Chapter 9

Empirical Research on Integrating Indigenous Knowledge into Sustainable Urban Planning

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Introduction

Urban centers, as the most intricate manifestations of human civilization, play a pivotal role on the global stage, showcasing remarkable progress and innovation. Cities, as socio-economic systems, represent some of the most advanced and complex creations of human society, exerting significant influence globally. Such phenomenal development and progression require comprehensive planning to optimize resource allocation and promote harmonious growth across urban populations. To effectively harness this development and ensure its equitable distribution, thorough city planning becomes imperative. The primary aim of such planning is to enhance the overall quality of life while ensuring inclusivity, both spatially and socially, and maintaining a sustainable understanding of the city's critical systems. Historical evidence from various countries underscores the systematic approaches developed across political, geographical, ecological, cultural, and socio-economic domains in shaping settlements. Effective urban planning has consistently integrated diverse factors such as governance, infrastructure, public health, and social cohesion, aligning them with the evolving needs of urban populations. The legacy of city planning spans from ancient times to modern-day smart city initiatives, demonstrating the universal quest for creating livable and resilient urban environments.

India has a rich historical legacy spanning over 2000 years, characterized by civilizations with well-defined systems, including town planning. Cities like Patliputra, Varanasi, and Nalanda (Nallathiga, 2009), dating back to Vedic times, stand as testaments to meticulously planned urban layouts. These early city-planning endeavors culminated in a structured body of indigenous knowledge, rooted in the experiences, observations, and socio-cultural dynamics of ancient Indian societies. Ancient Indian architects and engineers derived architectural and construction principles from a synthesis of experience, natural phenomena observation, and societal norms. These principles aimed to create built environments harmonious with inhabitants' needs while leveraging natural resources optimally. The sustainability ethos inherent in these indigenous planning models has ensured their resilience over time, making them relevant even in contemporary urban planning contexts. Ancient planning strategies often integrated water management systems, green spaces, and transportation networks, demonstrating a foresight that aligns with modern sustainability practices. These models emphasized community-centric designs, fostering social interaction and cultural continuity, crucial for maintaining the socio-economic vibrancy of urban areas.

India's ancient urban planning, grounded in empirical knowledge and cultural insights, holds contemporary relevance. This empirical research examines and analyzes indigenous models, emphasizing parameters for inclusive neighborhood planning. The identified parameters are systematically compared with the New Urban Agenda, Smart City mission, and United Nations Sustainable Development Goals, evaluating their contemporary significance. The core objective is to analyze historical methodologies, extracting insights for sustainable and inclusive urban planning. Parameters such as cardinal directions, geometric precision, and scientific knowledge permeated the planning frameworks of ancient Indian civilizations. Additionally, ancient models often incorporated strategies for disaster resilience and adaptability, elements increasingly crucial in the face of modern environmental challenges.

Through a comprehensive research methodology, a matrix for comparing contemporary development agendas has been developed. By reassessing and revitalizing indigenous planning principles, cities can optimize resources and promote sustainable development. This study contributes to urban planning by advocating a holistic approach, aligning contemporary systems with indigenous knowledge to support the environmental, cultural, and social dimensions of cities.

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Material and Methods

This empirical research study aims to synthesize actionable insights from historical methodologies and revitalize indigenous planning principles to promote sustainable and inclusive urban development. The study seeks to integrate modern systems with indigenous wisdom, fostering resilient, culturally rich, and socially equitable cities by prioritizing environmental stewardship, cultural preservation, and social equity. The following methodology framework was established for the empirical research study (Refer Table 1).

Table 1: Methodology Framework (Developed by authors).

Sl. No.	Methodology Framework
1	● Research problem statement ● Research objectives
2	Literature Review
3	● Empirical Research Analysis ● Development of Comparative Matrix
4	Detailed Case Example: Analysis of Parameter, Scores, and Weighted Index
5	Discussion and Conclusion

Research problem statement
Urban centers drive human progress and innovation as complex socio-economic systems with global impact. Effective urban planning optimizes resource allocation, promotes equitable development, and improves quality of life. Historical evidence, such as India's town planning legacy, underscores the value of integrating indigenous wisdom with modern practices. This research synthesizes historical insights and revitalizes indigenous planning principles to foster sustainable, inclusive urban growth. By prioritizing environmental stewardship, cultural preservation, and social equity, the study aims to harmonize contemporary systems with indigenous knowledge, creating resilient, culturally enriched, and socially equitable cities.

The research study aimed at addressing the following key research questions:
- How can historical and indigenous urban planning principles be integrated effectively into contemporary urban development frameworks to enhance sustainability, resilience, and inclusivity?
- What advantages do traditional planning principles offer over modern practices in addressing environmental sustainability, cultural preservation, and social equity in urban contexts?
- How can indigenous strategies for resource utilization optimize urban development outcomes while preserving environmental integrity and cultural heritage?

Research Objectives
The following are the research objectives:

1. To examine the significance of ancient and indigenous urban planning practices and their relevance to contemporary urban development.
2. To create a comparative matrix to assess how contemporary development agendas align with historical planning principles, integrating insights for improved urban planning strategies.
3. To analyze the implementation of indigenous strategies to optimize resource utilization and promote sustainability in urban areas, enhancing resilience and inclusivity while preserving cultural heritage.

Literature Review

The urban planning tradition in India is a product of diverse historically significant events, each leaving a distinctive imprint on settlement design. The extensive literature review analyzed the meticulously planned streets of the Indus Valley Civilization to the profound insights of Vedic texts. Foundational treatises like Vastu Shastra and Kautilya's Arthashastra emerged as guiding principles, shaping sustainable urban habitats. The Mughal era brought its architectural language, blending Central Asian influences with indigenous wisdom. Subsequently, the colonial period introduced Western planning ideals, albeit primarily serving imperial interests. This comprehensive exploration unveils the myriad influences that have shaped India's urban landscape, providing valuable insights into the evolution of urban planning practices.

The following table summarizes the key aspects of different Ancient Indian Texts on Architecture and City Planning (these texts collectively encompass the traditional Indian knowledge and principles on urban planning, architecture, and design), civilizations, and their impact on the settlement pattern (Refer Table 2):

Table 2: Key Aspects of Different Ancient Indian Texts on Architecture and City Planning Civilizations, and Their Impact on the Settlement Pattern (Developed by authors).

Sl. No.	Name	Key Aspects
1	**Indus Valley Civilization** (Kennedy, 2008); (Wright, 2010); (Possehl, 2002); (Green, 2019)	● Prehistoric period ranges from the Indus Valley Civilization to the Vedic period. ● Harappa and Mohenjo-Daro are well-planned settlements around 2500 BC. ● Knowledge of cardinal directions and geometry is reflected in the grid-iron street pattern of Mohenjo-Daro.
2	**Vedic India Planning** (Acharya, 1997) (Patra, 2014); (Michell, 2014); (Sharma, 2020)	● Indian culture and civilization are rooted in the Vedas. ● Proper design of buildings impacts human well-being. ● Vastu Shastra was used for planning and architecture. ● Kautilya's Arthashastra and Manasara Shilpa Shastra offer insights into ancient city planning. ● Cities like Madhurai, Kanchipuram, and Srirangam demonstrate scientific planning with concentric square streets centered around a temple.
3	**Manasara Shilpa Shastra** (Acharya, 1997); (Acharya, Manasara on Architecture and Sculpture, 1997); (Rao, 2018)	● Seventy-five chapters detail indigenous planning knowledge. ● Includes planning for palaces, houses, temples, roads, and rituals. ● Different types of settlements are meticulously organized to accommodate various structures.
4	**Kautilya's Arthashastra** (Rangarajan, 1992); (Singh, 2021)	● Outlines scientific and systematic city planning. ● Principles include light, ventilation, privacy, walkability, ratio of built to open spaces, and aesthetics. ● Development control regulations and zoning practices remain relevant.
5	**Vaastu Shastra** (Acharya, 1997); (Hardy, 2007); (Patel, 2019)	● Ancient science of placement and design. ● Principles for site selection, construction, layout, and design of buildings and towns. ● Main principle: balance between dwelling and elements of the universe for happiness and comfort. ● Combines Air, Earth, Fire, Space, and Water with human life and material. ● Architect, Draughtsman, Carpenter, and Mason symbolize the four facets of Brahma. ● Provides guidelines for site selection, construction, and layout of temples, residences, and towns.
6	**City Planning of the Mughals** (Asher, 1992); (Koch, 2001); (Khan, 2020)	● Mughal period (16th century to 300 years) saw extensive city planning. ● Covered capitals, defense outposts, trading establishments, ports, and military cantonments. ● Development of unique spatial forms and architectural language specific to India despite Central Asian influence.
7	Colonial Period Planning (King, 1976); (Hosagrahar, 2005); (Banerjee)	● British colonization introduced modern Western planning principles. ● Port towns developed for trade, commerce, and defense. ● Focused on organizing settlements, infrastructure, and legislation for planning proposals. ● British planning often served economic interests, leading to divisions between areas for the ruling elite and the public. ● Introduced dual character to cities with fragmented spaces and separated residential areas.

The Indian subcontinent has a rich history of urban planning, from the sophisticated layouts of the Indus Valley Civilization to the scientifically driven designs of Vedic India and the structured approaches of the Mughal and Colonial periods. Each era contributed unique principles and methods, influencing the development of cities and towns, reflecting a blend of indigenous knowledge and external influences.

Empirical Research Analysis

The weightage index method was chosen as the evaluative framework to systematically assess the relevance and significance of indigenous city planning principles (Porter, 2017) in contemporary urban development contexts. This methodological approach allowed for a nuanced analysis, considering the varying degrees of importance assigned to different parameters based on their perceived relevance to present-day urban planning agendas. The weightage assigned to each parameter in the study was informed by a comprehensive literature review, which delved into a wide array of historical sources and research studies aimed at unraveling the evolution of city planning systems in India. The review encompassed ancient sculptures, historical texts, and analyses of urban layouts from key periods such as the Vedic era and the Indus Valley Civilization. Particularly significant were texts like the Manasara Shilpa Shastra, Kautilya's Arthashastra, and Vaastu Shastra, which provided foundational principles for city planning deeply rooted in India's rich cultural heritage.

To ground the analysis, detailed case studies of several historic cities, including Harappa, Mohenjo-Daro, Patliputra, Varanasi, and Nalanda, were conducted. By examining the indigenous planning principles manifested in these cities, key parameters shaping urban development in ancient India were identified and analyzed. These case studies provided insights into the sophisticated water management systems, gridiron street layouts, and the integration of public spaces with residential and commercial zones.

Moreover, the investigation extended to cities like Delhi, Agra, and colonial port towns, enabling the discernment of shifts and continuities in city planning principles across different historical periods, including the Mughal and colonial eras. The study of Mughal cities highlighted the influence of Persian garden city concepts, characterized by charbagh layouts and grandiose public buildings, while the colonial analysis revealed the introduction of Western planning principles that emphasized segregation and infrastructural development.

Drawing upon insights gleaned from the literature review and case studies, a matrix was formulated to systematically compare the identified parameters of indigenous planning models with contemporary development agendas. This matrix serves as a robust tool for evaluating the relevance and applicability of historical methodologies in present-day urban planning contexts. From this rigorous process emerged ten paramount parameters encapsulating the essence of Indian indigenous city planning principles, including spatial organization, environmental sustainability, social inclusivity, economic functionality, aesthetic considerations, cultural symbolism, infrastructural integration, governance frameworks, adaptability, and community engagement.

The empirical research underscored the enduring relevance of ancient planning principles, demonstrating their potential to inform and enhance contemporary urban development practices. This integrative approach not only preserves cultural heritage but also promotes sustainable and holistic urban growth.

Development of Comparative Matrix

The study identifies key parameters (Refer Table 3) from ancient Indian city planning practices and their contemporary relevance. These parameters align with modern development agendas, including the United Nations Sustainable Development Goals (SDG 11), the New Urban Agenda, and India's Smart Cities Mission. The results highlight how historical urban planning principles can inform and enhance current urban development efforts.

a) Geometric Planning and Cardinal Directions: Ancient city layouts, like those of the Indus Valley Civilization, showcased a sophisticated approach to land use planning. The use of geometry and cardinal directions was prominent. This method aimed to encourage compact, interconnected urban development in alignment with contemporary urban agendas.

b) Grid Iron Street Patterns: The streets in Mohenjo-Daro, which divided the city into 12 blocks, exemplify organized urban layouts. Adopting gridiron street patterns can facilitate efficient movement (for example Chandigarh, Jaipur etc.) and promote compact, mixed-use urban development, aligning with the principles of the New Urban Agenda and the Smart Cities Mission.

c) Mixed-Use Development: Vedic civilizations featured towns that blended residential, commercial, and public spaces (e.g., Nagara, Rajdhani). This historical model promotes mixed land-use and creating efficient urban spaces with diverse functions.

d) Environmental Integration: Ancient cities like Mohenjo-Daro incorporated water bodies and green spaces, such as the Great Bath and vast granaries. Integrating such environmental elements into urban planning improves waste management and public spaces, supporting sustainable consumption and production patterns and the development of green infrastructure.

e) Infrastructure and Services Planning: The Manasara Shilpa Shastra detailed effective drainage systems and water storage solutions. Planning for efficient infrastructure, drainage, and services builds resilient infrastructure and reduces vulnerability to disasters, enhancing urban resilience in line with modern urban planning goals.

f) Cultural Heritage Preservation: The use of Vastu Shastra and Manasara Silpa Sastra in Vedic India highlights the importance of preserving cultural heritage and architectural principles. Strengthening efforts to safeguard cultural and natural heritage aligns with the New Urban Agenda's focus on preserving inclusive urban identities and revitalizing urban centers.

g) Zoning and Regulation: Kautilya's Arthashastra provided detailed building regulations and zoning practices, which remain relevant for organized development today. Implementing effective zoning regulations supports integrated and sustainable development planning, as emphasized by contemporary urban policies.

h) Community Engagement: Vedic principles of community engagement in urban development emphasize involving local communities in planning and decision-making. Ensuring access to public spaces and promoting social inclusion enhances participatory urban planning and management, a key aspect of the Smart Cities Mission.

i) Sustainable Practices: Kautilya's Arthashastra included zoning for temples, commercial areas, and gardens, reflecting sustainable practices in energy efficiency and waste management. Implementing such sustainable practices supports the development of resilient urban areas, leveraging technology for sustainable development.

j) Adaptive Urban Planning: The categorization of towns during the Mughal period into different types (e.g., cantonments, provincial capitals) demonstrates adaptive planning for changing urban needs. This approach enhances urban resilience, reduces disaster risk, and aligns with goals to develop infrastructure for disaster management and response.

These findings underscore the enduring relevance of indigenous planning principles and their potential to inform and enhance contemporary urban development efforts. Integrating these historical insights with modern planning frameworks can lead to more sustainable, resilient, and inclusive urban environments. Comparative analysis of ten key parameters derived from indigenous planning systems of the Indian subcontinent, juxtaposed with contemporary development agendas such as the UN SDG 11, New Urban Agenda, and India's Smart Cities Mission (Table 1). Each parameter represents a fundamental aspect of urban planning, ranging from geometric planning and mixed-use development to cultural heritage preservation and sustainable practices. Drawing upon examples from historical Indian civilizations like the Indus Valley Civilization, Vedic India, and the Mughal period, the table highlights the relevance of ancient planning principles in today's urban development context. The formulation of this table involved a meticulous literature review, examining ancient texts, archaeological findings, and historical city layouts to identify the key parameters of indigenous planning systems. Insights from texts such as the Manasara Shilpa Shastra, Kautilya's Arthashastra, and Vaastu Shastra provided foundational knowledge for understanding ancient planning methodologies. These parameters were then evaluated against contemporary development agendas to assess their continued significance in modern urban planning. The table serves as a valuable tool for urban planners and policymakers, offering insights into the enduring relevance of indigenous planning principles in addressing contemporary urban challenges. By recognizing the value of ancient wisdom, cities can adopt holistic and sustainable approaches to urban development, promoting inclusive growth, environmental sustainability, and cultural preservation. Furthermore, the table underscores the importance of integrating traditional knowledge systems with modern urban planning frameworks to create more resilient and livable cities for future generations.

Table 3: Comparative analysis of key parameters driven by Indigenous knowledge systems, SDG, NUA and India's SCM (Source: Developed by authors).

| S.No	Parameters	Relevance	Examples from the Indian Sub-Continent	Indicators identified from Literature	UN SDG 11	New Urban Agenda	India's Smart Cities Mission India
1	Geometric Planning and Cardinal Directions	Efficient land use planning based on geometry and cardinal directions	Ancient city layouts with gridiron streets (Indus Valley Civilization).	Utilize geometry and cardinal directions for efficient planning.	-	Promote compact and well connected urban development.	Plan efficient and organized urban layouts.
2	Grid Iron Street Patterns	Organized urban layouts	Streets in Mohenjo-Daro divided the city into 12 blocks (Indus Valley Civilization).	Organize urban layouts with gridiron street patterns.	-	Promote compact and mixed-use urban development.	Develop organized urban grids for efficient movement.
3	Mixed-Use Development	Blending residential, commercial, public spaces	Different types of towns in Vedic civilizations (Nagara, Rajdhani, etc.).	Blend residential, commercial, and public spaces.	Ensure access to adequate safe, and affordable housing and basic services	Ensure access to basic services for all and promote mixed land use.	Create efficient urban space with diverse functions.
4	Environmental Integration	Incorporating water bodies, green spaces	Mohenjo-Daro with Great Bath and vast granaries (Indus Valley Civilization).	Integrate water bodies, green spaces, and sustainable practices.	Improve urban planning and management of waste and public spaces.	Promote sustainable consumption and production patterns.	Develop green and sustainable infrastructure.
5	Infrastructure and Services Planning	Effective drainage, water supply, amenities	Proper drainage system and water storage in settlements (Manasara Shipa Shastra).	Plan for efficient infrastructure, drainage, and services.	Build resilient infrastructure and reduce vulnerability to disasters.	Enhance urban resilience and reduce disaster risk.	Develop smart infrastructure and services.
6	Cultural Heritage Preservation	Integrating historical and cultural elements	Use of Vastu Shastra and Manasara Silpa Sastra for architecture (Vedic India).	Preserve cultural heritage and architectural principles.	Strengthen efforts to protect and safeguard cultural and natural heritage.	Preserve cultural-heritage and promote inclusive urban identities.	Revitalize urban centers while preserving heritage.
7	Zoning and Regulation	Zoning for land use, building codes	Kautilya's Arthasasthra with building regulations (Vedic India).	Implement zoning regulations for organized development.	-	Implement integrated and sustainable development planning.	Implement effective zoning and regulations for development.
8	Community Engagement	Involving local community in planning	Principles of community engagement in urban development (Vedic India).	Involve the local community in planning and decision-making.	Ensure access for all to public spaces and social inclusion.	Enhance participatory urban planning and management.	Promote citizen engagement and participatory planning.
9	Sustainable Practices	Implementing energy efficiency, waste management	Zoning for temple, commercial, garden areas (Kautilya's Arthasasthra).	Implement sustainable practices for energy and waste management.	Provide access to safe, affordable, accessible, and sustainable transport systems.	Promote sustainable and resilient urban development.	Leverage technology for sustainable development.
10	Adaptive Urban Planning	Learning from historical patterns	Different town categories in Mughal planning (Cantonments, Provincial Capitals, etc.).	Practice adaptive planning for changing urban needs.	Build resilient infrastructure and reduce vulnerability to disasters.	Enhance urban resilience and reduce risk.	Develop infrastructure for disaster management and response.
			Use of geometric planning for settlements (Manasara Shipa shastra).	-	-	-	-
			Incorporation of environmental elements in planning (Vaastu Shastra).	-	-	-	-

Table 4: Weighted score for each parameter (Source: Developed by authors).

S.No	Parameters	Sub-Criteria	Weight	UN SDG 11 (Score)	UN SDG 11 (Weighted Score)	New Urban Agenda (Score)	New Urban Agenda (Weighted Score)	India's Smart Cities Mission (Score)	India's Smart Cities Mission (Weighted Score)
	Geometric Planning and Cardinal Directions	Efficient land use planning based on geometry	0.05	4	0.2	4	0.2	5	0.25
		Use of cardinal directions for planning	0.05	4	0.2	4	0.2	5	0.25
	Grid Iron Street Patterns	Organized urban layouts	0.05	4	0.2	3	0.15	4	0.2
		Efficient movement through grid patterns	0.05	4	0.2	3	0.15	4	0.2
	Mixed-Use Development	Blending residential, commercial, public spaces	0.1	5	0.5	5	0.5	5	0.5
		Access to housing and basic services	0.05	5	0.25	5	0.25	5	0.25
	Environmental Integration	Incorporating water bodies and green spaces	0.1	5	0.5	5	0.5	4	0.4
		Sustainable practices	0.05	5	0.25	5	0.25	4	0.2
	Infrastructure and Service Planning	Effective drainage, water supply, amenities	0.1	5	0.5	4	0.4	5	0.5
		Planning resilient infrastructure	0.05	5	0.25	4	0.2	5	0.25
	Cultural Heritage Preservation	Integrating historical and cultural elements	0.1	4	0.4	4	0.4	4	0.4
	Zoning and Regulation	Implement zoning regulations for organized development	0.1	4	0.4	4	0.4	5	0.5
	Community Engagement	Involving local community in planning and decision-making	0.05	4	0.2	4	0.2	4	0.2
	Sustainable Practices	Energy efficiency	0.025	5	0.125	5	0.125	5	0.125
		Waste management	0.025	5	0.125	5	0.125	5	0.125
	Adaptive Urban Planning	Learning from historical patterns	0.05	4	0.2	4	0.2	4	0.2
	Total		**1**		**4.5**		**4.25**		**4.55**

Table 4 provides a comprehensive evaluation of how parameters derived from the indigenous knowledge systems of India align with the broader objectives outlined in UN SDG 11, the New Urban Agenda, and India's Smart Cities Mission. Each parameter reflects aspects of historical city planning in India (explained in earlier), such as geometric planning, mixed-use development, and cultural heritage preservation, drawing from ancient texts and civilizations. The parameters assessed in this table stem from a meticulous literature review of indigenous planning systems elucidated earlier. Derived from ancient texts, historical civilizations, and architectural treatises like the Manasara Shilpa Shastra, Kautilya's Arthashastra, and Vaastu Shastra, these parameters embody the rich legacy of India's indigenous knowledge systems.

The analysis reveals varying degrees of relevance between these parameters and the contemporary urban development agendas (Fig 1). Parameters like Geometric Planning and Cardinal Directions, Mixed-Use Development, and Sustainable Practices exhibit strong alignment across all three agendas, indicating the enduring relevance and applicability of indigenous planning principles in modern urban contexts. Environmental Integration and Infrastructure and Services Planning also score well, reflecting the importance of sustainability and efficient infrastructure in contemporary urban planning frameworks. However, some parameters, such as Adaptive Urban Planning and Community Engagement, demonstrate relatively weaker alignment, suggesting potential areas for improvement or further integration of indigenous knowledge systems into current urban development strategies. This disparity highlights the need to bridge the gap between traditional planning methodologies and modern urban demands. By doing so, urban planners can create more holistic and inclusive development plans. It also points to the necessity of fostering greater community involvement and adaptive measures that can respond to evolving urban challenges effectively.

Figure 2. Radar chart plotting based on weightage index scores (Source: Developed by authors).
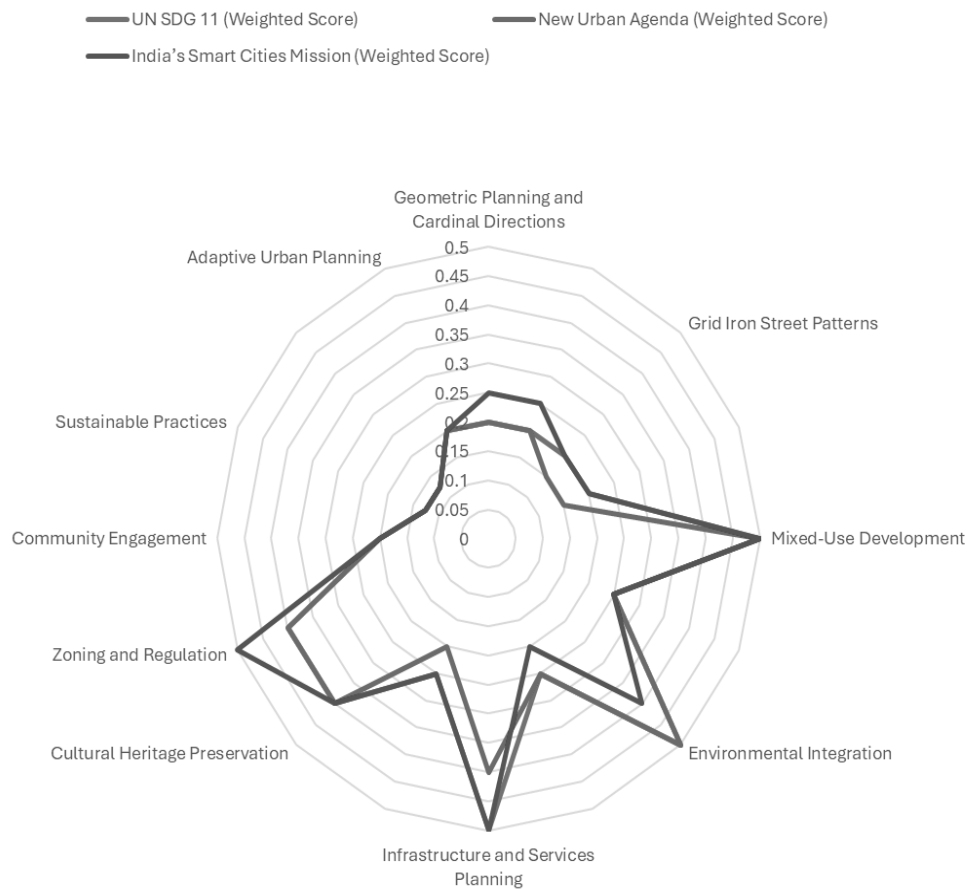
Case study of Bangalore City, Karnataka, India

Bangalore, often hailed as the Silicon Valley of India, has transformed from a humble town into a bustling metropolis. Its evolution, shaped by factors like water sources and drainage considerations, can be traced back to the vision of Chieftain Kempegowda-I in 1537. Inspired by the layout of Hampi, he established Bangalore as a prosperous city with forts, temples, and water tanks. Over the centuries, Bangalore has been systematically developed by various rulers and administrators, each contributing to its growth and prosperity. Noteworthy is the significant role played by philanthropists who invested in public infrastructure for the welfare of the citizens, laying the foundation for the city's progress. The planning and spatial layout of Bangalore underwent significant changes from 1537 to 1800 under Kempegowda-I's rule, characterized by a mud fort and specialized layouts for different trades. Later rulers like Hyder Ali and Chikka Deva Raja Wodeyar further fortified the city and expanded its boundaries. The British era marked the development of a cantonment region, segregating the city into Pete (native area) and Cantonment (British area). This

division persisted into the 19th century, shaping distinct neighborhoods and markets. Bangalore's urbanization presents both challenges and opportunities. Future planning efforts should draw from indigenous knowledge systems to promote inclusive growth and sustainable development. By revitalizing traditional planning principles and integrating them with contemporary approaches, Bangalore can navigate its rapid urbanization while preserving its cultural and environmental heritage. Ultimately, fostering a symbiotic relationship between identity and place is crucial for building resilient and livable cities in the 21st century.

Basavangudi

Basavanagudi, a planned extension in the late 19th century, exemplifies the city's urban planning principles. Conceived as a hygienic suburb following a gridiron plan, it prioritized public health and accessibility. Streets were designed for pedestrian convenience, with open squares for community gatherings. The area's layout reflected social hierarchies, with separate zones for different castes. Basavanagudi's enduring vibrancy and functionality highlight the success of these planning principles in adapting to changing urban dynamics.

Basavanagudi – Urban Planning Principles Applied

- **Urban Layout:** The expansion of Basavanagudi adhered to ancient Hindu traditions by orienting built structures towards the cardinal points, employing a rectangular design. Boundary roads ran North-South and East-West, with intermediate roads parallel to them, ensuring well-spaced blocks and efficient drainage systems. This emphasis on topography underscored the neighborhood's spatial planning.

- **Street Design:** Street patterns and typologies significantly influenced accessibility criteria, shaping the physical layout of the area. Basavanagudi Extension Plan of 1894 prioritized pedestrians with a hierarchical street network and wider footpaths, enhancing neighborhood walkability.

- **Neighborhood Planning:** Homes were clustered around large open quadrangles adorned with shady trees, providing space for social and community gatherings. These planned squares aimed to foster civic life, while delineating new divisions between public and private realms. Despite intended purposes, these spaces often extended into private use. Concerns for public health prompted city planners to consider social hierarchies. Based on caste and class, hierarchical arrangements allocated the best sites to the Brahmin community. Additionally, distinct layouts were designated for different castes, reflecting community bonds and occupations.

- **Public Spaces**: The public realm, integral to shared community space, significantly influenced the neighborhood's form and function. Basavanagudi's wide network of streets, public spaces, and parks continues to enrich the area's vibrancy, offering residents sensory experiences and opportunities for exploration.

Table 5: Urban Planning Assessment of Basavanagudi: Parameter, Scores and Weighted Index (Source: Developed by authors).

S.No	Parameters	Sub-Criteria	Weight	Basavanagudi (Score)	Basavanagudi (Weighted Score)
	Geometric Planning and Cardinal Directions	Efficient land use planning based on geometry	0.05	4	0.2
		Use of cardinal directions for planning	0.05	4	0.2
	Grid Iron Street Patterns	Organized urban layouts	0.05	4	0.2
		Efficient movement through grid patterns	0.05	4	0.2
	Mixed-Use Development	Blending residential, commercial, public spaces	0.1	5	0.5
		Access to housing and basic services	0.05	5	0.25
	Environmental Integration	Incorporating water bodies and green spaces	0.1	5	0.5
		Sustainable practices	0.05	5	0.25
	Infrastructure and Service Planning	Effective drainage, water supply, amenities	0.1	5	0.5
		Planning resilient infrastructure	0.05	5	0.25

	Cultural Heritage Preservation	Integrating historical and cultural elements	0.1	4	0.4
	Zoning and Regulation	Implement zoning regulations for organized development	0.1	4	0.4
	Community Engagement	Involving local community in plannir and decision-making	0.05	4	0.2
	Sustainable Practices	Energy efficiency	0.025	5	0.125
		Waste management	0.025	5	0.125
	Adaptive Urban Planning	Learning from historical patterns	0.05	4	0.2
Total			1		**3.6**

The table 5, offers a detailed assessment of Basavanagudi's urban planning, emphasizing its strong points in mixed-use development and environmental integration, both of which received high scores. Consistent scores in geometric planning, gridiron street patterns, and cultural heritage preservation suggest uniform application of these principles. However, the comparatively lower scores in zoning and regulation, as well as community engagement, highlight areas where Basavanagudi could improve to attain more balanced urban development.

Discussion and Conclusion

The urbanization of Bangalore has been influenced by several factors, leading to its spatial expansion. Zoning, designed to segregate different types of activities, has played a crucial role in most spatial developments. Major extensions of the city have served as mechanisms to decongest areas and prevent epidemics while enhancing the city's legibility. Government-led surveys and city schemes have significantly influenced future developments by allocating spaces and finances. These initiatives, coupled with housing for the middle class and environmental improvement measures, have reflected a commitment to social welfare across various sections of society. Despite being the site of major public sector industries, Bangalore was considered a modest-sized state capital until the 1970s. Its growth can be spatially categorized into economic and socio-cultural activity centers, mass transit corridors, neighborhood wedges, and expanding urban peripheries.

With sweeping changes across all realms, the city is experiencing accelerated urbanization. Future planning efforts should focus on revitalizing earlier city planning principles to foster inclusive spatial and social growth while optimizing resource provisions. Academics from diverse fields such as planning, design, geography, environmental science, history, political science, and anthropology should leverage indigenous knowledge systems to enhance urban planning and management interventions. As indigenous planning practices gain global recognition, it is evident that many socio-economic sectors and aspects of habitation rely on indigenous knowledge systems. This reliance underscores the significant impact of indigenous knowledge on sustaining cities.

Viewing established indigenous knowledge as an alternative approach can promote inclusive growth. Sustainable urban areas can be effectively planned by fostering renewed connections between indigenous and contemporary knowledge systems. This approach encourages awareness and a positive stance toward safeguarding environmental and socio-economic elements, ultimately benefiting urban dwellers and enhancing the quality of urban life.

The empirical research underscored the enduring relevance of ancient planning principles, demonstrating their potential to inform and enhance contemporary urban development practices. This integrative approach not only preserves cultural heritage but also promotes sustainable and holistic urban growth. Key parameters identified from historical texts, such as spatial organization, environmental sustainability, social inclusivity, economic functionality, aesthetic considerations, cultural symbolism, infrastructural integration, governance frameworks, adaptability, and community engagement, offer a comprehensive framework for future urban planning initiatives.

The recognition and integration of indigenous knowledge systems into modern urban planning can lead to more resilient, inclusive, and sustainable cities. Collaborative efforts across various academic disciplines will be essential in achieving this goal, ensuring that urban development is both culturally enriched and environmentally sound. By embracing the wisdom of ancient practices, urban planners can create vibrant cities that honor heritage while meeting the needs of contemporary society.

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Conflict of Interests

The author declares no conflict of interest.

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