providing parks, cultural centers, healthcare, and educational facilities	Amenities
Participatory Planning and Management	Stakeholder Engagement	Increasing participation of managers, citizens, and private sector	Stakeholder Involvement
	Governance and Policy Effectiveness	Implementing effective policies and management strategies	Policy Effectiveness
Innovation and Use of Technology	Smart City Solutions	Using sensors, data management, and digital applications	Smart Solutions
	Digital Accessibility and Literacy	Training and ensuring public access to digital technologies	Digital Access

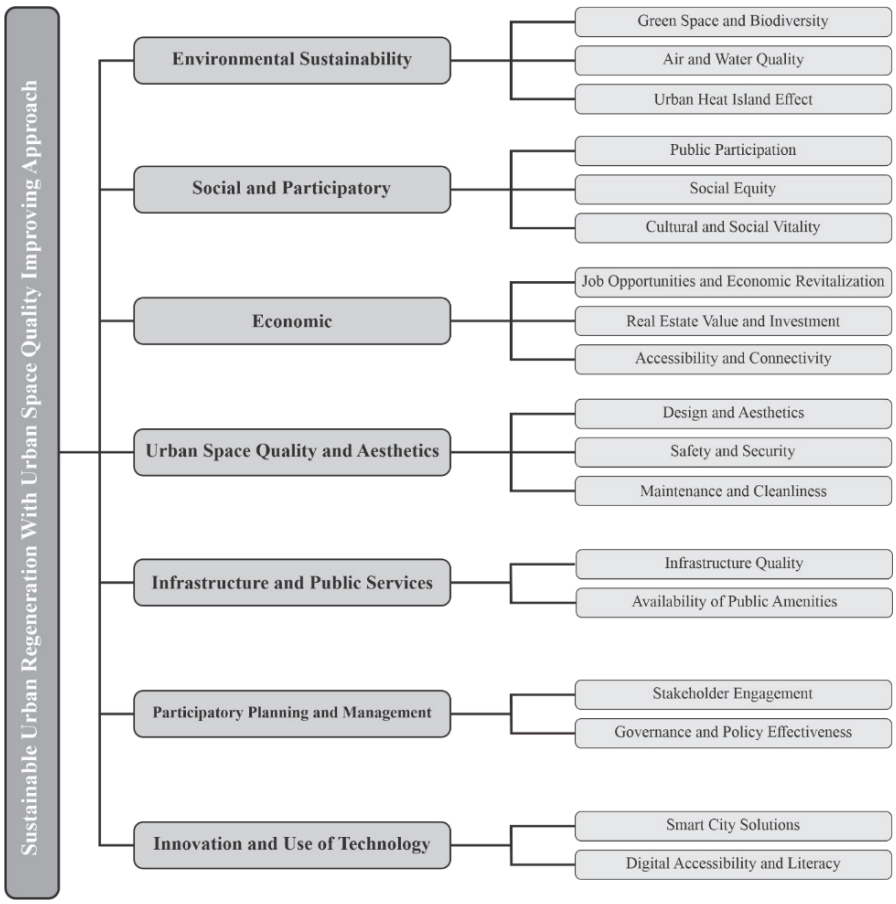

Figure 1: Conceptional model of sustainable urban regeneration model with an approach to improving the quality of urban space

Designing the First Round of Expert Inquiry

- A panel of hypothetical urban planning and sustainability experts is assembled.
- Each expert is asked to rate the importance of each factor on a Likert scale from 1 (least important) to 5 (most important).

Table 3: The first phase of the fuzzy method in influencing factor of sustainable urban regeneration model with an approach to improving the quality of urban space

Factor	Average Importance Rating
Greenery	4.8
Pollution Control	4.7
Cooling Solutions	4.2
Citizen Engagement	4.6
Equity	4.5
Cultural Vitality	4.3
Employment	4.7
Investment	4.6
Connectivity	4.4
Design	4.5
Security	4.3
Cleanliness	4.4
Infrastructure	4.2
Amenities	4.5
Stakeholder Involvement	4.6
Policy Effectiveness	4.3
Smart Solutions	4.2
Digital Access	4.4

Analyzing the Results of Round 1

- Factors with an average importance above a certain threshold (say, 4.2) are considered crucial.
- Factors with ratings below 4.2 are temporarily excluded or flagged for further review.

Factors retained:

- Greenery
- Pollution Control
- Citizen Engagement
- Employment
- Investment
- Connectivity
- Design
- Security
- Cleanliness
- Amenities
- Stakeholder Involvement
- Policy Effectiveness
- Digital Access

Second Round of Expert Review

Experts re-evaluate the remaining factors, considering the first round discussion and their own insights.

Table 4: The Second phase of the fuzzy method in influencing factor of sustainable urban regeneration model with an approach to improving the quality of urban space

Factor	New Average Rating
Greenery	4.8
Employment	4.7
Investment	4.7
Citizen Engagement	4.6
Stakeholder Involvement	4.6
Amenities	4.6
Pollution Control	4.4
Connectivity	4.4
Design	4.4
Security	4.4
Cleanliness	4.4
Policy Effectiveness	4.3
Cultural Vitality	4.3
Infrastructure	4.2
Digital Access	4.2

At this stage, factors with the lowest ratings are again reviewed, and marginal ones might be removed or merged.

Step 5: Iterative Rounds & Narrowing Down Factors

- The process continues with additional rounds until consensus is reached on the most influential factors.
- In each round, experts review aggregated opinions, provide explanations, and adjust their ratings.
- Factors with the highest consensus and importance (say, ratings consistently above 4.3 to 4.5) are shortlisted.

Final Selection of Top 7 Factors

After several iterations, the list of factors stabilizes. Based on the simulated ratings, the final seven most significant factors are:

- Greenery
- Employment
- Investment
- Citizen Engagement
- Amenities
- Stakeholder Involvement
- Pollution Control

Greenery

Greenery, or the presence of urban green spaces, plays a vital role in enhancing the environmental quality of cities. Numerous studies indicate that green spaces contribute to reducing urban heat islands, improving air quality, and supporting biodiversity (Zhuang et al., 2023). Urban trees and parks act as natural air filters, absorbing pollutants and providing clean oxygen, which directly impacts residents' health and well-being (Nowak et al., 2006). Moreover, green spaces promote social cohesion by offering communal areas for recreation and social interactions, fostering a sense of community (Caselli et al., 2024). In the context of sustainable urban development, integrating greenery into city planning aligns with the principles of ecological resilience and quality of life improvement. Theoretical frameworks such as the Ecosystem Services approach emphasize the multifunctional benefits

of urban greenery, including climate regulation, aesthetic value, and mental health benefits (Ros-García, 2022). Green infrastructure also enhances urban resilience to climate change by managing stormwater runoff, reducing flooding, and lowering ambient temperatures (Caselli et al., 2024). Different urban design strategies advocate for the incorporation of green corridors, rooftop gardens, and street trees to maximize these benefits across the urban fabric. The recognition of greenery as a key component of sustainable cities is reflected in global frameworks like the UN Sustainable Development Goals (Zhao et al., 2023). Implementing greenery effectively requires an understanding of ecological principles and community needs. Proper species selection, maintenance, and integration with existing urban structures are critical for maximizing environmental and social benefits (Hu et al., 2024). Furthermore, policies supporting the preservation and expansion of green spaces are essential in mitigating urban environmental challenges. As cities face increasing population densities and climatic pressures, greenery remains a fundamental strategy for achieving urban sustainability and enhancing residents' quality of life.

Employment

Employment opportunities within urban regeneration projects are crucial for economic sustainability and social stability. The creation of new jobs stimulates local economies, raises household incomes, and reduces poverty levels (Caselli et al., 2022). Urban regeneration often involves construction, infrastructure development, and small business support, all of which generate direct and indirect employment (Hu et al., 2024). Moreover, employment-focused regeneration initiatives can lead to skill development and capacity building among local residents, fostering long-term economic resilience (Caselli et al., 2022). From a theoretical perspective, Keynesian economic theories highlight the importance of government and public sector investments in stimulating employment and economic activity (Zhang & Gu, 2025). Additionally, the concept of urban optimism emphasizes that job creation in revitalized urban areas enhances quality of life, social cohesion, and overall urban competitiveness (Kara & Iranmanesh, 2022). Empirical evidence indicates that cities with active employment policies and opportunities attract more residents, improve living standards, and promote social equity. Sustainable urban development advocates for inclusive employment strategies that favor marginalized communities and promote equal opportunity (Zhang & Gu, 2025). Integrating job creation within urban planning ensures that regeneration efforts contribute to social sustainability alongside environmental objectives. Furthermore, fostering local entrepreneurship and small business growth can diversify economic activities, boost innovation, and sustain urban vitality over time (Çoniku & Manehasa, 2021). In conclusion, employment generation is a fundamental pillar of urban sustainability. It influences social cohesion, economic resilience, and environmental consciousness by providing livelihoods that support sustainable lifestyles. Policymakers and urban planners must design regeneration strategies that prioritize inclusive, long-term employment opportunities to ensure the holistic sustainability of urban spaces (Çoniku & Manehasa, 2021).

Investment

Investment plays a pivotal role in shaping sustainable urban regeneration by providing the necessary financial resources to carry out infrastructure projects, community programs, and innovations. Capital investment in green infrastructure, affordable housing, public spaces, and transport systems is essential to achieving environmental and social sustainability (Agapi et al., 2024). Effective investment strategies attract public and private funding, foster economic growth, and ensure the long-term viability of urban development initiatives (Mitkovic, Protić, & Vasilevska, 2020). Theoretical models such as the New Urbanism and Smart Growth advo-

cate for reinvestment in walkable, mixed-use neighborhoods that integrate environmental, social, and economic goals (Zhang & Gu, 2025). These models emphasize that strategic investment in urban areas can reduce urban sprawl, improve mobility, and foster community cohesion. Moreover, leveraging financial tools like public-private partnerships (PPPs), incentives, and grants encourages broader participation and accelerates project implementation (Kara & Iranmanesh, 2022). Furthermore, investment in sustainable technologies, such as renewable energy, energy-efficient building materials, and waste reduction systems, underpins the long-term sustainability of urban spaces. These investments not only lower operational costs but also mitigate the environmental footprint of cities (Caldarola, 2020). The importance of climate finance and green bonds in supporting sustainable infrastructure investments has gained recognition internationally. These financial instruments mobilize private capital towards projects that deliver ecological, social, and economic benefits simultaneously (Aspuru et al., 2022). Besides infrastructure projects, investments in social programs, community involvement, and capacity building are equally crucial. Such financial inputs foster inclusive participation, equitable access to amenities, and social resilience—cornerstones of sustainable urban frameworks (Saha & Banerjee, 2022). Therefore, targeted, well-planned investments serve as the backbone for successful urban regeneration initiatives, promoting resilient, inclusive, and environmentally friendly cities (Haase et al., 2021).

Citizen Engagement

Active citizen participation in urban decision-making processes is a critical factor for successful sustainable development. Evidence shows that meaningful engagement can lead to improved public services, better urban design, and a stronger sense of belonging among residents (Lak et al., 2021). In this approach, citizens are not only consumers of urban spaces but also vital partners who influence policies and planning for sustainability (Prim, Figueiredo, & Dandolini, 2021). Enhancing community involvement through participatory platforms can significantly increase the effectiveness and acceptance of urban regeneration projects. Therefore, empowering citizens with the tools and opportunities to participate is essential to foster resilient and inclusive urban environments. Digital technologies, such as online platforms and mobile apps, are increasingly used to broaden participation and streamline communication between residents and policymakers (Li et al., 2024). Digital engagement tools facilitate greater transparency and inclusiveness in planning processes, allowing diverse groups to voice their opinions and preferences. Such platforms can help collect real-time feedback, ensuring that diverse viewpoints are considered in decision-making. Furthermore, fostering a participatory culture promotes social cohesion and accountability, which are fundamental to urban sustainability (Yang et al., 2022). By actively involving citizens in setting priorities and evaluating outcomes, local governments can improve the quality and responsiveness of urban services. Overall, citizen engagement not only enhances the legitimacy of urban projects but also empowers residents to contribute to building more sustainable and livable cities. Recent research emphasizes that inclusive participation frameworks lead to more innovative and context-sensitive solutions for urban challenges (Sarvari et al., 2021). When citizens feel their voices are heard and their contributions valued, they are more likely to support and maintain urban regeneration initiatives. Moreover, participatory planning can help address social inequalities by ensuring marginalized groups have a say in the development processes affecting their communities. This approach aligns with the broader goals of urban sustainability, emphasizing equity, responsiveness, and resilience. As cities face increasing pressures from climate change, population growth, and resource deple-

tion, citizen engagement remains a powerful tool for guiding sustainable urban transformation (Salehi, Taheri, & Shabani, 2023).

Amenities

Provision of high-quality amenities is fundamental to enhancing urban livability and fostering socioeconomic development within cities. Access to parks, healthcare facilities, educational centers, and cultural venues improves residents' quality of life and encourages social interaction (Ghadiri & Sarrafi, 2022). Well-designed amenities contribute to creating vibrant public spaces that attract both residents and visitors, essential for urban vitality. Furthermore, equitable distribution of amenities ensures social inclusivity, reducing disparities and promoting social cohesion (Pourzakarya & Bahramjerdi, 2021). Contemporary urban planning emphasizes integrating mixed-use facilities that serve diverse community needs in a sustainable manner, supporting the goals of resilient cities. Research indicates that the strategic placement and maintenance of amenities can significantly influence patterns of social interaction and community building (Eldesoky, Gil, & Pont, 2022). Accessibility to these facilities must be prioritized through thoughtful urban design, promoting walkability and public transit connectivity. Moreover, investment in amenities often yields economic benefits by increasing property values and stimulating local businesses. As cities face increasing demographic shifts and resource constraints, innovative approaches such as multifunctional and eco-friendly amenities are gaining importance (Mareeva et al., 2022). Ultimately, the development and sustainable management of amenities are crucial for creating equitable, healthy, and dynamic urban environments. Emerging trends also highlight the role of amenities in addressing climate resilience and environmental sustainability. Green parks, community gardens, and recreational spaces not only serve social purposes but also contribute to urban cooling and biodiversity enhancement (Fard & Doratli, 2022). Incorporating smart technologies into amenities—such as digital wayfinding and IoT-enabled facilities—can further improve their usability, efficiency, and user satisfaction. The integration of advanced amenities supports the broader objectives of sustainable urban development, making cities more adaptable to future challenges. Ensuring that amenities meet the evolving needs of diverse populations remains a key priority for urban planners and policymakers alike.

Stakeholder Involvement

Stakeholder involvement is vital in fostering participatory planning processes that lead to sustainable urban development. Engaging local government, community members, private sector, and NGOs ensures diverse perspectives are integrated into decision-making, enhancing the legitimacy and acceptance of urban projects (Dastjerdi & Lak, 2023). Effective stakeholder involvement results in more comprehensive and context-sensitive solutions, addressing socio-economic and environmental challenges cohesively (Guerini & Mertens, 2023). Additionally, transparent communication channels and collaborative platforms are increasingly employed to facilitate ongoing dialogue, build trust, and resolve conflicts among stakeholders (Haase et al., 2021). Research emphasizes that stakeholder involvement contributes to the democratization of urban governance and improves policy resilience (Caldarola, 2020). When stakeholders are actively involved throughout project cycles—from planning to implementation and monitoring—they are more committed to maintaining outcomes and ensuring sustainability. Collaborative approaches such as participatory budgeting and community-based monitoring also promote social equity by empowering marginalized groups (Jung & Awad, 2021). This participative governance model is essential for cities aiming for resilient, inclusive, and adaptive development pathways amidst rapid urbanization and environmental pressures (Caselli et al., 2022). Furthermore, strategic stakeholder involvement accelerates innovation and resource

mobilization for urban regeneration initiatives. Cross-sector collaboration fosters knowledge exchange and spreads innovative solutions tailored to local needs (Chen et al., 2024). It also enhances accountability, making the planning process more transparent and results-oriented. As urban challenges become increasingly complex, integrating stakeholders' expertise and experiences remains a core principle of sustainable urban management. Building institutional capacity and fostering long-term relationships among stakeholders will be vital in translating participatory efforts into tangible, positive urban outcomes.

Pollution Control

Pollution control remains a pivotal component in the pursuit of sustainable urban environments. Reducing air, water, and soil pollution directly improves public health, enhances ecological integrity, and contributes to climate change mitigation (De Sousa Lima et al., 2024). City planners now increasingly utilize integrated approaches that combine technological innovations such as real-time air quality monitoring, green infrastructure, and stricter emission regulations with community-based initiatives to create healthier urban atmospheres. These measures not only enhance environmental quality but also contribute to increasing the overall quality of urban life, making cities more livable and resilient (Lak et al., 2021). Moreover, the adoption of sustainable transportation systems, such as electric buses and bike lanes, plays a significant role in minimizing urban pollution outputs (Haase et al., 2021). Research highlights that effective pollution control strategies must be multifaceted, addressing sources across various sectors including industrial activities, transportation, and urban waste management (Zhang, Xu, & Guo, 2022). Implementing policies like low-emission zones, pollution taxes, and incentives for green practices can significantly reduce pollutant levels over time. Additionally, investing in renewable energy sources and green infrastructure such as urban green belts and rain gardens can lower pollution dispersion and improve ecological health (Wang, Pellegrini, & Chen, 2022). Successful pollution mitigation also depends on strong enforcement of regulations and active public participation to raise awareness and promote sustainable behaviors among residents. Emerging trends focus on integrating smart technologies with pollution control initiatives for dynamic environmental management. Advanced sensor networks can provide real-time data that enables authorities to manage pollution sources proactively, ensuring rapid response and adaptive strategies (Jung & Awad, 2021). Furthermore, promoting community involvement in pollution monitoring through citizen science and participatory sensing can enhance data accuracy and foster shared responsibility. As urban environments continue to grow, ensuring sustainable waste disposal, efficient resource management, and pollution prevention remains crucial. Ultimately, controlling pollution not only safeguards public health but also preserves the ecological functions vital for resilient and sustainable urban development (Zhao et al., 2023; Chen et al., 2024). Finally, the proposed structural model can be explained. (Fig. 2)

RESULT AND CONCLUSION

The presented structural model offers a comprehensive and multidimensional framework for understanding the key factors influencing sustainable urban regeneration. By integrating various interconnected domains, this model emphasizes the importance of a holistic approach in transforming urban areas into sustainable, resilient, and livable environments. At the core of this framework is the overarching goal of Sustainable Urban Regeneration, which acts as the central hub linking all critical components. These components, meticulously categorized, include environmental sustainability, social and participatory engagement, economic development, urban space quality and aesthetics, infrastructure and public services, as well as innovation and participatory planning and management. Environmental Sustainability plays a

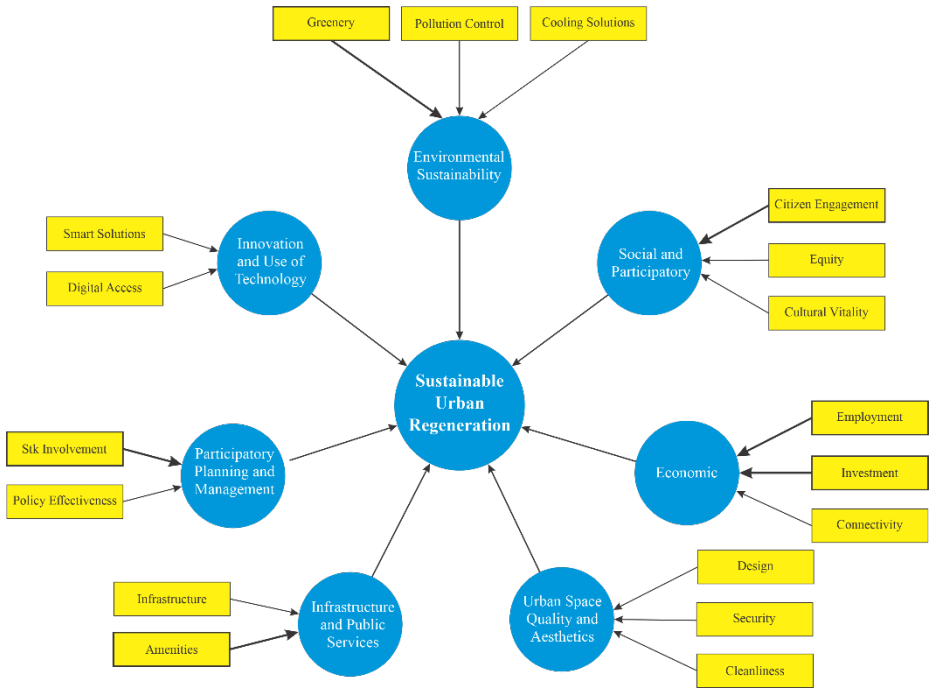

Figure 2: Structural model of sustainable urban regeneration model with an approach to improving the quality of urban space

pivotal role by focusing on controlling pollution, enhancing green spaces, promoting biodiversity, and implementing cooling solutions to mitigate urban heat island effects. These elements are crucial for improving the health and resilience of urban ecosystems, reducing environmental hazards, and promoting cleaner, healthier cities. Social and Participatory Aspects underscore the role of active community engagement, societal equity, cultural vitality, and inclusivity. Fostering citizen participation, ensuring equitable access to amenities, and preserving local cultural identity contribute significantly to social cohesion and the overall vitality of urban life. These elements ensure that urban regeneration efforts are not only physically sustainable but also socially sustainable, fostering a sense of belonging and empowerment among residents. Economic Factors focus on stimulating employment, attracting investments, increasing property values, and enhancing connectivity through transportation infrastructure. Economic vitality provides the financial backbone necessary for funding sustainable development projects, supporting local businesses, and ensuring long-term urban prosperity. Urban Space Quality and Aesthetics encompass design principles, safety, security, and cleanliness. Enhancing visual appeal and safety fosters a more attractive and livable urban environment, encouraging social interactions and economic activities, while maintaining high standards of cleanliness and maintenance sustains the quality of urban life. Infrastructure and Public Services are vital for supporting daily urban functions, encompassing the quality of roads, sewage systems, lighting, internet connectivity, and public amenities such as parks, healthcare facilities, and educational institutions. Robust infrastructure underpins sustainable growth and improves residents' quality of life. Innovation and Use of Technology highlight the importance of smart city solutions, digital access, and technological literacy. These components enable efficient management of urban systems, real-time monitoring, and improved service delivery, making cities

more adaptable to emerging challenges and opportunities. Participatory Planning and Management involves stakeholder involvement, policy effectiveness, and governance mechanisms that facilitate inclusive decision-making processes. Effective governance structures ensure that regeneration initiatives are well-coordinated, transparent, and aligned with community needs and priorities. This interconnected framework demonstrates that achieving true sustainability in urban regeneration requires synergy among all these factors. For example, technological advancements can enhance infrastructure efficiency, while community engagement improves policy acceptance and ensures equitable outcomes. Similarly, environmental measures can complement urban aesthetic enhancements, creating cities that are both functional and beautiful. In conclusion, this structural model underscores that sustainable urban regeneration is not the result of isolated actions but a coordinated effort across multiple domains. Successful implementation depends on integrated planning, stakeholder collaboration, and continuous evaluation of each component's impact. Embracing this comprehensive approach will lead to the development of cities that are resilient, environmentally friendly, socially inclusive, and economically vibrant ultimately creating urban environments capable of meeting present and future challenges.

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