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Effectiveness of superblock in elevating urban livability and their practicality in Indian cities

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Abstract - *Urban centers worldwide face recurring issues like unbearable traffic congestion, environmental pollution, shrinking public spaces, and pedestrian safety risks, all of which undermine livability. The superblock concept developed in Barcelona, which reshapes urban designs by giving the priority to pedestrians, public spaces, and zero-emission and low-carbon transportation, and thus offering a viable solution. This research focuses on the careful examination of efficacy in enhancing urban livability, focusing on its adaptability to Indian Tier I cities. The study utilizes a systematic methodology and a compilation of global case study (e.g. Barcelona) to draw on the Global Livability Index for assessing key indicators - environmental quality, mobility, safety inclusivity etc. It also probes into the urban issues and planning policies of India by discerning the influence of those principles on the superblock. The data show that superblocks are a feasible solution to livability improvement because they not only bring down environmental stress factors but also encourage green practices, yet at the same time the mentioned obstacles such as governance fragmentation, vehicle choice, and socio-economic disparities prevent them. On the one hand, the study recommends pilot projects, community involvement, and policy integration to tailor the model for India, providing strategic recommendations for adopting superblock concept for addressing rapid urbanization.*

Key Words: **Urban Challenges, Traffic Congestion, Superblock concept, Urban transformative model, liveability, GLI, Indian Tier I cities, environmental pollution.**

1. INTRODUCTION

The urban population of India during 2024 reached 530 million which resulted in 36.6% of total population statistics. Rapid urbanization patterns between 1981 to 2022 resulted in the urban population rising from 34% to 43.2% (World Bank, 2022). The primary commitment of car-oriented urban development in Indian cities has resulted in worsening levels of pollution and urban heating effects while reducing urban green areas. Physical activity along with social interaction and general health status are limited because of these environmental elements. The World Health Organization safe limit exceeds the air quality experienced by 70% of residents in Delhi and Mumbai according to WHO (2021) estimates. In 2017 poor air quality led to more than 1.2 million fatalities throughout India (The Lancet Planetary Health, 2018). The infrastructure supporting roads and parking infrastructure in Indian cities dominates more than 60% of public spaces thereby decreasing available safe walking and cycling areas (Urban Mobility India, 2020). Successful implementations of the urban planning concept Superblocks have occurred in Barcelona and other cities. Superblocks function to prioritize walking and biking over driving which in turn develops more social places and constructs safer transportation links and adds ecological space. The city of Ahmedabad together with Pune conducted experimental superblock demonstrations which showcased these urban design elements as effective in lowering temperatures by up to 2°C and producing 30% less noise pollution (Centre for Science and Environment, 2019). The Ministry of Housing and Urban Affairs (2021) has set sustainability goals for India to achieve 20-30% emission reductions while strengthening climate resilience. As a result India can implement superblocks to support active transport systems and enhance community welfare that will create sustainable urban living environments.

Research investigates superblock effectiveness for urban livability improvement and examines frameworks suitable for Indian urban settings. This analysis conducts a review of superblock concepts through international case studies while reviewing GLI changes and discusses both obstacles and possibilities for their Indian implementation. The study delivers recommendations suitable for Indian urban conditions which support sustainable and inclusive urban development.

The study provides useful knowledge but faces restrictions from its focus on European research while lacking comprehensive information on urban measure data and its inability to apply results broadly because of varied urban context. The analysis stops short of examining actual implementation practices because each site requires individual evaluations.

2. LITERATURE REVIEW

2.1 Superblock

Salvador Rueda created the superblock concept to develop pedestrian-oriented urban solutions for Spanish cities through a new urban design model. Superblocks originated

from Barcelona where they unite nine city blocks in a 3x3 formation to create pedestrian and cycle-friendly zones along with traffic restriction areas. The superblock model focuses on public areas and supports environmentally sustainable movement solutions while cutting down car emissions.

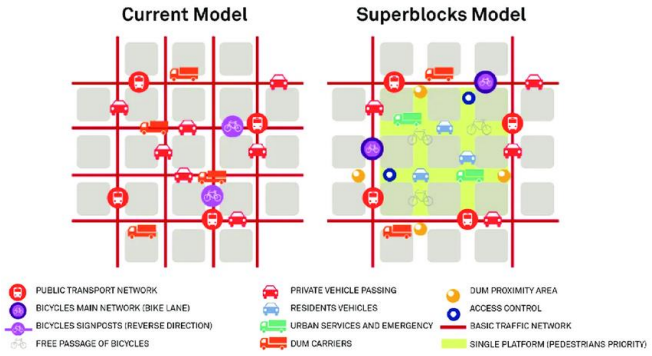

Fig -1: Superblock model

Source: Ajuntament de Barcelona (City of Barcelona).

Key Design Principles

In 2014, Rueda defined the following seven design principles for superblocks as part of the "city as a system of proportions":

[1] Context of urban action
[2] Land use and urban morphology
[3] Urban functionality
[4] Urban complexity
[5] Urban green and biodiversity
[6] Metabolic efficiency
[7] Social cohesion

Features and Implementation

The entry of superblocks restricts traffic to only essential vehicles with local delivery service. Public areas receive new functions because streets evolve into plazas followed by parks then pedestrian-only zones. The outside roads enable car traffic yet protect the inner pedestrian-only zones of the superblock system. The El Poblenou Superblock of Barcelona successfully started operation in 2016 by decreasing pollution while supporting walking and cycling.

This innovative design approach led developers to create comparable projects throughout Los Angeles and Buenos Aires. Benefits and Popularity Drivers The decrease of traffic emissions results in improved environmental conditions which produce cleaner air in the environment. Noise and air pollution control through these changes bring about better quality of life conditions for residents. Areas without vehicles lead to better community relations through public participation along with enhanced social ties. The management of traffic functions to reduce congestion along with carbon emission amounts.

2.2 Urban Transformative Model

The Urban transformative approaches consist of the creation of frameworks which will be used for resolving the most pertinent contemporary urban problems through a process of urban transformation that establishes sustainable urban spaces resulting in large urban areas which bring inclusion and resilience. The traditional urban planning methods are excluded and are based on people-centered designs and environmental sustainability with incidents of social equality. The models join the infrastructure network with political, economic, and social activities as well as community engagement efforts to develop resilient cities responsive to the needs of the future.

Key Features

[1] Comprehensive Approach.
[2] People-Centric Design.
[3] Community Engagement.
[4] Sustainability Focus
[5] Resilience and Adaptability
[6] Social Equity Promotion

Superblocks as a Transformative Model

The urban transformative model demonstrates itself through Superblocks by taking back public-access spaces from the urban fabric. Barcelona stands as the innovation origin of superblocks which combine traffic restrictions with pedestrian and cycling paths and city block-based green spaces. Superblocks improve urban living standards because they cut pollution levels while promoting community contact and strengthening neighborhood economic activities.

The Potential of Implementing Superblocks for Multifunctional Street Use in Cities- Sven Eggimann

The research paper evaluates superblocks as a modern urban design approach which reduces automobile dependency to create sustainable walking and cycling ecosystems in communities. This paper examines Barcelona's model while it investigates urban issues connected with climate change along with pollution and health problems. Geospatial analysis together with network methods from OpenStreetMap data allows researchers to locate suitable areas for superblocks and mini blocks through graph-based street network modeling. The evaluation uses Edmonds-Karp algorithm combined with node degree and street length indicators to analyze traffic flow and urban mobility effects. Research indicates that cities with rectangular street patterns demonstrate better implementation potential since they contain between 1% and 46% of streets suitable for transformation (Mexico City and Atlanta represent the high and low ends). Irregular urban designs contain higher proportions of mini blocks. The analysis points towards current pedestrian areas as suitable locations for increasing car-free spaces. The research centers on finding the environmental advantages from superblocks

together with public health benefits but also points out regulatory hurdles and community reception and traffic control issues. The authors propose that urban planning should use data to assist superblock implementation alongside ground testing of impacts in various urban environments.

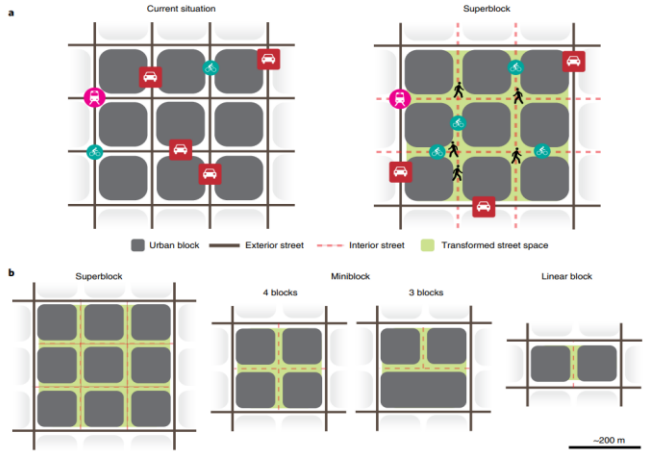

Fig -2: Schematic of superblock design. a, Barcelona superblock adopted from the urban mobility plan of Barcelona. Superblock design is characterized by exterior streets surrounding urban blocks and the transformation of interior street space. b, The superblock design is further developed into similar urban configurations such as mini blocks or linear blocks Source: Natural sustainability research paper.

Fig -3: Modelled classification of the street network for selected cities. source: Nature sustainability research paper

2.3 Urban Livability

Urban livability has become a pivotal concept in contemporary planning discourse, influencing long-term policy goals and community initiatives across various governance levels. Academic and practical discussions recognize livability as an assessment of resident life quality across urban environment that demonstrates the fulfillment of residential physical, social and economic requirements. Multiple layers of sustainability assessment include open green spaces with easy access and top-level public service delivery and environmental protection alongside social connections and cultural environments and economic growth and efficient transportation capabilities. As local government officials and decision-makers adopt the livability concept as their directive, the practice is found in several sub-fields such as transportation, community growth, and resilience, and thereby confirms the importance of this ideal in sustainable and inclusive urban area planning.

Key components

[1] Quality of Housing and Infrastructure
[2] Environmental Quality
[3] Mobility and Transportation
[4] Social and Cultural Amenities
[5] Economic Opportunities
[6] Safety and Security
[7] Social Equity and Inclusion

Global Livability Index

The Global Livability Index evaluates cities through evaluation of five subscales including Stability, Healthcare, Culture and Environment, Education, and Infrastructure. The various categories receive weight values which determine the composite score measurements between 1 and 100 points that reflect the quality of living.

[1] Stability (25%)
[2] Healthcare (20%)
[3] Culture and Environment (25%)
[4] Education (10%)
[5] Infrastructure (20%)

2. LITERATURE CASE STUDY

Barcelona: Evaluating the Impact of Superblocks on Urban Livability

Stability

Before the superblocks project Barcelona faced extreme traffic problems because 60% of public areas and 85% of roads served vehicles while pedestrian safety deteriorated substantially. The new superblock distribution pattern took vehicles to boundary streets which created fewer traveling cars by 61% and a larger 80% area dedicated to pedestrians. The development of enhanced public areas created safer

spaces to walk and this improvement reduced accidents leading to better community health.

Healthcare

The air pollution issue in Barcelona created 3,500 deaths each year. Noise pollution together with small amounts of accessible green space intensified public health risks. The implementation of superblocks succeeded in enhancing air quality levels. Residential exposure to noise pollution decreased to 73.5% despite an increase of acceptable air quality levels reaching 94%. The introduction of pedestrian and cycling networks through superblocks infrastructure helped people lead healthier lives through exercise and physical activity.

Culture and environment

Urban heat islands increased city temperatures by more than 2 °C. Green spaces were limited and urban settings became less attractive throughout the neighborhoods. Through the establishment of Superblocks the urban environment gained 403.7 hectares of green space thus expanding the amount of green space available to each resident from 2.7 m^2 to 6.3 m^2. Public spaces which were 6.22 million m^2 increased both recreational and cultural usage to promote social cohesion among residents. Due to the wide deployment of permeable surfaces along with new plantings trees the urban heat island effect decreased by 35.9%.

Education

Increased accessibility together with better school safety remained the principal outcomes of superblocks' implementation though these projects did not build new educational facilities. The implementation of walkable roads combined with lowered transportation volume led to enhanced safety conditions for students while they walked to school.

Infrastructure

The accessibility for pedestrians was severely restricted before the intervention as 15.8% of streets were meant for pedestrian walks. The transportation ,bus services operated at frequencies ranging from 14 to 15 minutes. The superblock implementation strategy created new pedestrian zones covering 67.2% of the area which boosted access connectivity and active mobility. The implementation of an orthogonal bus network shortened waits to 2 minutes thus making public transit more dependable. Electric transport systems and their initiatives lowered carbon pollution in the urban environment. Boosted storm water infrastructure combined with heat reduction measures strengthened the urban area's resistance to change.

Table -1: Superblock indicators and GLI index

superblock indicators	sub -indicators	S_25%	H_20%	C&Ev_25%	E_10%	I_20%	Global liveability index
Social	Public Space Allocation						
	Pedestrian and Cyclist Accessibility						
	Community Interaction and Social Cohesion						
	Health and Well-being						
Economic	Local Business Growth						
	Cost Savings from Reduced Pollution and Traffic						
Environment	Air Quality Improvement						
	Noise Pollution Reduction						
	Green Space						
	Energy Efficiency						
	Climate Resilience						
Infrastructure	Mobility and Transport Efficiency						
	Traffic Flow and Congestion Reduction						
	Safety Improvements						
	Water and Waste Management						

3. Applicability in Indian cities

Rapid urbanization and vehicular congestion along with deteriorating air quality create unheard-of difficulties for Indian urban centers today. Scrutinizing road structures and unregulated city expansion led to disrupted transportation systems and unsafe walking conditions and shrinking public area sizes. The planning strategy of Superblocks has gained international momentum as a solution for the urgent combination of issues that includes improving walk ability while decreasing traffic congestion and promoting sustainable transportation systems. The research assesses if Superblocks can work in Indian cities, tier I cities (Ahmedabad, Bangalore, Pune, Kolkata, New Delhi, Mumbai, Hyderabad, and Chennai) while identifying primary urban issues and reviewing policies that facilitate their implementation.

3.1 Key Urban Challenges

1. **Traffic Congestion and Pollution**

   The heavy congestion results from excessive dependence on private motor vehicles plus inadequate public transportation options.

   Auto vehicle emissions play a major role in contaminating the air because pollution levels surpass established guidelines in numerous urban locations.

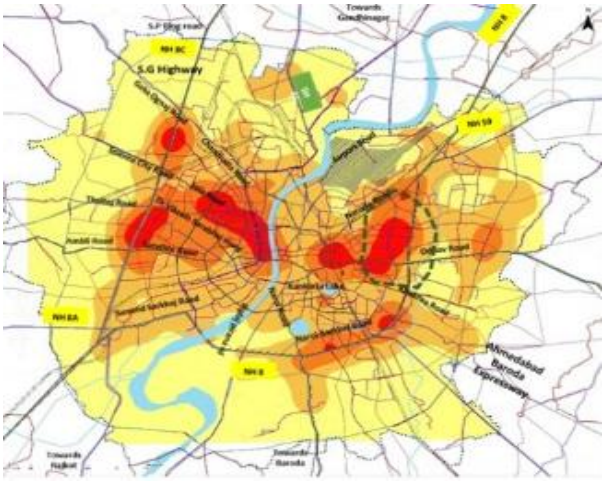

Fig -4: Map showing the concentration of road accidents
Source: ScienceDirect

2. **Limited Pedestrian and Cycling Infrastructure**

   Unsafe pedestrian areas have occurred from both a high population density as well as mixing land usage, leading to the insufficient sidewalks and cycling lanes.

   In the case of a road accident, pedestrians and cyclists are the main victims due to a lack of walking paths.

3. **Unstructured Urban Growth and Land Use**

   Rapid urbanization without proper planning has given rise to informal settlements, thus, making it difficult to implement large-scale urban mobility solutions.

   Land-use patterns frequently are conflicting with sustainable transportation solutions, which leads to ineffective transportation routes and growing dependence on cars.

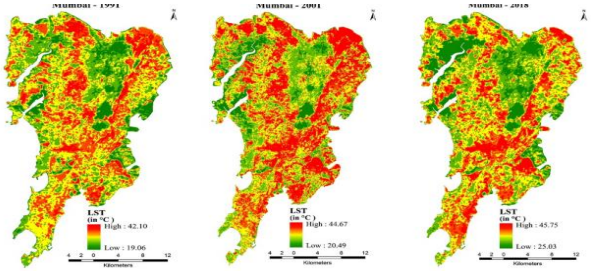

Fig -5: Urban heat island-Mumbai

4. **Lack of Green and Public Spaces**

   Indian cities battle with a severe shortage of green spaces, which is caused by the uncontrolled construction and encroachment of land.

   Public health and community well-being suffer from the lack of recreational spaces.

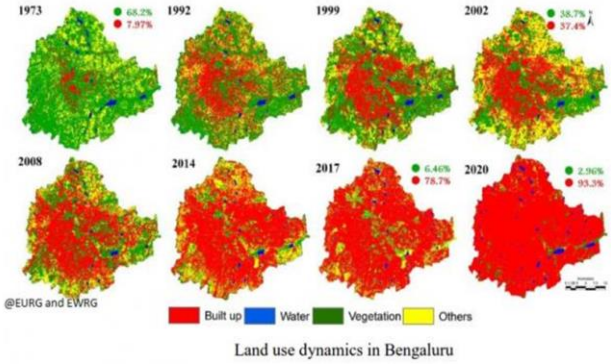

Fig -6: Decreasing green cover-Bangalore.
Source: Research gate

3.2 Policy support for superblock in India

Several policies and urban development initiatives provide a foundation for implementing the Superblock concept:

1. **National Urban Transport Policy (NUTP)**

   Fostering the sustainable and integrated urban transport planning that has an emphasis on public transport and active travel.

   Active transportation and pedestrian-friendly infrastructural and mixed-use development are the primary solutions to the reduction of the vehicle addictive behavior.

2. **Smart Cities Mission**

   Prioritizes improved urban mobility, non-motorized transport, and sustainable land-use planning.

   Encourages to integrate walkable neighborhoods and open spaces into development plans.

3. **Gati Shakti National Master Plan**

   Enhance multimodal connectivity and efficient land-use planning.

   Supports the integration of transport infrastructure with urban development initiatives.

4. **Streets for People Challenge**

   Launched by the MoHUA to promote pedestrian-friendly street design and urban mobility solutions.

   Encourages cities to create car-free zones and prioritize public spaces.

5. **State and City-Level Urban Mobility Plans**

   Adopted policies that encourage walkable neighborhoods and reduced car dependency.

   Initiatives such as Bengaluru's Tender SURE project and Delhi's pedestrianization plans align with the principles of Superblocks.

4. INFERENCE

Challenges and Adaptations

To implement the Superblock model in Indian cities, the various difficulties faced owing to urban density, land use patterns, the informal economy, and limited infrastructure should be resolved. The limited space further necessitates that micro-Superblocks be created in two or more phases in order to ensure their feasibility. Mixed land use should be accommodated via flexible zoning and pedestrian-oriented areas, while the informal economy should be addressed by designating vendor zones that do not adversely affect urban inclusivity. Strategies employed in the handling of the traffic problem should include traffic-calming measures and the provision of perimeter parking. Public transport and connectivity require the installation of multimodal integration and last-mile mobility solutions so as to be effective. Community engagement is a significant aspect that entails informing the public through awareness campaigns and pilot projects involving the community to gather their feedback. Open spaces that are sustainable need to be developed, e.g. parks, green corridors, and green neighbourhoods. Access and parking control mechanisms should include smart systems to regulate entry and ensure that parking areas can be located easily. By designing business-friendly setups that also monitor vendor and delivery access, economic sustainability becomes the main thing to obtain. In order to accommodate the needs of different socioeconomic and cultural groups, space needs to be created as a cultural place and knowledge exchange point. Maintenance and monitoring efforts need to be supported through the use of digital platforms that give real-time feedback and enable community-led activities.

5. RECOMMENDATION

The recommendations for the implementation of superblock model in Indian cities.

TRANSPORTATION

Developing integrated multimodal transport routes with protected bike lanes and well-lit pedestrian walkways is recommended to improve urban mobility. Enhancing accessibility will require the expansion of public transportation systems with smooth linkages between bus, rail, and metro hubs. Adaptive superblock patterns, like 2x2 block designs, can be used to maximize pedestrian and traffic flow. Transitioning from high-capacity public transportation to pedestrian-friendly areas will be easier with the establishment of entrance points that are accessible by transit. Including micro-mobility solutions, such as electric bicycles and scooters, will also improve last-mile connection. Lastly, the creation of parking zones around the perimeter will aid in reducing traffic in the heart of the city along with real-Time Information technology to plan journeys efficiently.

LAND USE AND ZONING

The implementation of adaptive zoning restrictions that promote mixed-use zones and self-sufficient neighborhoods is advised in order to improve urban planning and sustainability. Encouraging mixed-use developments will facilitate the integration of commercial, residential, and recreational areas, lowering the need for travel and promoting walkability. Additionally, incorporating climate-resilient design features and allocating dedicated areas for green spaces, parks, and recreational zones will improve environmental sustainability and community well-being. Densification promotion will promote more effective infrastructure development and further optimize land usage.

SOCIAL AND COMMUNITY DEVELOPMENT

Ensuring accessibility and inclusivity for all while creating spaces that encourage gathering, interaction, and collaboration is essential for developing more engaging and inclusive public spaces. To promote a sense of ownership and community involvement, public participation should be incorporated into all phases, including decision-making, implementation, and monitoring. Additionally, efforts should focus on developing vibrant communities by promoting cultural activities and social programs within superblock zones, enhancing community engagement and strengthening social connections.

ECONOMY

Specialized spaces for street vendors and small-scale businesses should be created, placed to draw foot traffic, in order to boost economic opportunities and support local businesses. Public areas will be further activated by the installation of street furniture that is flexible and adaptable, as well as kiosks for food vendors and pop-up markets. Additionally, ensuring equitable access for street vendors through structured licensing, designated vending zones, and essential amenities such as storage and waste disposal will create a more inclusive and sustainable urban environment.

ENVIRONMENT AND SUSTAINABILITY

Low-Impact Development strategies, such permeable pavements and rain gardens inside superblocks, are advised to improve sustainability and urban resilience by efficiently managing rainwater and reducing runoff. Integrating green rooftops and vertical gardens on buildings will help absorb CO_2 and reduce overall energy consumption. Climate-responsive design should be prioritized by incorporating native vegetation and shade-providing structures in open spaces to mitigate heat. Additionally, the use of landscaping and sound barriers along perimeters can minimize noise pollution from busy roads, fostering a quieter and healthier environment. By using high-albedo materials on building exteriors and pavements, urban heat island effects can be

minimized and heat absorption can be further decreased. The enhancement of urban greenery should involve the conversion of certain streets and parking lots into parks, green corridors, and community gardens. Lastly, incorporating fitness zones, jogging tracks, and open gyms will encourage active living and promote overall well-being.

TECHNOLOGICAL INTEGRATION

Utilize Using GIS and urban data analytics for spatial optimization and ongoing monitoring is recommended to improve urban planning and management. The development of digital platforms and applications can improve accessibility and efficiency by offering real-time information about amenities, services, and transportation. Integrating IoT sensors within superblocks will enable the monitoring of traffic patterns, pollution levels, and energy consumption, contributing to data-driven decision-making. Additionally, implementing smart city technologies will optimize resource management and facilitate performance evaluation. To guarantee that stakeholder and resident input is actively integrated into urban development strategies, interactive feedback systems should be established.

6. CONCLUSIONS

This research highlights the superblock concept's transformative potential in improving urban liveability, especially in Indian cities. Superblocks provide a feasible solution to critical urban issues like traffic congestion, noise and air pollution, a lack of green spaces, and declining pedestrian safety by rearranging urban layouts to prioritize pedestrians, public spaces, and sustainable modes of transportation.

Based on international case studies, findings demonstrate how superblocks can greatly enhance important urban livability metrics, such as social integration, mobility, safety, and environmental quality. Implementing this approach in Indian cities, however, will involve addressing a number of real-world obstacles, including an extensive reliance on motor vehicles, fragmented urban government, socioeconomic inequality, and inadequate infrastructure.

An strong foundation for integrating superblocks is provided by current regulations in Indian cities, such as those pertaining to transit-oriented developments, pedestrian-friendly street initiatives, and urban greening initiatives . But for them to be successful, these regulations must be aligned with an integrated framework for urban planning that prioritizes sustainability, equity, and community engagement.

According to the study's findings, superblocks have a lot of potential for Indian cities, but their deployment requires a flexible and phased strategy. If the superblock model is carefully modified, it might completely transform Indian cities, making them more livable, sustainable, and resilient to future challenges.

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