



SUSTAINABLE URBAN RENEWAL WITH GREEN INFRASTRUCTURE AND SMART APPROACHES TOWARDS INFORMAL SETTLEMENTS IN HYDERABAD

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KEYWORDS	ABSTRACT
Sustainable Urban Renewal; Green Infrastructure; Smart Cities; Informal Settlements; Urban Resilience; GIS; Hyderabad; Pakistan.	Rapid urbanization in developing countries has led to a rapid growth of informal settlements, causing environmental degradation, poor infrastructure, and socio-economic inequalities. The unplanned growth of the city leads to major problems such as substandard housing, lack of proper public services, inefficient waste management, urban flooding, and lack of green spaces in Hyderabad, Pakistan. The established paradigm of urban revitalization has concentrated on physical renewal, frequently at the cost of environmental sustainability, climate resilience, and technological innovation. Therefore, there is a growing need for integrated urban renewal strategies that combine Green Infrastructure (GI) and smart urban approaches to improve the sustainability and resilience of informal settlements. This study proposes an integrated framework for sustainable urban renewal by combining green infrastructure interventions (urban green spaces, bioswales, permeable pavements, rainwater harvesting systems, urban forestry, community gardens) with smart technologies (Geographic Information Systems (GIS), Internet of Things (IoT), smart waste management, remote sensing, digital governance). It is recommended that a mixed-method research design including spatial analysis, GIS mapping, household surveys, stakeholder interviews, and environmental assessment be used to assess the current situation and determine suitable sustainable interventions. Expected results include an integrated planning framework that improves the quality of the environment, climate resilience, infrastructure efficiency, and community well-being in Hyderabad's informal settlements. The study contributes to sustainable urban planning by showing how ecological and technological solutions can be integrated toward resilient urban transformation and achieving Sustainable Development Goals.
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Introduction

Urbanization has become one of the defining global trends of the 21st century. According to the United Nations, over 56% of the world's population now lives in urban areas, and this percentage is projected to grow significantly by 2050 (Anestis & Stathakis, 2024). The rapid expansion of urban areas in developing countries like Pakistan has outstripped planning and infrastructure development, resulting in the growth of informal settlements with substandard housing, poor sanitation, absence of public services, and environmental degradation (Wuzhati, Y. et al 2026).

Hyderabad, the second largest city in Sindh province, has grown substantially in the past few decades. (Memon, S. et al., 2024). The city has experienced growth of informal settlements due to rural-to-urban migration, economic disparity, and poor urban planning. Poor drainage, inadequate waste management, limited access to clean water, insufficient green spaces, and a greater susceptibility to climate-induced hazards like flooding and urban heat islands often plague the inhabitants of these settlements. These conditions are detrimental to public health, environmental quality and socio-economic development (Asmal, I. et al., 2022).

The traditional approaches to urban renewal have mainly focused on physical redevelopment through infrastructure upgrading and housing improvement. These interventions are useful in improving the built environment but often ignore ecological restoration, climate adaptation, and community participation (Nygaard, C. et al., 2021). The importance of integrating environmental sustainability with technological innovation to achieve resilient urban development is increasingly recognized in contemporary urban planning (Ajirotutu, R. et al., 2024).

Green Infrastructure (GI) has been increasingly recognized and utilized as an effective planning mechanism by integrating natural and near-nature elements into urban development processes (Mitra, S. et al., 2024). Green infrastructure encompasses a wide range of elements, including urban forests, ecological networks, rain gardens, bioswales, permeable pavements, and community parks, all of which provide essential ecosystem services, from stormwater management to biodiversity conservation, urban climate regulation, and air quality improvement. These green elements have proven to be highly efficient in promoting environmental sustainability while simultaneously contributing to community well-being (Thompson, O. et al., 2024).

Similarly, in terms of smart cities, it is possible to mention such technologies as GIS, IoT, remote sensing, environmental sensors, and digital governance platforms that could be applied to enhance management, planning, and governing processes within cities (Attah, R. et al., 2024). In particular, the combination of green technologies and smart technologies presents a great opportunity to address the challenges of informal settlements and achieve sustainable urban development (Nkurikiye & Ma, 2025).

Despite a substantial amount of international scientific research into green infrastructure and smart cities, few studies attempted to apply these concepts to the development of sustainable practices in informal settlements in Pakistan. For this reason, the present paper attempts to provide an integrated

approach based on ecological and technological principles for achieving sustainability in urban informal settlements in Hyderabad.

Literature Review

Sustainable Urban Renewal

Urban renewal has evolved from the traditional redevelopment process, which was primarily focused on physical redevelopment, to more comprehensive and integrative strategies that seek to promote sustainability, adaptability, and social inclusion (Chin, C. et al., 2025). Sustainable urban renewal focuses on improving urban centers while promoting ecological, economic, and social values. It employs development strategies and processes that are people-centered, responsive, and adaptive to climate change, promote resource efficiency, and build urban resilience (Kosoe, E. et al., 2025).

Recent developments in sustainable renewal research suggest that the effective renewal of urban environments requires a holistic approach to the process that includes ecological, infrastructural, and community-based planning and development strategies. It is now recognized that sustainable renewal is a critical process for ensuring the adaptive capacity of expanding metropolitan areas (Bai, Y., et.al., Zhang2023)

Informal Settlements and Urban Sustainability Challenges

Informal settlements pose the biggest challenge to planners in developing countries. The formation of informal settlements occurs under conditions of rapid urbanization, insufficient development of housing construction, low living standards, inadequate governance, and weak institutional capacity. They are characterized by insecure tenure, inadequate housing, poor sanitation, bad road infrastructure, lack of drainage, and ecological degradation (Suhartini & Jones, 2023).

Informal settlements in Hyderabad are highly vulnerable to flooding, extreme temperatures, waste accumulation, water scarcity, and poor environmental conditions. Moreover, the lack of a coordinated approach to their development aggravates social inequality and the spread of disease. It is necessary to implement specific initiatives to ensure sustainable settlement development (Patel, A., et.al., 2021).

Green Infrastructure as a Tool for Urban Renewal

Green Infrastructure is a concept comprising integrated natural and near-natural systems that deliver multiple ecosystem services and meet diverse needs in urban areas. GI is different from traditional grey infrastructure because it focuses on sustaining biodiversity, supporting adaptation to climate change, and providing other essential ecosystem services that cannot be delivered by conventional infrastructure (Korkou, M., et.al., 2023). Examples of green infrastructure options appropriate for informal settlements include;

- Community and urban parks
- Forests in urban areas and street trees
- Rain gardens and bioswales
- Green roofs and walls
- Permeable pavements
- Rainwater harvesting systems
- Ecological drainage ways

Research has shown that GI has the capacity to reduce urban flooding, improve air quality, reduce urban heat islands, increase biodiversity, and support public health. GI also contributes to the resilience of urban communities to climate change by restoring natural ecosystems.

Smart Urban Approaches

Smart urbanization uses state-of-the-art digital technologies to transform and empower municipalities to improve management and governance of cities. Some technologies that can be used in slums here include Geographical Information Systems (GIS), remote sensing technologies, Internet of Things (IoT), sensors, smart water and waste management systems, and digital governance (Mazzetto, S. 2024).

GIS is a digital technology that can be used to carry out mapping, assess human-environment interactions, carry out environmental impact analyses, and identify potential hotspots. GIS will be used to come up with solutions to problems affecting informal settlements based on land use (Liu & Cheng, 2020). The IoT can be deployed to monitor and manage water, sewers, waste management, and other services in informal settlements. The IoT can be used in monitoring the environment and promoting smart water and waste management in informal settlements. Digital governance, on the other hand, will promote accountability and transparency in urban governance (Chambers & Evans 2020).

Integrating Green Infrastructure with Smart Technologies

The convergence of Green Infrastructure (GI) and smart technologies for sustainable urban renewal is an innovative approach that promotes using appropriate technologies to plan, design, and maintain GI throughout its life cycle to maximize social, economic, and environmental benefits (Hassan & Kotb 2025). Smart technologies enable effective governance and management of GI, improve the functioning of ecosystems, increase the resilience of communities to the impacts of

climate change, and promote sustainable urban development while engaging citizens in the process (Ayo-Odifiri et al., 2026).

Hyderabad needs integrated interventions in informal settlements, such as developing a GIS-based inventory of green corridors, using sensors in stormwater networks, and implementing smart waste management systems to enhance sustainability. Smart technologies can also be used to involve the community in managing the urban environment through green online monitoring systems and promote GI management practices at the local level (Mishra, R., et.al.,2026).

Research Gap

Although many studies have thoroughly examined green infrastructure and smart city technologies separately, only a few have explored their combined role in informal cities and the context of secondary cities in Pakistan. Most urban renewal studies in Pakistan’s secondary city of Hyderabad have focused on the state of infrastructure and housing, while leaving ecological and smart infrastructure under-researched. Therefore, there is a need to develop an integrated planning framework that utilizes both green and smart technologies for ecological and digital urban renewal and climate resilience.

Research Methodology

This study proposes a comprehensive research methodology to explore the role of Green Infrastructure (GI) and smart techniques in sustainable urban renewal in Pakistan's Hyderabad informal settlement.

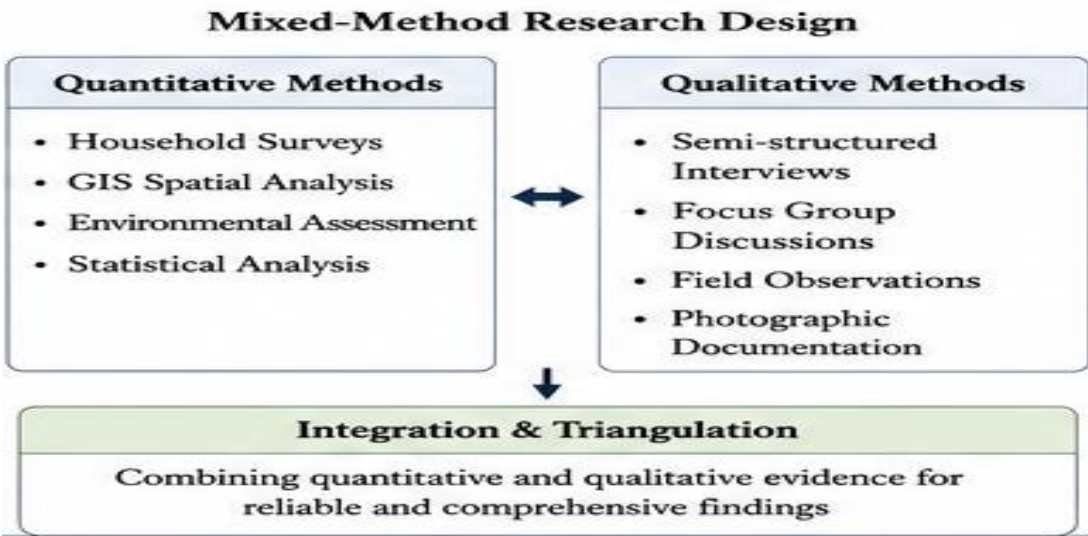


Figure 01. Research Methodology

The methodology aims to embrace variables such as environmental, spatial, technological, and socio-economic aspects of the objects studied. The research design used in the study includes mixed methods (both qualitative and quantitative approaches). The chosen methodology allows investigating the existing situation and identifying the key issues that need to be addressed to promote the urban renewal process based on the collected data and conducted analysis. The study uses a mixed-method approach to gather comprehensive information about the phenomena under investigation and address the research questions posed

Research Philosophy

The researcher follows the pragmatism philosophy because it allows him/her to choose the most appropriate research methods according to the nature of the identified problem. It focuses on finding practical solutions to real-world issues without being tied to a particular philosophical position. Pragmatism is especially relevant to this study since informal settlements are multidimensional problems that require an integrated approach. The adoption of this philosophical standpoint will enable the researcher to combine quantitative and qualitative research methods to address various aspects of the issue, ranging from environmental and social to economic and technological ones. In addition, pragmatism is compatible with the researcher's intention to utilise both GIS-based analysis and conventional observation and perception methods.

The study employs a deductive research strategy and includes an inductive research component, as it explores and evaluates the existing theories concerning sustainable urban renewal, Green Infrastructure, smart city, climate resilience, and informal settlement planning. The deductive component forms the primary basis for this research study, as it is used to hypothesize and assess the logical relationships between variables. On the other hand, the inductive component is applied in order to formulate new ideas and hypotheses that complement the deductive research strategy. By relying on both research strategies, the study attempts to evaluate the existing theories and propose a unified planning model that would be viable for Hyderabad.

Research Design

A mixed-method research design is applied because a study of this nature cannot be accomplished by qualitative or quantitative research alone.

The quantitative research will be achieved through household surveys, GIS-based spatial analysis, environmental assessment, and statistical analysis to evaluate the level of infrastructure, the environment, accessibility to green areas, availability of services, and the perception of the environment. The qualitative study will consist of conducting semi-structured interviews with urban planners, municipal authorities, environmental experts, and community representatives. Moreover, field observations and photography will also be employed to comprehend the physical conditions and confirm the interview data. Overall, combining quantitative and qualitative approaches will provide reliability and validity to the research.

Study Area

The study will be carried out in the selected informal settlements in Hyderabad, Sindh, Pakistan. Hyderabad is one of the fastest-growing secondary cities in Pakistan, and it has undergone significant urbanization in recent decades. The city has witnessed the development of informal settlements, which have sprung up due to high population growth, migration from rural areas, and inadequate planning. The informal settlements have resulted in poor social services, environmental degradation, and a lack of green belts.

Therefore, the study will be carried out in Hyderabad due to the prevalence of informal housing schemes. The selection of the site will be based on the degree of urbanization, accessibility, population density, ecological hazards, and the presence of urban renewal issues. The informal settlements that will be selected for the study will be different to ensure that the results are not skewed or generalized.

Geographical Information Systems (GIS) will be utilized to demarcate boundaries of settlements as well as study land use, drainage, transport, and green infrastructure.

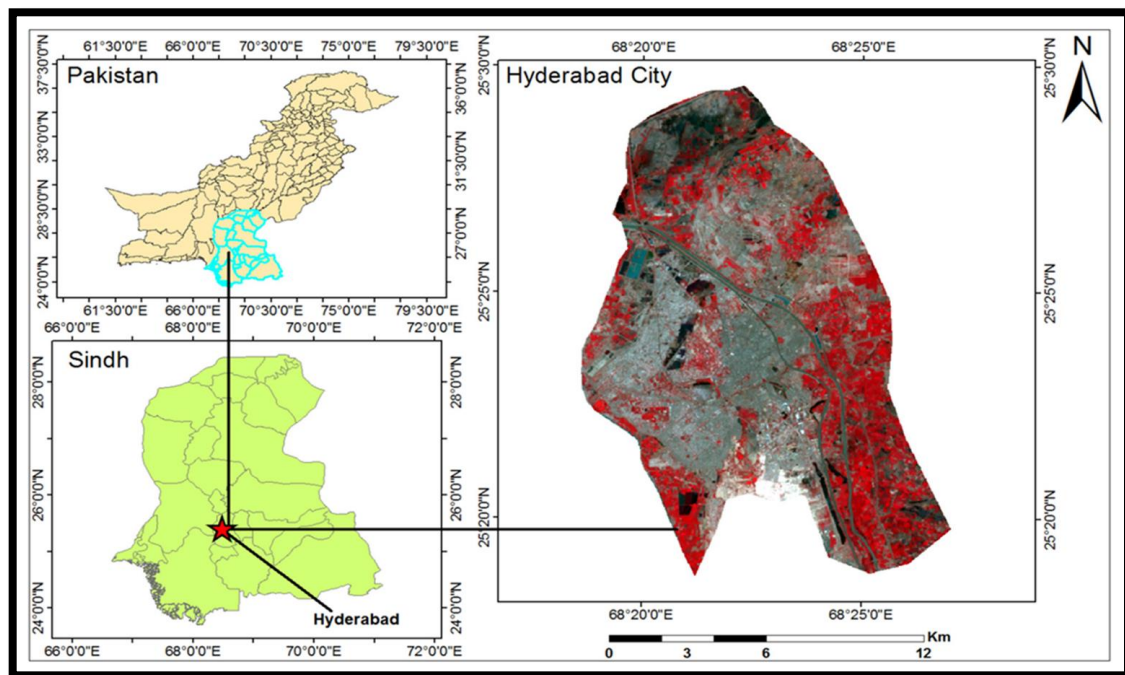


Figure 02. Study area: Hyderabad, Sindh

Research Framework

The conceptual framework of this study assumes that Green Infrastructure and smart urban approaches jointly influence sustainable urban renewal.

The conceptual framework assumes that Green Infrastructure (GI) and Smart Urban Approaches (SUA) jointly contribute to sustainable urban renewal through integrated planning, technology, monitoring, and evidence-based decision-making.

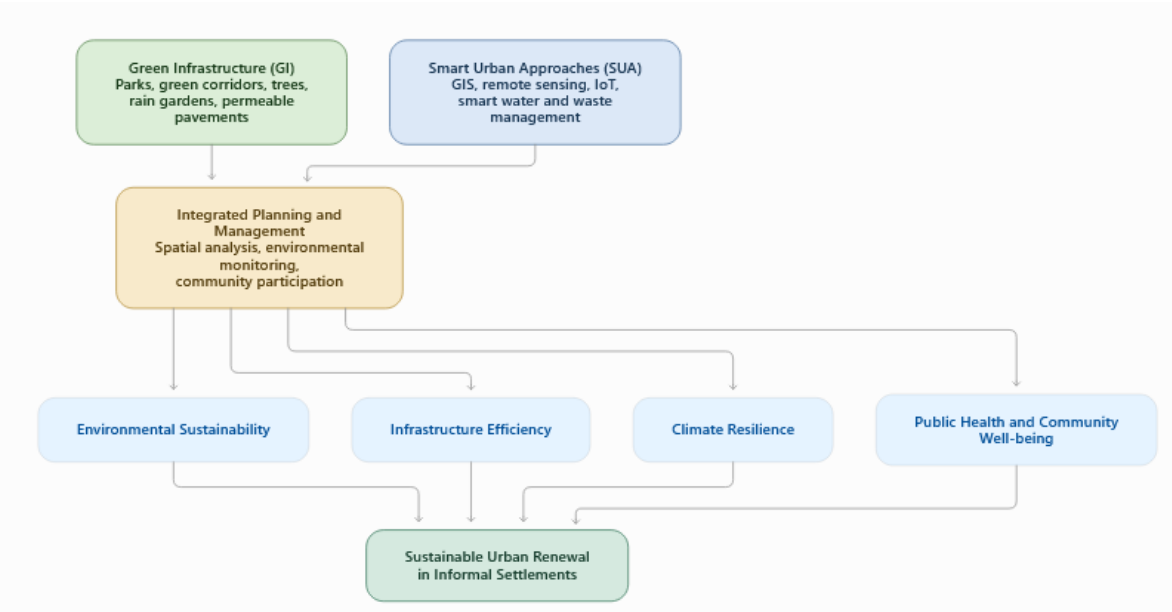


Figure 03: Conceptual Framework of Green Infrastructure and Smart Urban Approaches for Sustainable Urban Renewal

The conceptual framework is based on the principles of Green Infrastructure, Smart Urban Development, and Sustainable Urban Renewal. It assumes that applying nature to renew and redevelop the urban informal settlement and implementing smart technologies will improve the environment, infrastructure, and climate. These attributes will benefit public health and the community in general. Consequently, it will promote sustainable urban renewal through green infrastructure and smart technologies.

Table 01. Simplified Causal Relationship

Independent Variables	Integrated Process	Intermediate Outcomes	Dependent Variable
Green Infrastructure (GI)	Integrated planning GIS + IoT + Remote	Environmental quality	SUSTAINABLE URBAN RENEWAL

+ Smart Approaches (SUA)	Urban	Sensing	Infrastructure	Resilient • Inclusive • Healthy • Sustainable
		Data analytics	efficiency	
		Digital governance	Climate resilience	
		Community participation	Public health Community well-being	

These interventions are expected to improve environmental quality, infrastructure efficiency, climate resilience, public health, and community well-being, ultimately contributing to sustainable urban renewal.

Target Population

The study population will consist of residents living in the selected informal settlements, Hyderabad Municipal Corporation representatives, Sindh Building Control Authority officials, planners, architects, environmental experts, academia, non-governmental organizations, and community leaders. This population comprises stakeholders from diverse backgrounds, which allows for different views on upgrading informal settlements, analyzing the planning process, studying the application of technology, and discussing various approaches to solving urban-related problems. Purposive and random sampling techniques will be applied. First, informal settlements will be selected using the purposive sampling method. Then, within the identified settlements, the random sampling technique will be used to select households to be included in the study. Planners, municipal engineers, environmental experts, and community representatives will also be recruited using a purposive sampling method. The sample size for the number of households surveyed will be determined using Cochran’s sample size formula.

Data Collection

Primary Data

Primary data was collected by employing mixed-methods research questionnaires comprising household questionnaires, interviews, focus group discussions, field surveys, GPS surveys, and photography. The household survey was aimed at capturing the socio-demographic data, household characteristics, housing and infrastructure, environment, accessibility to services and green areas, climate change risks, and perception of smart services in the study area. Semi-structured interviews were conducted with selected stakeholders and government officials to generate information related to existing spatial planning policies and procedures, current problems and issues in relation to infrastructure, GI, and smart city development in the study area. Focus group discussions and field observation were conducted to elicit information on the implementation process of GI and smart city projects in the study area. In addition, GPS survey and field observation were employed to record geographical information on land use, impoundment, accessibility and pedestrian, environmental aspects, roads and drainage, vegetation, and human activities such as dumping sites and other features and activities that may contribute to the understanding of the study area.

Secondary Data

Secondary data were collected from Hyderabad Municipal Corporation, Sindh Bureau of Statistics, Pakistan Bureau of Statistics, Environmental Protection Agency, and relevant government departments. In addition, Landsat and Sentinel satellites' images, GIS-based land-use data, master plans, research articles, government reports, UN-Habitat, and World Bank were used as secondary data sources. All these sources were considered to generate information for spatial analysis and interpretation, as well as appraisal of the existing situation and environmental characteristics.

Questionnaire Design

The household questionnaire was structured into six sections covering: (i) socio-demographic characteristics, (ii) housing and infrastructure conditions, (iii) environmental quality and Green Infrastructure, (iv) climate-related vulnerabilities, (v) awareness and acceptance of smart urban technologies, and (vi) perceptions of sustainable urban renewal.

Results and Discussions

Spatial Distribution of Green Infrastructure

The application of GIS-based spatial analysis will uncover the disparity in the availability of green zones within Hyderabad's informal settlements. The current state of green space is likely to be uneven, underdeveloped, and inaccessible to many residents. GIS will expose clusters of highly disadvantaged communities with poor drainage, insufficient public places, and fewer recreational spots. GIS-based spatial analysis will help select suitable locations for community parks, greenbelts, forests, bioswales, rain gardens, and sidewalks with permeable surfaces. The study will prioritize hotspots for improvement by incorporating and analyzing existing spatial data on land use, roads, and vegetation.

Table 02. Expected Spatial Analysis Outcomes

Spatial Indicator		Existing Condition		Expected Improvement through Proposed Framework
Green Space Availability		Limited and fragmented		Increased connectivity through green corridors
Drainage Network		Poorly maintained		Sustainable drainage supported by bioswales and rain gardens
Flood-Prone Areas		High vulnerability		Reduced runoff through permeable surfaces and rainwater harvesting
Accessibility to Parks		Low		Improved accessibility within walking distance
Vegetation Coverage		Sparse		Increased urban tree canopy and biodiversity

Environmental Improvements

The proposed integration of Green Infrastructure is expected to improve several environmental indicators by restoring ecological functions within informal settlements. Urban forests, street trees, and community parks are anticipated to reduce ambient temperatures, improve air quality, and increase carbon sequestration. Rain gardens, bioswales, and permeable pavements are expected to improve stormwater infiltration, reduce surface runoff, and minimize flood risks during heavy rainfall events.

The framework also emphasizes ecological restoration through enhanced biodiversity and improved urban ecosystem services. These interventions are expected to contribute to healthier urban environments and increased resilience to climate-related hazards.

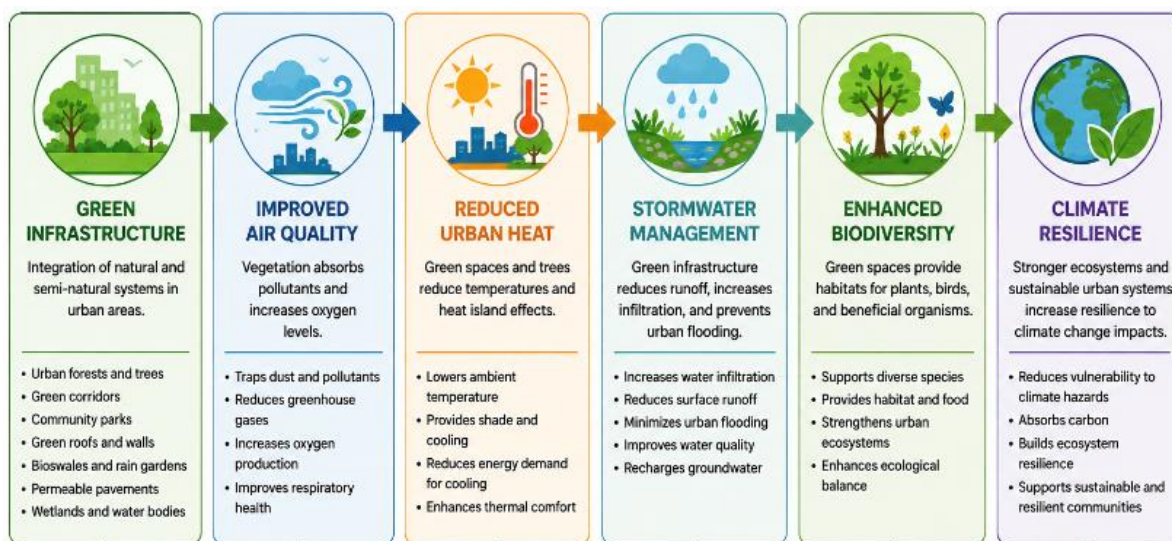


Figure 04. Environmental Benefits of Green Infrastructure

Smart Urban Outcomes

The integration of smart technologies into urban management systems can be expected to yield improvements in the management and delivery of services. GIS can be expected to contribute to the realization of efficient planning through evidence-based decision-making. In addition, remote sensing technologies can be utilized to monitor land use and the state of the environment on a continual basis. Other technologies such as IoT-enabled sensors can be utilized to monitor drainage, garbage disposal, and water supply systems among other utilities. Digital technologies can also be utilized to enhance governance by promoting transparency, encouraging civic engagement, and enhancing coordination. This can be achieved by providing an avenue for residents to report and track the resolution of issues and access to municipal services.

Table 03. Contributions of Smart Urban Technologies

Smart Technology	Expected Function	Anticipated Outcome
GIS	Spatial planning	Better land-use decisions
Remote Sensing	Environmental monitoring	Early identification of environmental changes
IoT	Infrastructure monitoring	Efficient maintenance and service delivery
Smart Waste Management	Waste collection optimization	Cleaner urban environment
Smart Water Management	Water monitoring	Improved water-use efficiency
Digital Governance	Citizen engagement	Transparent and participatory governance

Socio-economic Benefits

The proposed idea is expected to have positive socio-economic effects by improving the general well-being of the community through the creation of additional green areas. For instance, the number of healthy individuals will increase due to better access to recreational places and the overall improvement of the environment. Additionally, the value of the houses and local businesses will be impacted positively, thus stimulating the local economy.

Moreover, the involvement of the community in the process will maximize their engagement in the ongoing changes and promote social inclusion and sustainable development in the informal settlement.

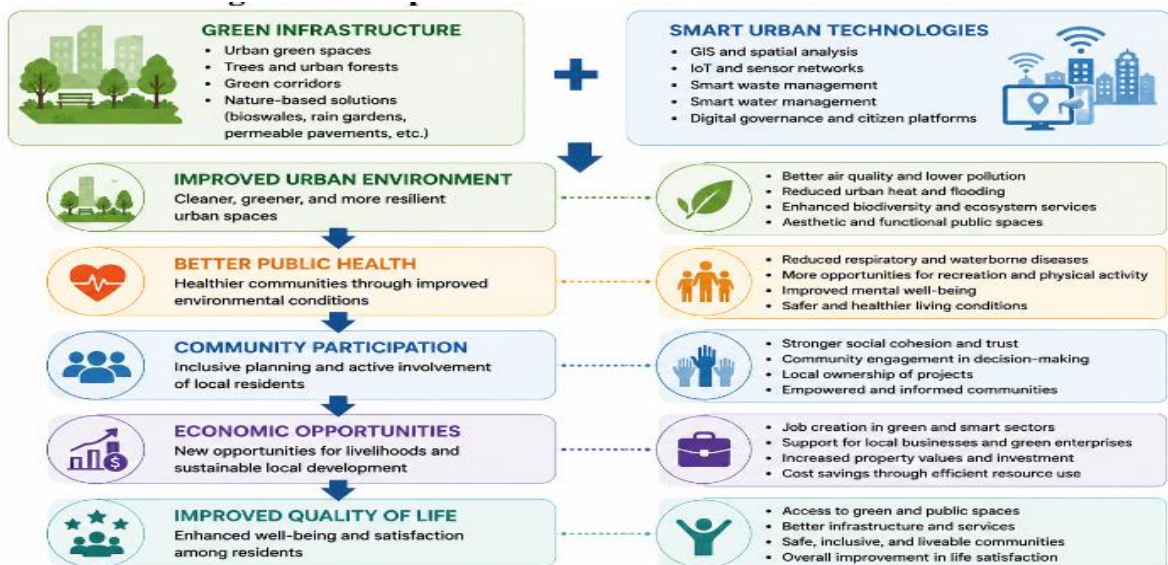


Figure 05. Social and Economic Outcomes Green Infrastructure

Expected Institutional and Governance Outcomes

The framework developed will be of great importance for the cooperation between municipal authorities, planning authorities, environmentalists, and communities. The application of GIS databases and digitalization systems will ensure data exchange, decision-making, and urban management.

In addition, it is necessary to emphasize the importance of this approach for stakeholder engagement and involvement in the process of urban ecological renewal. Effective coordination and cooperation between authorities and communities will contribute to the effective implementation of GI projects and their further development and maintenance.

Contribution to Sustainable Development Goals (SDGs)

The proposed framework is expected to contribute directly to the achievement of several Sustainable Development Goals by integrating ecological restoration with technological innovation.

Table 04 Alignment with Sustainable Development Goals

	Sustainable Development Goal	Expected Contribution
SDG 6	Clean Water and Sanitation	Sustainable drainage and rainwater harvesting
SDG 11	Sustainable Cities and Communities	Inclusive and resilient urban renewal
SDG 13	Climate Action	Climate adaptation and reduced urban vulnerability
SDG 15	Life on Land	Biodiversity conservation and urban greening

Overall Outcomes of the Proposed Framework

The proposed framework is expected to deliver a sustainable renewal model that meets ecological, technological, and social demands. Unlike traditional renewal approaches that focus on engineering improvements, the framework will use nature- and technology-based approaches to improve informal settlements.

Overall, the expected benefits and implications of the proposed framework include:

- Enhanced values of the environment due to the incorporation of green elements
- Higher climatic resilience through the provision of green areas and improved flood management
- Improved management of infrastructure through GIS-based and smart technologies

- Increased accessibility to green areas and communal places
- Betterment of public health and community development
- Enhanced governance and institutional framework
- Effective planning, which utilizes spatial analysis and decision support systems
- The achievement of sustainability goals, including SDG 6, 11, 13, and 15.

This is a tentative benefit that the newly developed framework will bring about, as described by the authors to readers. In these ways, the framework will be helpful in addressing the informal settlement issues using a combination of natural and technological resources. This part of the article is appropriate for a conceptual paper because no results have been reported; only potential benefits derived from the framework are provided for readers' consideration. In addition, the authors offer readers tables and figures in support of their arguments.

Discussion

The proposed framework adequately addresses the need for innovative planning solutions for urban renewal processes and the complex issues related to informal settlements. Traditional urban renewal programs have focused on physical planning and improvements while incorporating ecological, climate, and digital aspects. However, the current proposed framework highlights how Green Infrastructure and smart technologies can be incorporated into renewed planning strategies.

Green Infrastructure will contribute to ecological sustainability while meeting many socio-economic needs. Parks, roadside trees, bioswales, and impervious surfaces are some of the green infrastructures that have proven beneficial when properly maintained. They can provide habitats for wildlife, control flooding and groundwater recharge, and reduce the effects of heat islands.

Green infrastructures such as parks and street trees offer open spaces that enhance social interactions, encourage physical activities, and improve mental health.

Smart technologies such as GIS and remote sensing can support and supplement the planning and design of urban regions to be more self-sustaining and climate adaptive. GIS and remote sensing can help in analyzing natural and human-made environments while supporting the decision-making process. Environmental monitoring using the Internet of Things and remote sensing can help urban regions have a real-time status of water, sanitation, drainage, and waste management. Besides, digital governance promotes transparency and accountability in urban administration and encourages citizen participation in governance, thus facilitating sustainable urban renewal processes.

Notably, the proposed framework recognizes that sustainable urban renewal requires institutional coordination, planning, and community development. Therefore, I believe that the strategy will promote holistic urban renewal processes by addressing the physical, social, and managerial aspects of urbanization. Effective coordination among local governments, planning authorities, environmental groups, academia, and communities will ensure successful implementation of renewal projects. Furthermore, community involvement is critical to ensure long-term maintenance and appreciation of green infrastructure in urban regions. I also believe that the proposed framework will address climate change concerns, such as rising temperatures, flooding, and ecological degradation.

Climate change negatively affects informal settlements in Hyderabad. Therefore, I hope the proposed framework will address climate change by creating more green spaces, restoring natural ecosystems, enhancing water management, and promoting smart technologies that support climate change adaptation and mitigation. Moreover, the proposed framework can also be a replicable model for urban renewal in secondary cities.

Proposed Integrated Framework for Sustainable Urban Renewal

The proposed framework addresses multiple factors related to the environment, technology, institutions, and communities in proposing a model for sustainable urban renewal.

The framework starts with conducting a baseline assessment that includes GIS, environmental, field, household surveys, and stakeholder analysis to examine the existing urban conditions. The findings highlight key areas of concern, including the provision of infrastructure, environmental risks, insufficient green areas, poor drainage, waste management, water potential, and institutional capacity.

From the baseline survey, the proposal suggests two categories of interventions. The first category promotes Green Infrastructure, which includes parks, community gardens, green belts, trees, bioswales, rain gardens, permeable pavements, urban forests, and rainwater harvesting. The second category implements Smart Growth approaches, which comprise Geographic Information Systems, remote sensing, Internet of Things, environmental monitoring, smart waste management, smart water, digital governance, and spatial planning. Overall, the proposed framework will provide baseline information that promotes stakeholder engagement in undertaking sustainable urban renewal projects. Some of the benefits of the framework include addressing environmental and climate issues and promoting smart planning and governance reforms. In addition, it also facilitates efficient waste management and water management, improves health, and enhances social inclusion of the local community while supporting sustainable urban renewal interventions.

Policy Implications

The proposed framework carries various policy implications for urban planners, municipal authorities, and policymakers engaged in the management of informal settlements in Pakistan.

First, urban planning policies must encourage the adoption of Green Infrastructure in slum upgrading programs through the integration of urban parks, ecological networks, sustainable drainage, and urban forestry.

Second, municipal governments and policymakers should promote the widespread use of Geographic Information Systems (GIS), remote sensing, Internet of Things (IoT), and digital governance technologies for infrastructure development and environmental management to maximize benefits.

Third, it is paramount to promote community involvement in planning, implementation, and evaluation to ensure project sustainability while boosting social desirability.

Fourth, municipal governments, environmental regulators, academia, and civil society must collaborate more closely to promote smart urban transformation and climate-resilient development.

Lastly, urban development and housing policies at the provincial and federal levels should adopt Green Infrastructure and smart technologies as critical components of sustainable human settlement development while providing sufficient funding for their effective utilization.

Conclusion

This conceptual paper aims to propose an integrated framework for sustainable urban renewal, which will incorporate Green Infrastructure and smart urbanization to tackle environmental, infrastructure, and governance issues. Instead of considering ecological and technological interventions as separate issues, addressing them together as part of broader-based urban renewal strategies has the potential to maximize the benefits for the local environment, infrastructure, climate, and society.

The framework suggested below can be used to standardize the process of incorporating GIS (Geographic Information System), Green Infrastructure, smart city technologies, and community participation. It can serve as a theoretical basis for future studies aiming to improve environmental, social, and economic outcomes in informal settlements. Although this paper is conceptual, suggesting the necessity of empirical studies is vital for future research. The next step is to conduct the actual studies and examine the framework's effectiveness to confirm its potential for improving urban renewal outcomes. Conducting GIS analysis, household surveys, and interviews can provide critical insight into the environmental and social state of Hyderabad's informal settlements. This information will become vital for informing future interventions and policies on sustainable urbanization in Pakistan and beyond, as similar patterns can emerge in other densely populated developing countries.

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