Quality and Quantity Parameters for Developing Urban Design Regulations for Public Open Spaces in Kerala

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Abstract

Urbanization is rapidly diminishing open spaces, presenting numerous challenges for Kerala, including reduced access to green areas, intensified urban heat island effects, fragmented ecosystems, diminished water retention, erosion, pollution, weakened community cohesion, economic impacts, loss of cultural identity, and decreased resilience to climate change. This study aims to address these issues by developing a comprehensive framework for open spaces in Kerala, ensuring both quantitative and qualitative standards are met. Through a detailed examination of existing policy frameworks and master plans, significant gaps were identified in the criteria used to assess the quantity and quality of public open spaces. To bridge these gaps, this research identifies essential qualitative and quantitative parameters necessary for creating a robust and context-specific framework for Kerala. The study employs a mixed-methods approach, including policy analysis, stakeholder interviews, and field assessments, to formulate actionable guidelines. The findings contribute to improved urban planning practices, promoting sustainable, accessible, and culturally relevant open spaces in Kerala, enhancing overall urban resilience and community well-being.

Keywords: Open space; Public space; Urbanisation; Ecosystem; Landscape; Urban resilience; Quality of open space.

1. Introduction
1.1 Background and Context

Urbanization is a global phenomenon that has led to the rapid transformation of cities, influencing various aspects of daily life. In the Indian state of Kerala, this urbanization trend is particularly pronounced, raising significant challenges and opportunities for urban designers and planners. Kerala, with its lush green landscapes, captivating backwaters, and vibrant cultural heritage, attracts tourists and residents alike. However, rapid urbanization in recent decades has posed challenges to preserving the state's unique character and ensuring the well-being of its citizens (M. Lorenzo, 2023). One critical aspect impacted by this growth is the availability and quality of public open spaces, which play a vital role in urban life. The development of public open spaces in urban areas is a critical component of sustainable planning. These spaces serve as crucial nodes for social interaction, recreation, cultural activities, and environmental sustainability (Centre for liveable cities, 2017). Therefore, the formulation of a comprehensive urban design framework for public open spaces in Kerala becomes imperative to address the evolving needs of its urban populace.

1.2 Problem Statement and Research Gap

Open spaces have emerged as the beating heart of resilient cities. Like lungs filtering air, these green havens breathe life into urban landscapes, shielding against climate change through carbon capture and flood mitigation. Their verdant canopies cool scorching streets, offering refuge from heat islands and fostering healthier environments. But their impact goes beyond the physical. Open spaces weave a tapestry of social resilience, bringing diverse communities together in parks, fostering mental well-being through nature's embrace, and nurturing inclusivity by ensuring equitable access to these invaluable resources (Ignou). They even become economic catalysts, boosting property values, attracting investment, and promoting sustainable practices like urban agriculture. The importance of open public spaces is highlighted in Goal 11.7 of SDG: "By 2030, provide universal access to safe, inclusive, and accessible, green, and public spaces, in particular for women, children, older persons, and persons with disabilities." (Raimundo Bambo´ Naya, 2023)

Need for open spaces mentioned in SDG (Sustainable Development Goals) include:

1. Promoting Health and Well-being (SDG 3) - Open spaces provide opportunities for physical activity, relaxation, and social interaction, all of which contribute to physical and mental health. They can reduce stress, improve air quality, and provide a place for people of all ages and abilities to gather and exercise.

2. Promoting Sustainable Cities and Communities (SDG 11) - Open spaces can help to create more livable and sustainable cities by providing green spaces, reducing urban heat island effects, and improving air and water quality. They can also enhance the aesthetics of cities and attract residents and businesses.

3. Protecting Biodiversity and Ecosystems (SDG 15) - Open spaces can serve as important habitats for plants and animals, helping to preserve biodiversity and maintain healthy ecosystems. They can also provide corridors for wildlife movement and connect fragmented habitats.

4. Mitigating Climate Change (SDG 13) - Open spaces can help to mitigate climate change by absorbing carbon dioxide, reducing the urban heat island effect, and providing shade. They can also help to manage storm water runoff and reduce flooding.

5. Fostering Social Inclusion and Equity (SDG 10) - Open spaces can provide opportunities for people of all backgrounds to come together, promote social cohesion, and reduce inequalities. They can also be used for community gardens, playgrounds, and other activities that benefit all members of the community.

Kerala, known for its unique cultural heritage, geographical diversity, and high population density, is witnessing a growing urban population. The increasing urbanization, coupled with the state's specific socio-economic and environmental conditions, necessitates a focused examination of the existing public open spaces and the development of a robust urban design framework. As the demand for urban infrastructure intensifies, there is a pressing need to strike a balance between development and preservation, ensuring that public open spaces are not only created but are also sustainable, accessible, and reflective of the local context.The urbanisation in Kerala seems to be expanding from the low land coastal urban areas towards eastern side. Open spaces vary with different degrees of urbanisation and hence it is challenging to provide quality open spaces to meet the needs of the growing population (Planning, 2012).
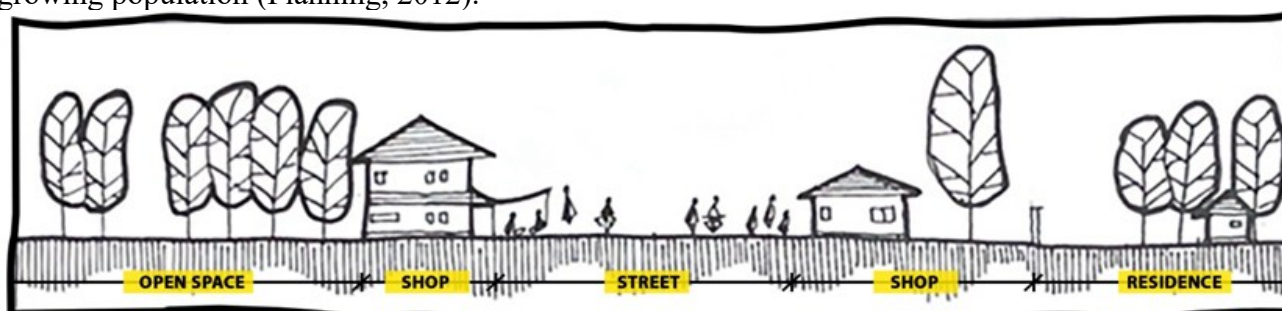

Figure 1. Rurban area section

Rurban area- Commerce develops along main streets and large parcels of land with residence can be seen and hence is the open space.
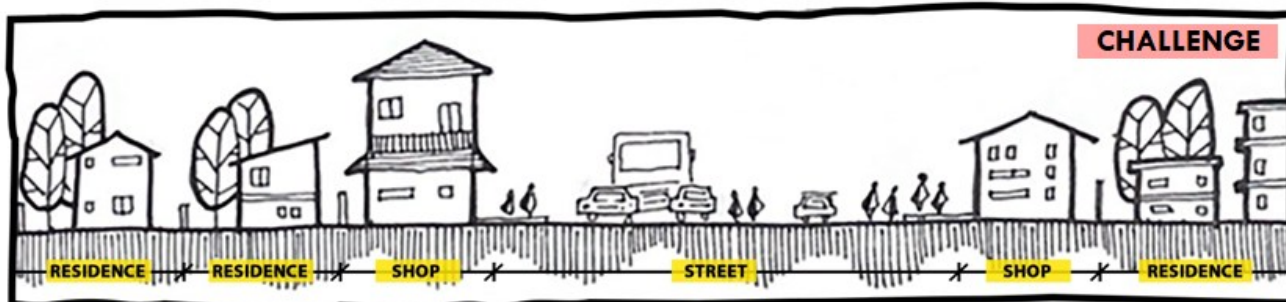

Figure 2. Urban areas (Large town) section

Urban areas (Large towns)-Commercial establishments emerge along primary, secondary, and tertiary streets. Small-sized plots (approximately 10 to 20 cents) characterize the area, featuring limited open spaces.
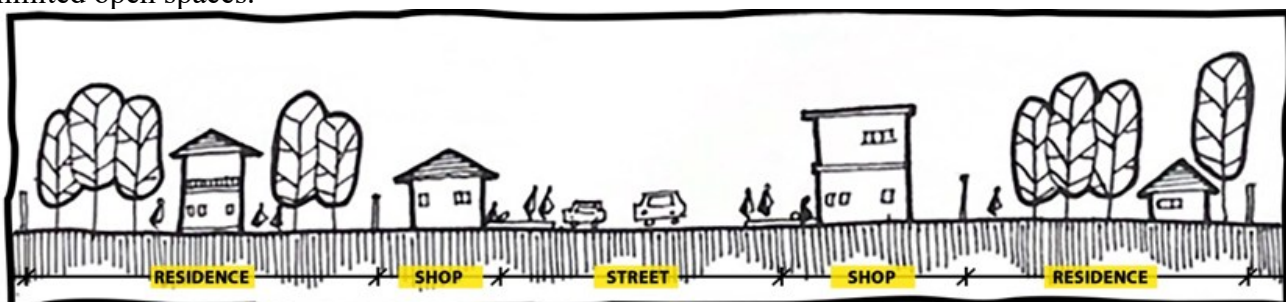

Figure 3. Urban areas (Small town) section.

Urban areas (Small towns)- Commercial areas thrive along both main and secondary streets, while residential zones unfold towards the rear with more extensive plots and open spaces.

The major challenges of open spaces can be observed in urban areas due to the lack of area to provide sufficient open spaces. Also the open spaces that exist also possess several challenges like visibility issues, yard open spaces getting covered, ribbon like development with providing open spaces, accessibility issues, surveillance issue, heavy built mass creating heat islands, creation of islanded open spaces, poor management, lack of shades, etc.
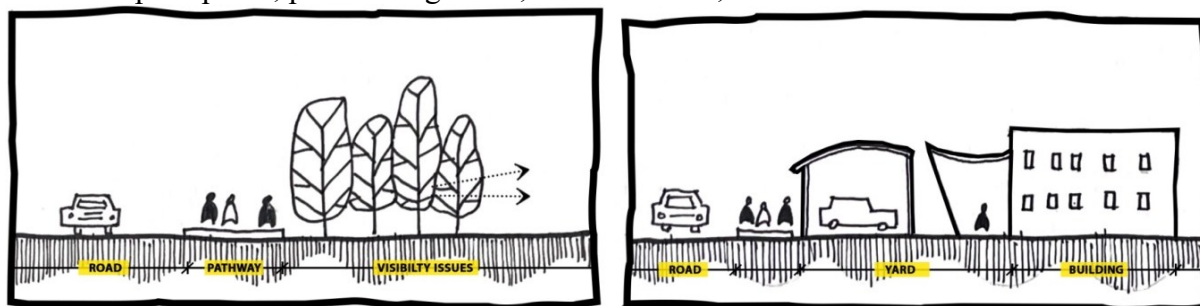

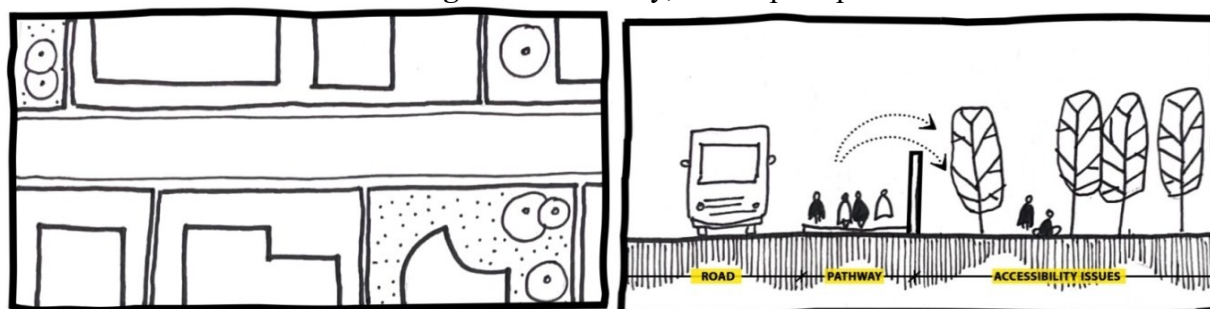**Figure 4.** Visibility, Yard open space
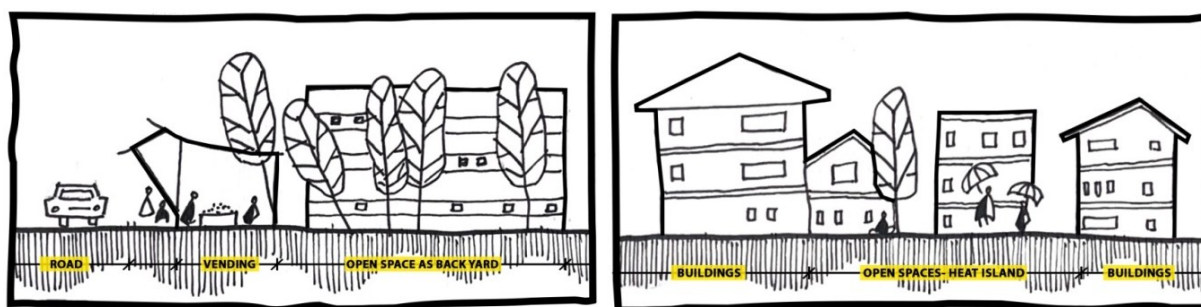

Figure 5. Ribbon like development, Accessibility

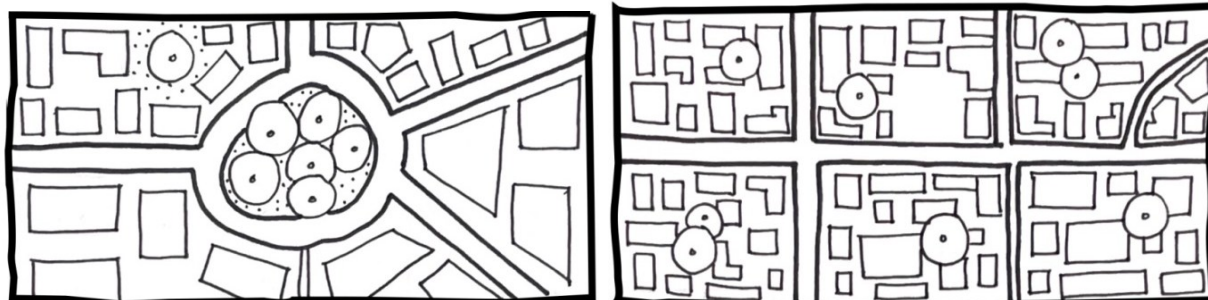**Figure 6.** Surveillance issue, Heavy built mass

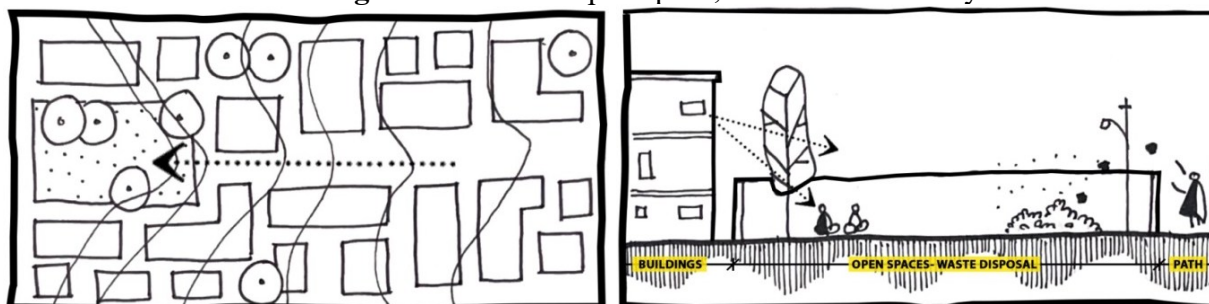**Figure 7.** Islanded open space, Lack of walkability

Figure 8. Ignoring larger landscapes, poor management
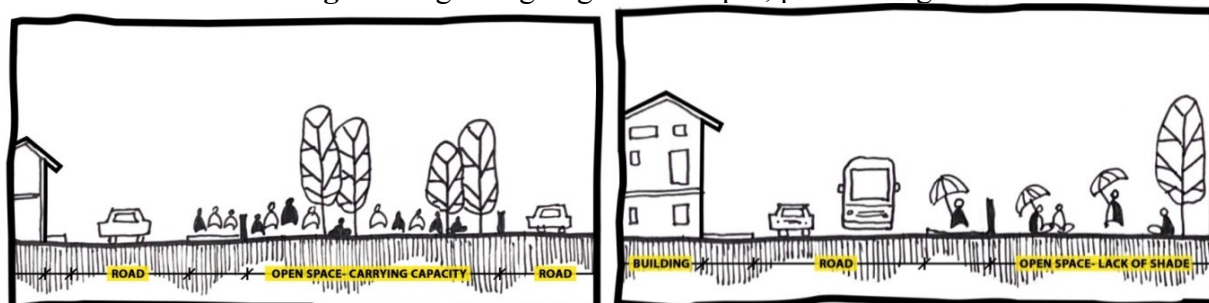

Figure 9. Lack of carrying capacity, Lack of shelter/ shades.

1.3 Objectives and Hypotheses

The primary objective of this research is to gain a comprehensive understanding of public open spaces through the lens of theoretical frameworks and to derive quality assessment parameters. By exploring various theories related to urban design and public spaces, the study aims to establish a set of criteria that can effectively evaluate the quality of these spaces, ensuring they meet both functional and aesthetic standards.

Another critical objective is to investigate and evaluate the current policy framework governing public spaces in Kerala. This involves a thorough analysis of existing regulations and guidelines to identify any gaps or deficiencies that may hinder the development and maintenance of high-quality open spaces. Understanding these gaps will provide a foundation for proposing necessary amendments or new policies.

Furthermore, the study seeks to compare the policy arrangements for public spaces in Kerala with successful models from other regions or countries. By examining best practices and innovative

approaches from around the world, the research aims to extract valuable insights and potential improvements that can be adapted to the unique cultural and geographical context of Kerala.

Finally, the study aims to develop a framework for open public spaces that aligns with the cultural and geographical context of Kerala. This framework will promote the effective use of public spaces, ensuring they are accessible, inclusive, and reflective of the local heritage and environmental conditions. The goal is to create guidelines that not only enhance the quality and quantity of open spaces but also foster a sense of community and well-being among residents.

The hypothesis of this study is that by identifying and implementing specific quality and quantity parameters tailored to the cultural and geographical context of Kerala, it is possible to develop effective urban design regulations that significantly improve the quality and accessibility of public open spaces. The resulting framework will address existing gaps in the policy framework therby enhance community well-being, support environmental sustainability, and contribute to the overall resilience of urban areas in Kerala.

1.4 Significance and Structure of the Paper

The scope of this research encompasses analysis of existing public open spaces in selected urban areas of Kerala. The study will investigate the socio-cultural dynamics influencing the usage of these spaces, evaluate their current design and functionality, and identify shortcomings and opportunities for improvement. Drawing from this analysis, the research will propose a comprehensive urban design framework that integrates local cultural elements, addresses environmental considerations, and aligns with global practices. The scope will extend to recommendations for implementation strategies, taking into account the diverse urban typologies within Kerala.

In conclusion, the study's implications extend to shaping the future of urban design and policy implementation of open spaces in Kerala. These commendations derived from the study provide a road map for refining existing regulations or developing new ones, ensuring they align more closely with the distinctive cultural and contextual characteristics of Kerala.

The study consists of four parts. The first part involves conducting an extensive review of urban design theories and relevant literature on public open spaces. Identify key concepts and principles associated with successful public spaces. Derive quality assessing parameters from theoretical frameworks. In the second part, acts, guidelines and policies governing open spaces in Kerala and Indian context are studied. This involves the evaluation of Master Plans, URDPFI (Urban and Regional Development Plans Formulation and Implementation) Guidelines, KMBR (Kerala Municipality Building Rules) and other Acts to identify potential gaps for development. The next part involves the case study of successful model to derive practices that can be incorporated in Kerala context. The final part involves the development of overall framework. This can be achieved by conducting on-site analysis of selected public spaces in Kerala, considering cultural and geographical nuances (Qualitative study). Evaluate the usage patterns, user preferences, and spatial characteristics; Organize surveys to engage with local communities and gather their input on the design and usage preferences for public spaces (Quantitative study); the combination of qualitative method, diagrammatic study and quantitative method, PSQI (Public space quality index) will help to develop a comprehensive framework.

2. Materials and Methods
2.1 Study Design and Setting

This study employs a mixed-methods design, combining qualitative and quantitative approaches. The research is primarily observational and cross-sectional, focusing on the current state of public open spaces and the policies that govern them. By integrating theoretical analysis, policy review, comparative case studies, and field assessments, the study aims to identify quality parameters essential for effective urban design regulations.

The study is conducted in the context of Kerala, a state in southern India characterized by its unique cultural heritage, diverse geographical features, and high population density. Kerala's urban area, Kochi, serve as the primary settings for this research. The city represent a range of urban typologies, from densely populated commercial hubs to rapidly urbanizing residential areas, providing a

comprehensive understanding of the various challenges and opportunities related to public open spaces.

Field assessments are carried out in selected urban areas within the city to gather empirical data on the existing open spaces, their usage patterns, and the public's perception of their quality. In addition to fieldwork, the study involves a thorough review of current policy frameworks and master plans at the state and municipal levels. This includes analyzing documents, regulations, and guidelines that impact the planning, development, and management of public open spaces.

2.2 Participants or Subjects

The participants in this study are diverse stakeholders involved in the planning, development, and use of public open spaces in Kerala. The study involves a sample size of approximately 200 individuals, selected through a combination of purposive and random sampling techniques to ensure a representative mix of perspectives and experiences. The inclusion criteria for participants are as follows:

1. Urban planners and policymakers involved in the development and regulation of public spaces.
2. Local government officials responsible for urban development and maintenance of public spaces.
3. Community members, from various age groups, genders, and socio-economic backgrounds, who are frequent users of the public open spaces.

Exclusion criteria include individuals who are unwilling or unable to provide informed consent.

The recruitment process ensured voluntary participation, with all participants providing informed consent prior to their involvement in the study. Detailed information about the study's purpose, procedures, potential risks, and benefits was provided to all participants.

Participants' confidentiality and anonymity were strictly maintained throughout the study, with data being securely stored.

2.3 Materials and Equipment

The research utilizes a variety of materials, equipment, and technologies to gather, analyze, and interpret data. The primary materials include survey instruments, mapping tools, and policy documents. Structured questionnaires and interview guides were developed to collect data from participants. These instruments were designed to capture detailed information on the current state of public open spaces, usage patterns, and stakeholder perceptions.

To conduct field assessments, the study employed high-resolution satellite imagery and Geographic Information System (GIS) software.

For data analysis, the study relied on Spider diagram, diagrammatic study and PSQI (Public Space Quality Index) to understand the present situation, which will help to frame future guidelines.

2.4 Procedures and Protocols

The study on followed a systematic and structured approach to data collection and analysis. The research began with a comprehensive literature review to identify theoretical frameworks and quality assessment parameters related to public open spaces. This step involved reviewing academic articles, urban planning guidelines, and best practice case studies from various regions.

Next, policy documents and master plans specific to Kerala were obtained and analyzed to understand the existing regulatory framework governing public open spaces. This involved collecting documents from municipal and state urban planning departments, which were then reviewed to identify gaps and areas for improvement.

Field assessments were conducted in selected urban area of Kerala to gather empirical data on existing public open spaces. The selected areas included major city Kochi, representing a range of urban typologies.

Data analysis involved both qualitative and quantitative methods.

The final step in the procedure was the development of a framework for urban design regulations tailored to the cultural and geographical context of Kerala. This involved integrating findings from the literature review, policy analysis, field assessments, and comparative case studies.

2.4.1 Understanding public open spaces through theories

Through a comprehensive literature review, the research delves into the wisdom of established scholars and practitioners in landscape architecture, urban design, urban planning, and related fields. The process involves sifting through academic journals, books, and articles, gleaning insights on the diverse roles, qualities, and functionalities of public open spaces. This review will guide towards relevant parameters for assessing the quality and effectiveness of public spaces.

Across decades, authors have mapped the parameters of ideal open spaces, weaving threads of accessibility, visual intrigue, social vibrancy, and nature's embrace. From Lynch's "paths and edges" to Carmona's "cleanliness," diverse thinkers have offered their lenses, highlighting elements like safety, prospect, activities, and even mystery, all composing the symphony of a welcoming and enriching open space.

Table 1. Parameters from Literature.

Authors	Year	Parameters
Kevin Lynch	1960	Path, edges, districts, nodes, landmarks
Edward T. Hall	1966	Personal space, social space, public space
Jan Gehl	1971	Protection, comfort, enjoyment
Robert Coles	1974	Safety, social support, diversity, creativity
Donald Appleyard	1979	Visual enclosure, mystery, prospect, refuge
William H. Whyte	1980	Seating, food, water, activities, variety
Carr et al.	1992	Comfort, relaxation, passive engagement, active engagement, discovery and encounter
Stephen Kellert	1993	Biophilia, prospect, refuge, mystery, complexity
Smith et al.	1997	Livability, character, connection, mobility, personal freedom and diversity
Clare Cooper Marcus	1999	People-orientation, sense of place, refuge, variety
Project for Public Spaces	2000	Linkage, uses and activities, comfort and image, and sociability
Elizabeth K. Miller	2006	Enclosure, openness, complexity, coherence
Matthew Carmona	2010	Cleanliness, tidiness, accessibility, attractiveness, comfort, inclusiveness, vitality and viability, function, distinctiveness, safety and security, robustness, greenness, unpollutedness and capacity for fulfilment
Ewing & Clemente	2013	Imageability, visual enclosure, human scale, transparency and complexity
Vikas Mehta	2013	Inclusiveness, meaningfulness, safety, comfort and pleasurability
Frederic J. Lawlor	2016	Accessibility, diversity, functionality, equity, sustainability, resilience, equity
Seema Praliya & Pushplata Garg	2019	Accessible and linked, maintenance, attractiveness and appeal, comfort, inclusiveness, activity and uses, purposefulness, safety and security
M. Lorenzo, M.L. Rios Rodriguez, E. Suarez, . Hernandez, C. Rosales	2023	Architectural, functional, Contextual

Drawing on the diverse perspectives of these authors, this research identified three key pillars of successful open spaces: architectural character (encompassing accessibility, visual appeal, and a sense of purpose), contextual character (vibrant with activity, safe and secure), and functional character (well-maintained, comfortable, and welcoming to all).
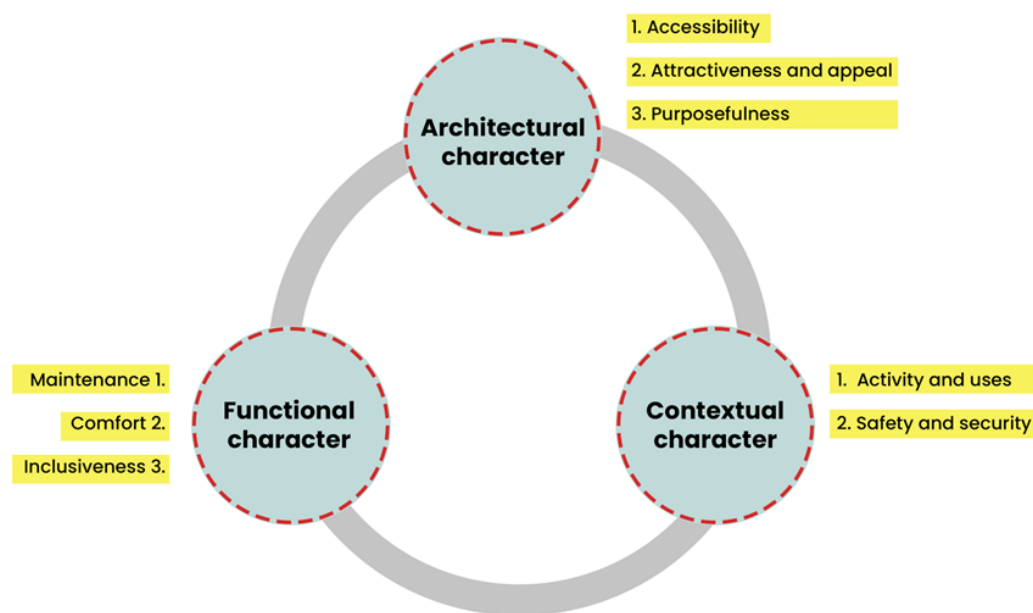
Figure 10. Parameters Identified.

2.4.2 Investigating and evaluating the policy framework In this stage, a thorough document analysis, meticulously examining relevant policies, plans, and guidelines that shape the creation and management of public open spaces in Kerala is studied. This includes scrutinizing Acts, Policies, Guidelines and Building codes. By deciphering this, the research aim to understand the governing rules, regulations, and potential gaps within the existing policy framework.

There exist policy frameworks for open spaces at both National and State level. This study have analysed the National level acts, URDPFI (Urban and Regional Development Plans Formulation and Implementation) Guidelines, State level acts, Master Plan comparisons of various districts within Kerala and KMBR (Kerala Municipal Building Rule)

Analysis:

1. Acts and policies- mention only about the importance of open spaces
2. URDPFI Guidelines- Mention about the open space requirement per person and few parameters like inclusivity, safety, maintenance, and accessibility.
3. Master plan- Areas as per URDPFI Guidelines are not met in Master plans;
4. Although the quantitative distribution of public spaces in towns and cities follows established norms and standards, these guidelines fail to address the qualitative and management aspects of these spaces.
5. The quantitative distribution does not look into the larger ecosystem.

Based on the analysis of guidelines, master plans, and building codes, three critical concerns emerge from an analysis: ensuring sufficient open space (quantity), enhancing its character and functionality (quality), and establishing effective maintenance and governance (management).

Table 2. Current Scenario.

Issues	Proccess	Implementation
Need for open space (Quantity)	Open space as part of the whole system (Developing a comprehensive structure plan with all open spaces)	Master plans, Development plans, Building codes
Regulations (Quality)	Understanding literature to derive parameters and formulate guidelines Develop context specific guidelines for existing and new developments	Building codes
Maintanence (Management)	Develop and maintain both existing and proposed open spaces	Monitored by state and regulated by respective local body

Here, the research embarks on a comparative case study analysis, exploring public space policy arrangements in other regions or countries known for successful public space development. These comparative voyages would focus on innovative approaches to public space design and management. By gathering key takeaways and identifying best practices from these successful models, the research equips with valuable insights for potential improvements in Kerala's policy framework.

2.4.3 Developing framework for public open spaces
This stage involves the development of a comprehensive framework for public open spaces in Kerala. The framework will be tailored to the state's unique cultural and geographical context, aligning with its societal needs, environmental considerations, and available resources.

2.4.4.1 Achieving Open spaces- Quantitative strategy
Open spaces, by their very nature, are not isolated entities but rather vital components of broader landscapes. They are interconnected, influencing and being influenced by the surrounding environment. This interconnectedness is crucial for maintaining ecological balance, supporting biodiversity, and providing a sense of place. Proposing a comprehensive Land use by overlaying Regulation function, Habitat function and Cultural function. The result of which would be a structure plan indicating areas to be conserved, reclaimed and rehabilitated.

1. Regulation function- non-living elements such as geological structure, water, soil, and climate.
2. Habitat function- Habitat diversity, habitat connectivity, etc.
3. Cultural function- scientific significance, historical and cultural heritage, and related aspects.

Developing design guidelines based on Urban character (Guidelines based on population, sectors, geomorphological structure)

1. Population- Classifying areas based on population density to calculate open space requirement.
2. Sectors- Classifying the area under different sectors like residential, institutional, industrial, commercial, religious, etc. to categories the types of open spaces.
3. Geomorphological structure- Classifying areas based on Geomorphology like Coastal, mountainous, plains, etc. to propose guidelines.

Degree of urbanization (Guidelines for urban core, fringe and rural)

1. Categorizing areas by density and activity into urban core, fringe, and rural areas, followed by developing suitable guidelines for each. (Example: Urban core- Guidelines for permeability, green infrastructure, setbacks, other building regulations, etc.; urban fringe and rural areas- buffering from core area, and other building regulations.)
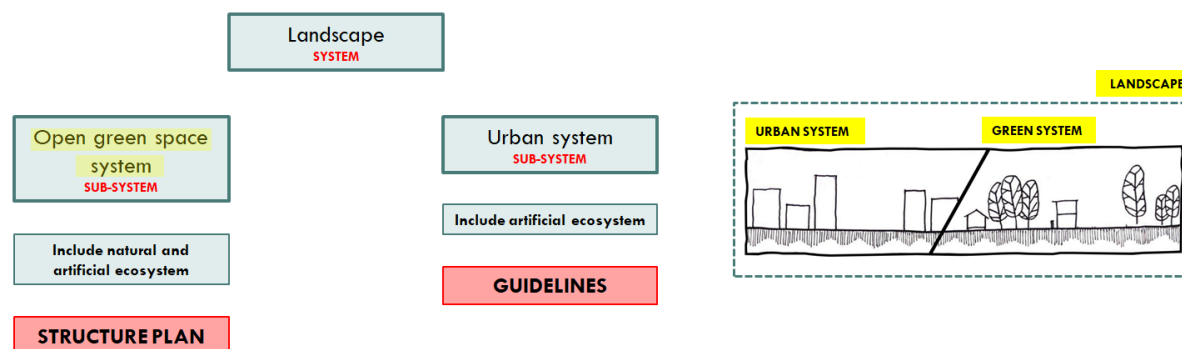

Figure 11. Open Space as part of whole system.

2.4.4.2 Achieving Open spaces- Qualitative strategy
Indicators are derived from the parameters established in order to analyse a case from both user's perspective and researcher's perspective.

Architectural characteristics:
1. Accessibility (Walking accessibility from work/ Live, Accessibility via public transport, Accessibility via private transport, Parking, Ease of movement in and around)
2. Attractiveness and appeal (Visual attractiveness, Unobstructed view, Arrangement of public infrastructure)
3. Purposefulness (Presence, quality and condition of loci, Suitability of layout and design)

Functional characteristics:
1. Maintenance (Management of litter and filth, Management of waste, Presence and condition of waste bin, Management of vandalism, Condition of infrastructure)
2. Comfort (Presence and condition of public amenities, Presence and condition of shelter spaces, Presence and condition of signage, Climate inclusivity)
3. Inclusiveness (Control of entrance, Used by all)

Contextual characteristics:
1. Activity and uses (Performance of designated activity, Activeness of the area throughout the day, Activities for all genders)
2. Safety and security (Secureness, Surveillance measures, Criminal activities, Anti-social elements, Presence of lighting and illumination)

2.4.3 Current Scenario
Analysis of the current scenario of public open spaces from the gaps identified from Acts, policies and guidelines. This will provide a nuanced picture of existing strengths and weaknesses within the current landscape and helps to derive framework for filling the gaps.

2.4.3 Live Case Analysis
This stage involves the conducting of an in-depth live case study of an area in Kerala using the parameters identified. This stage involves on-site observations, user interviews based on the parameters identified, stakeholder consultations, and data analysis technique like spider diagram. This approach will help understand the importance of the context surrounding the open space and will guide to derive context specific framework.

2.4.4 Overall framework
The culmination of the research will be the presentation of the comprehensive framework for public open spaces in Kerala. This framework will not only serve as a set of actionable principles and recommendations for public space design and management, but also as a catalyst for fostering vibrant, accessible, and culturally responsive public spaces that contribute to the overall well-being of Kerala's communities.

In order to attain both quality and quantity of open spaces, it is imperative to view the area as an integral component of the broader ecological framework and take into account various contextual factors.
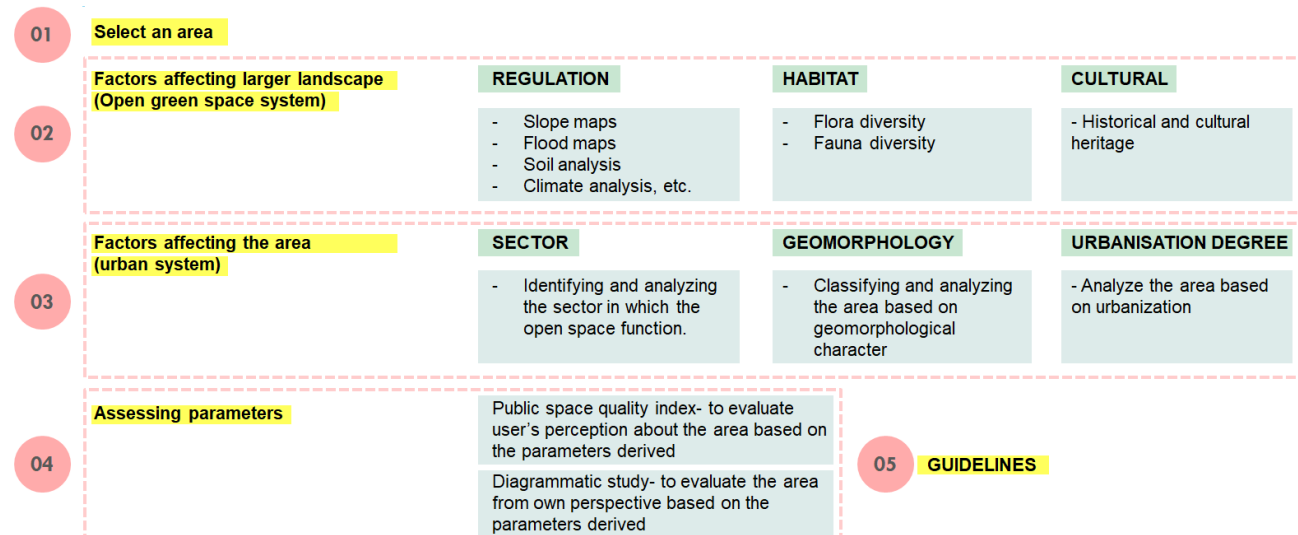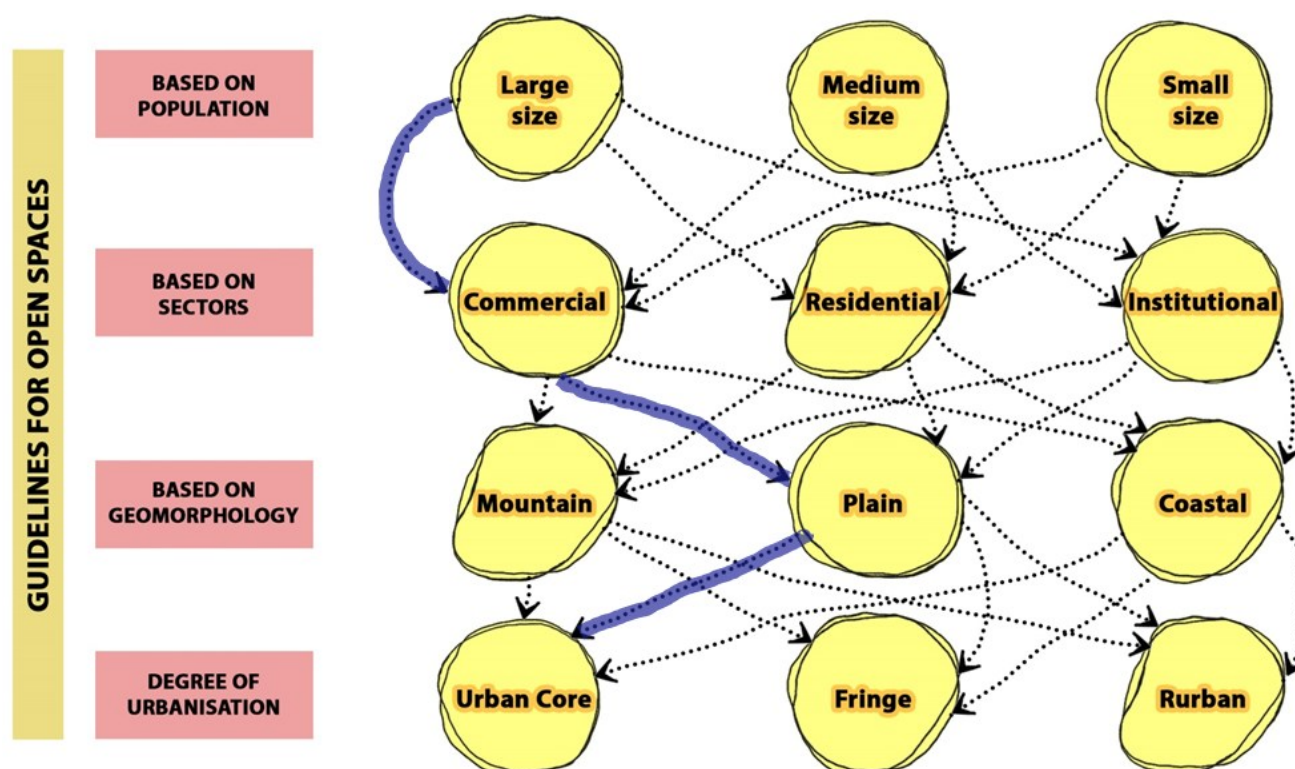

Figure 12. Methodology.

Figure 13. Classification of Guidelines to be proposed for Open Spaces.

2.5 Data Analysis

2.5.1 Context of Kerala

The open spaces in Kerala, including parks and recreational areas, often face challenges related to inadequate maintenance, encroachment, and lack of proper infrastructure. It also plays play a crucial role in the state's environmental landscape. These spaces contribute to biodiversity, provide recreational opportunities, and act as natural buffers against climate-related challenges. Rapid urbanization and population growth can lead to the underutilization of these spaces, reducing their potential benefits for residents. Additionally, the impact of climate change on open spaces is becoming more apparent, with rising temperatures, changing precipitation patterns, and extreme weather events posing significant threats to their health and sustainability. The degradation of open spaces can exacerbate issues such as flooding, loss of biodiversity, and diminished resilience to climate-related challenges. The poor condition of open spaces can adversely affect the overall quality of urban life and community well-being.

Kochi, as a case study, is particularly relevant due to its vulnerability to climate change and its susceptibility to flooding. The city, known for its historical significance and cultural richness, has witnessed substantial urban development in recent years. This rapid urbanization, combined with its coastal location, makes it a hotspot for environmental challenges. However, the growth has not always been accompanied by sufficient attention to the preservation and enhancement of open spaces. Issues such as urban expansion, encroachment, insufficient maintenance, and limited accessibility may contribute to the degradation of these areas.

Factors affecting the larger landscape of Kochi has to be analysed. This include the study of different layers like topography, urbanisation pattern, major sectors (Commercial, Residential, Industrial, etc), low lying areas, flooding zone, existing and potential open spaces, watershed analysis, etc. Overlayed understanding these layers helps to formulate a structure plan, which helps to attain the required quantity of open spaces.
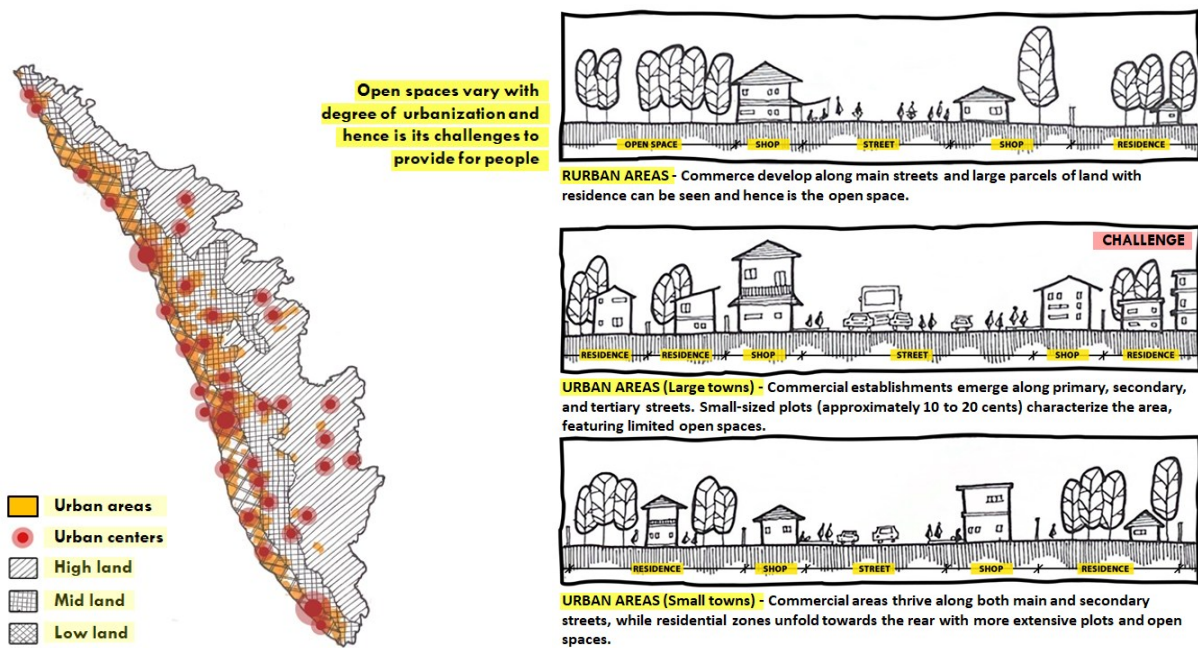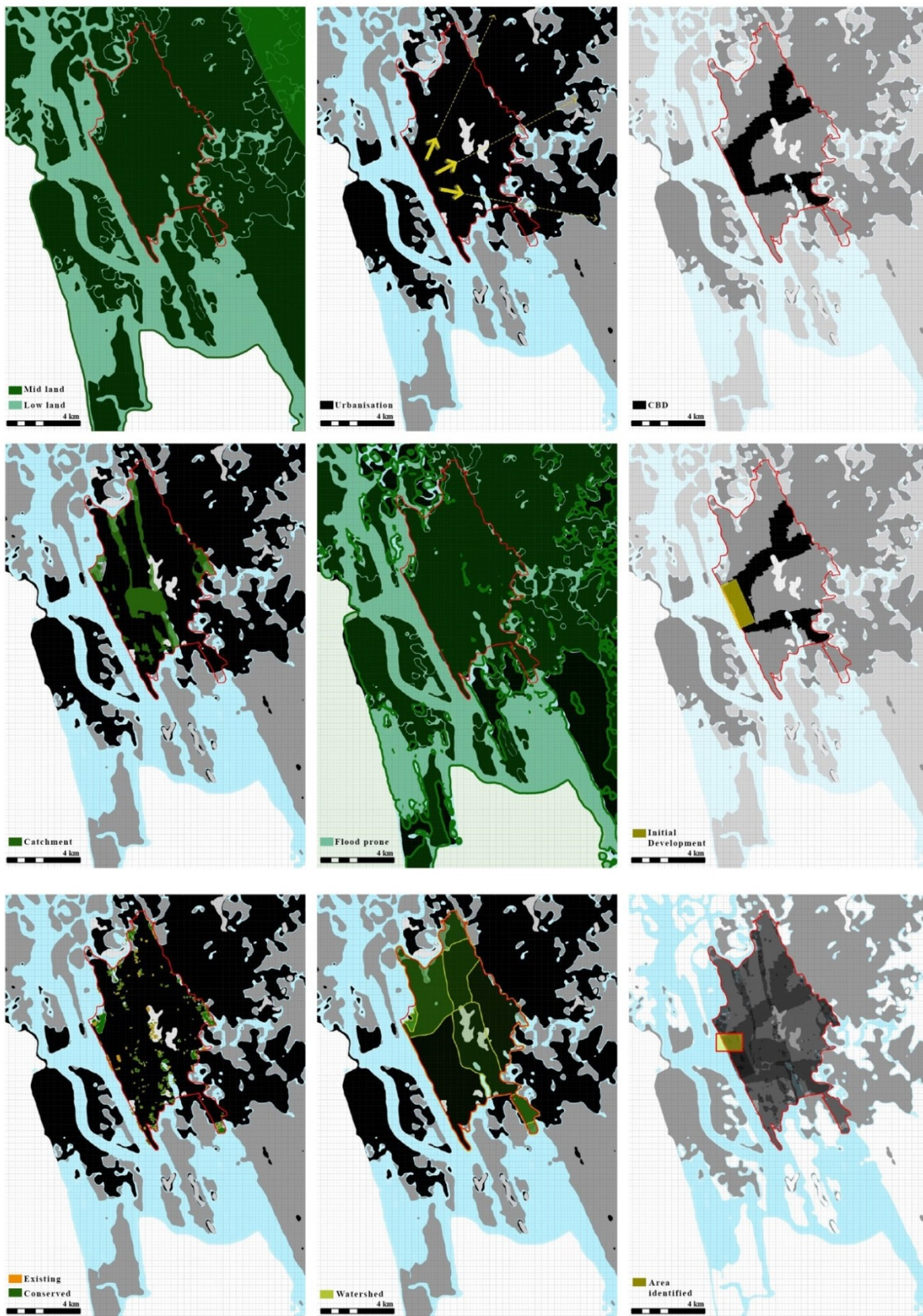
Figure 14. Context of Kerala

Figure 15. Analysis- Catchment, Flood Prone, Initial Development, Open Spaces, Watershed, Overlay Map

2.5.1.1 Macro level framework

The strategies proposed should bind all the factors affecting the region. This include reducing the negative impact of urbanization, understanding the topography of the area, reducing heat island, etc. Identifying the low lying areas help to identify potential natural water catchmet zones. This can be

integrated with recreational areas and will help reduce flooding. The commercial stretch can be reimagined as privately owned public spaces that have multiple opportunities for different open spaces where people can congregate. This will inturn boost economy and increases permeability. Proposing ecological corridors connecting open spaces will help retain biodiversity, increase resilience to disasters (Water flow, climate) and helps achieve better human interactions.
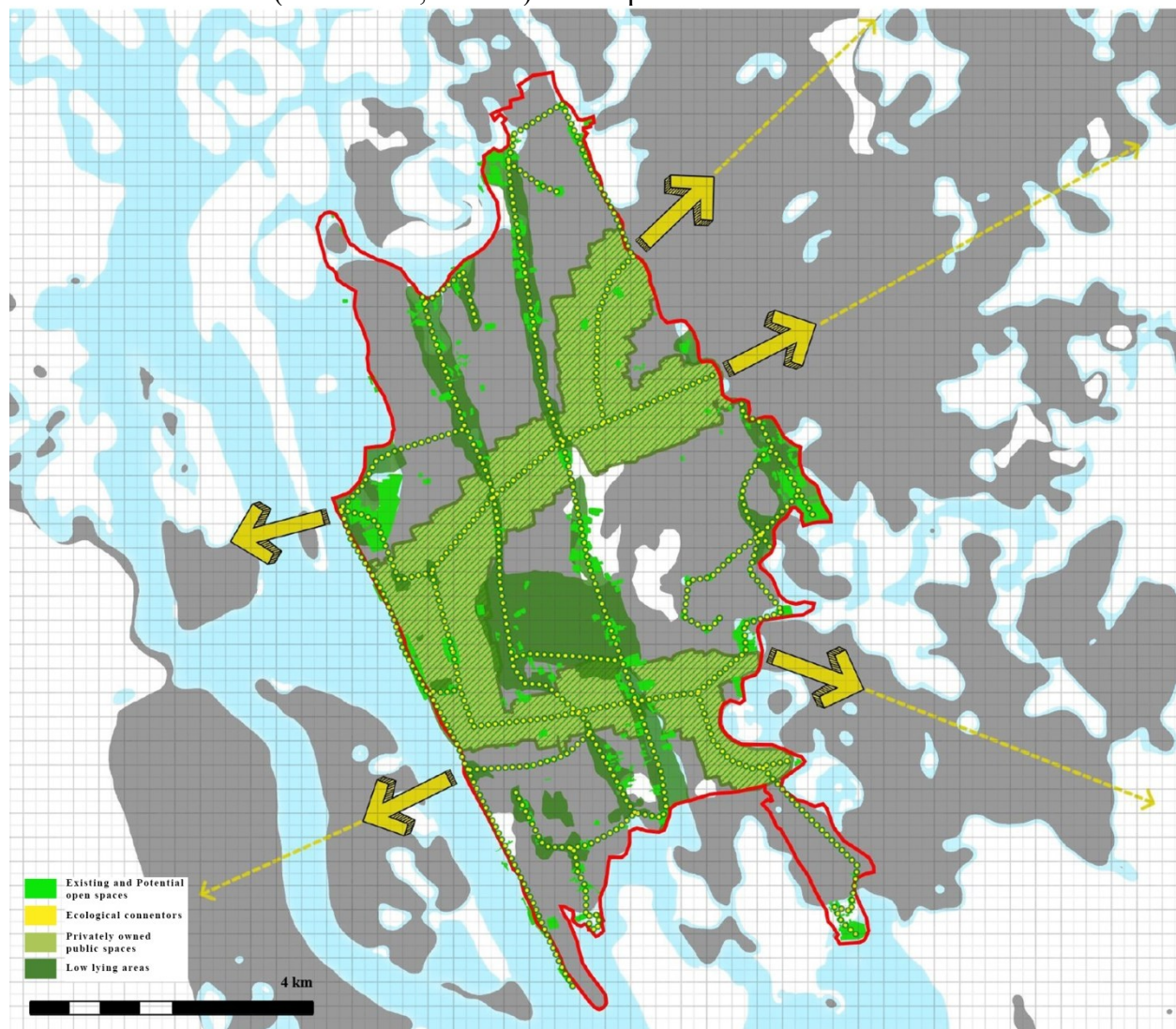

Figure 16. Macro Level Structure Plan

2.5.1.2 *Micro level analysis*

Detailed understanding of the site using parameters derived from theories help to identify present condition/ quality of open spaces. This is carried out using observation study and PSQI (Public Space Quality Index) tool, which is the quantified using weighted index method and analysed using spider diagram.

The study is focused on existing open spaces along Marine Drive, Broadway and M.G Road to analyse the quality of existing areas. Marine Drive is developed as a mixed use area with commercial, residential and mixed- use activities. This was one among the initial developments that took place in Kochi. Broadway being the traditional market have several historical and cultural significance. M.G Road stated as the heart of economic activity is the major CBD (Central Business District). Urbanisation of Kochi expanded from these three parallel areas toward East of Ernakulam.

The analysis of the areas shows that all the parameter score between 41 to 60 out of 100. (Accessibility- 59.66, Attractiveness and Appeal- 59.24, Purposefulness- 59.84, Maintenance- 50.28, Comfort 41.22, Inclusiveness- 45.46, Activity and Uses- 49.90, Safety and Security- 52.16). Thus the area does not meet the required quality as per user's perception and thus requires an upgradation for its proper functioning.
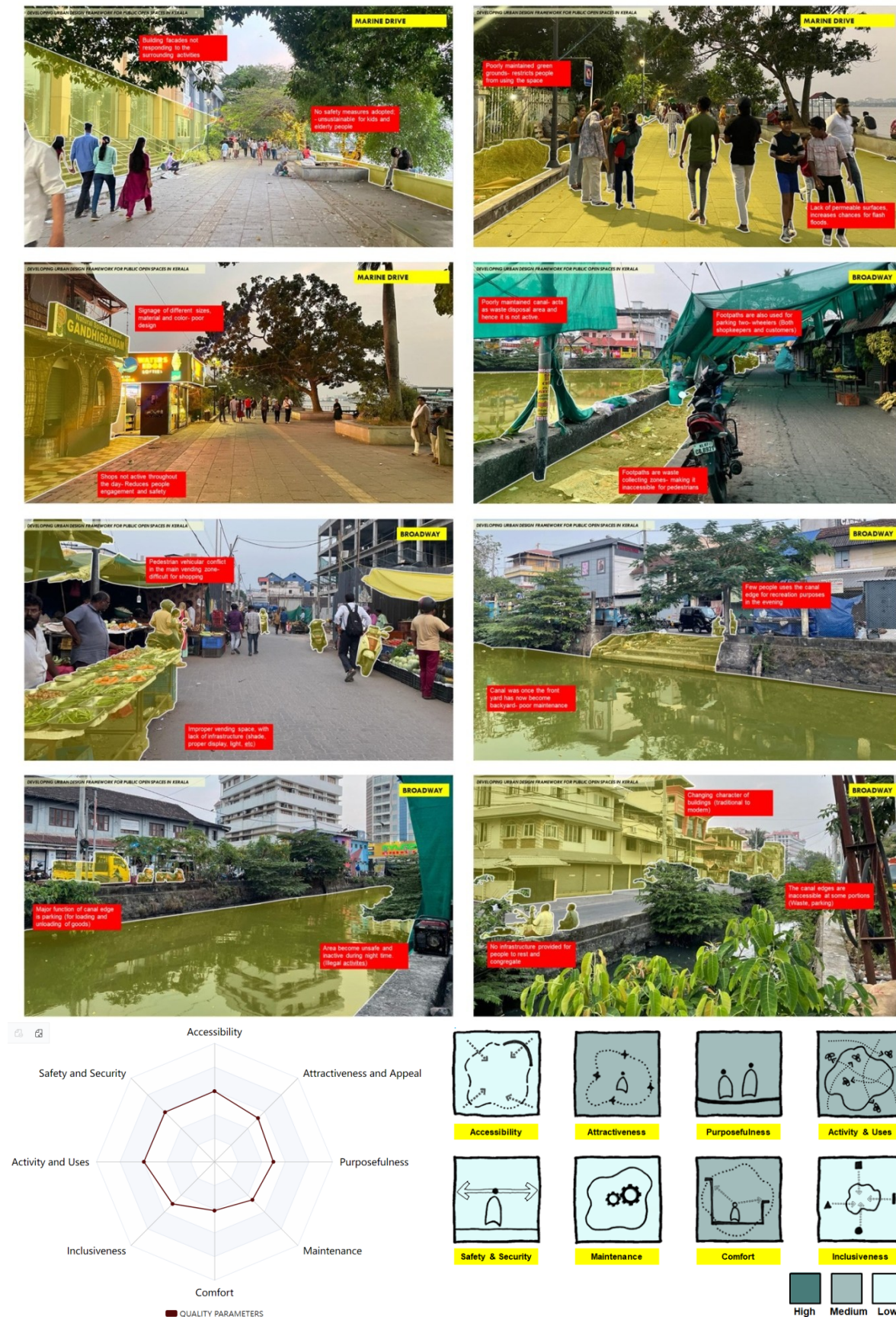
Figure 17. Photo Analysis, Spider Diagram and Observation Study

3. Results

Strategies From the study, it was understood that there is lack of comprehensive framework to achieve open spaces in Kerala. To address this, a thorough understanding of the geography, considering regulatory, habitat, and cultural functions, is essential. This knowledge will inform a structured plan that identifies areas to be conserved, reclaimed, and rehabilitated, which can then serve as open spaces. A framework tailored to different combinations of population size, sectors, geomorphology, and degree of urbanization must be developed to determine the necessary open space quantity for each region.

In addition to quantity, achieving quality in open spaces is vital. Guidelines encompassing accessibility, attractiveness, purposefulness, activity and uses, safety and security, maintenance, comfort, and inclusiveness should be established. The research adopts a negotiated approach, focusing on a large commercial area in the urban core of a plain topography city.

The study analyzes the area's open space requirements and resilience to disasters. Using a map overlay technique, low-lying or critical areas susceptible to disasters, such as floods, are identified. These areas can serve a dual purpose of disaster mitigation and providing spaces for community interaction.
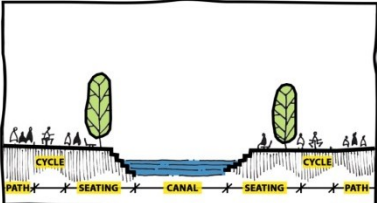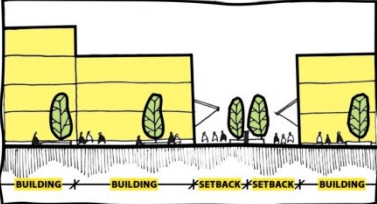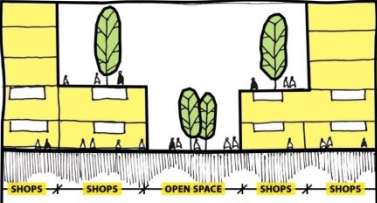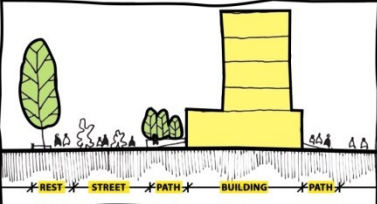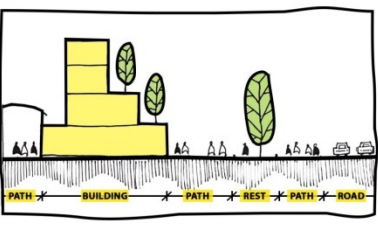
The subsequent examination delves into the current condition of the commercial area, evaluating existing open spaces, their benefits, and strategies for creating more. The outcome involves breaking down blocks and implementing land pooling to generate additional open spaces. This holistic approach ensures both the quantity and quality of open spaces are considered, contributing to the overall well-being of the community and the environment.
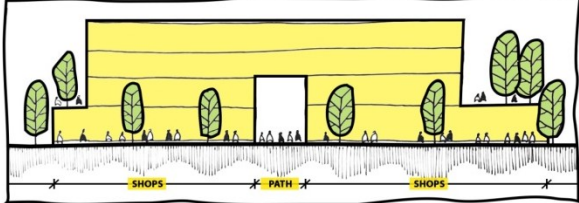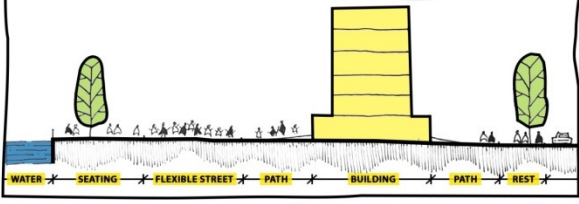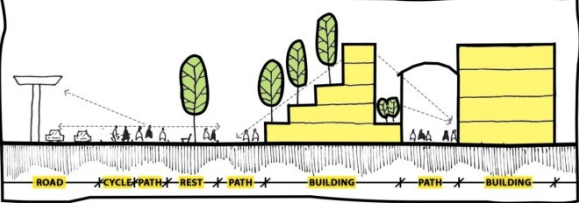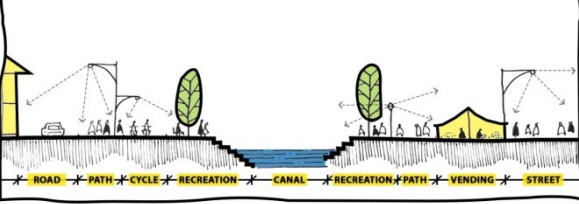
To attain the quality of open spaces guidelines for parameters formed for this typology of large size commercial area located at the urban core of a plain topography city are:

1. To achieve accessibility, the recommended guidelines include establishing connected pedestrian paths, strategically locating and designing ramps and stairs, ensuring building frontages are accessible from pedestrian streets, incorporating cycle tracks and racks, and ensuring open spaces are within a 5 to 10-minute walk.

2. In pursuit of attractiveness and appeal, the guidelines emphasize maintaining consistency in signage at the same level, using the same material and fonts. Additionally, open spaces should be thoughtfully landscaped, incorporating interactive public art and water features. The pavement of walkways should align with the road for a cohesive aesthetic.

3. To fulfill the aspect of purposefulness, the guidelines propose a front setback of 7m to 11m to create open spaces, promoting common boundaries, integrating public spaces within private developments, allocating 25% of the built footprint as public space, planning car parking and loading/unloading away from pedestrian/open spaces, and offering incentives for establishing terrace gardens in occupied ground areas.

4. To ensure activity and varied uses, the recommended guidelines advocate for open spaces to be publicly accessible at all times, suggesting the provision of one seat per 20 sqm of public spaces. To enhance connectivity, through-block links for larger blocks from pedestrian streets are encouraged, with secondary street/through links being 4m to 7m in width and 10m in height. The permeability of streets should be improved using suitable materials.

5. To enhance safety and security, the guidelines stress the importance of high visual and physical porosity, a well-designed night lighting scheme, active functions on ground floors, and the strategic selection of street and roof plants based on factors such as views and wind movement.

6. For comfort, the guidelines recommend that covered public spaces should have a high volume proportion to their size. Services such as drinking water, toilets, Wi-Fi, and phone charging should be provided. Open spaces should be shaded using buildings, trees, canopies, and umbrellas, and materials should not radiate heat. Conducting a sun shadow study is advised to ensure sufficient shade during peak hours.

7. To foster inclusiveness, the guidelines suggest unobstructed frontages, barrier-free design, and the incorporation of a variety of seating options to cater to different users based on age and physical abilities.

Table 3. Guidelines based on parameters.

ACCESSIBILITY	ATTRACTIVENESS AND APPEAL	PURPOSEFULNESS
Connected pedestrian paths Ramps, stairs- appropriate location, design and material Building frontage should be accessible from pedestrian streets Incorporate cycle tracks and racks Open spaces at 5 to 10 min walks	Signage should be provide at same level, with same material and fonts Open spaces should be well landscaped Interactive public art, water features Pavement of walkways should be same and align with road	Front setbacks- 7m to 11m to provide open spaces Promote common boundary Provision of public spaces within private developments 25% of built footprint should be designated as public space Car parking, loading/ unloading, should be planned away from pedestrian/ open spaces Incentives for providing terrace garden for occupied area on ground

ACTIVITY AND USES	SAFETY AND SECURITY
Open spaces should be publicly accessible at all times 1 seat per 20 sqm. of public spaces should be provided Provide through block links for larger blocks from pedestrian streets Secondary street/ through links should be 4m to 7m in width and 10m in height Improve permeability of street using appropriate materials	High degree of visual and physical porosity Well designed night lighting scheme Ground floor should be provided with active functions Types of plants on street and roof based on (view and wind movement)

COMFORT	INCLUSIVENESS
Covered public space should be high volume proportion to its size Provide services- Drinking water, toilets, wi- fi, phone charging Open spaces should be shaded (with buildings, trees, canopies, umbrellas and materials should not radiate	Frontage should be unobstructed Barrier free design Variety of seating to cater different users based on age and physical abilities
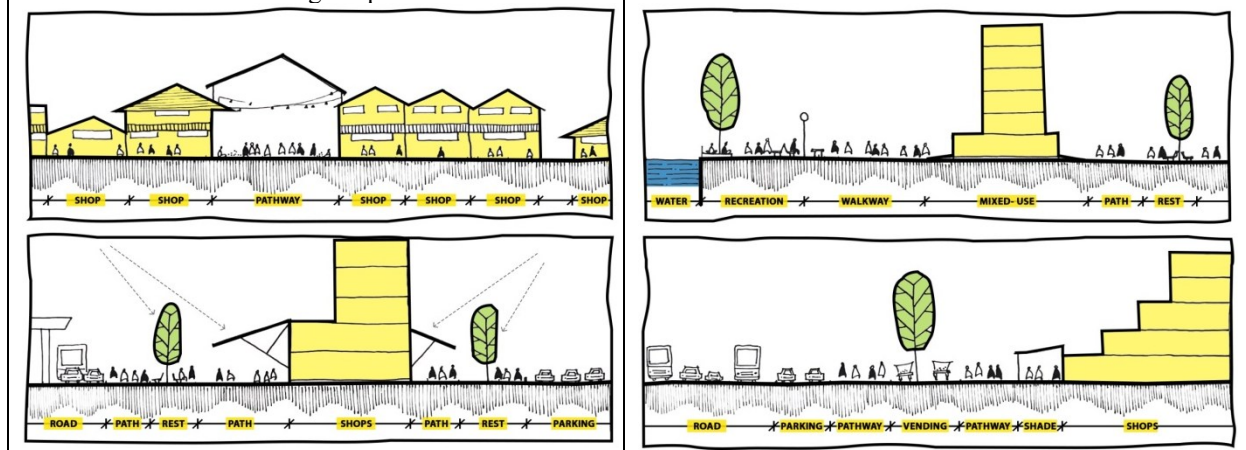
4. Discussion

The study reveals a significant gap in the comprehensive framework needed to achieve optimal open spaces in Kerala. This deficiency highlights the necessity of a thorough understanding of the geography, including regulatory, habitat, and cultural functions. Such an understanding is crucial for developing a structure plan that identifies areas for conservation, reclamation, and rehabilitation, which can then be designated as open spaces. The framework must be tailored to accommodate various combinations of population size, sectors, geomorphology, and degrees of urbanization to determine the necessary quantity of open space for each region.

The study's findings emphasize that quantity alone is insufficient; achieving high-quality open spaces is equally vital. This requires establishing guidelines that address accessibility, attractiveness, purposefulness, activity and uses, safety and security, maintenance, comfort, and inclusiveness. The study's focus on a large commercial area in the urban core of a plain topography city provides a microcosm for understanding broader issues and potential solutions applicable to Kerala as a whole.

While the study provides valuable insights, it also has limitations. The focus on Kochi may not entirely represent the diverse urban contexts across Kerala. Future research should include a more diverse range of urban and rural areas to provide a comprehensive understanding. Potential biases, such as the focus on commercial areas, should also be addressed to ensure a balanced perspective.

The integration of the study's findings with existing literature on open spaces and urban resilience is essential. Previous studies have underscored the multifaceted benefits of open spaces, including environmental, social, and economic advantages. By aligning this study with such literature, it becomes clear that the proposed framework not only fills a gap in Kerala's urban planning but also contributes to the broader discourse on sustainable urban development.

The discussion assumes that findings from Kochi can be generalized to all of Kerala. While Kochi provides a valuable case study, it is important to acknowledge the unique cultural and geographical diversity across Kerala. Future research should validate these findings in other cities and rural areas to ensure the framework's applicability across different contexts.

5. Conclusion

This study underscores the critical role that sufficient and high-quality open spaces play in enhancing both individual well-being and environmental health. The examination of existing policies in Kerala reveals significant shortcomings in the availability and quality of open spaces. Furthermore, there is a notable absence of comprehensive analysis regarding the necessary quantity of these spaces. By addressing these gaps, the framework established in this research aims to improve both the qualitative and quantitative dimensions of open spaces in Kerala.

To provide actionable recommendations, the study suggests the development of connected pedestrian paths, accessible building frontages, integrated cycle tracks, and strategically located open spaces within a short walking distance. For improving attractiveness, consistent signage, interactive public art, and cohesive pavement designs are recommended. Purposeful use of space can be achieved through adequate setbacks, integrated public spaces within private developments, and incentives for terrace gardens. Ensuring varied uses, safety, comfort, and inclusiveness are also critical components of the proposed framework.

Future research should explore the applicability of this framework across different urban and rural contexts in Kerala. While the current study focuses on the commercial typology, future studies could extend this framework to residential, industrial, and mixed-use areas. Additionally, examining the long-term impacts of implementing these guidelines on community well-being and urban resilience would provide valuable insights for continuous improvement.

The potential impact of this study on urban planning practices in Kerala is substantial. By providing a structured and comprehensive framework for developing and managing open spaces, this research offers practical solutions for policymakers and urban planners. Implementing these recommendations can lead to more sustainable and resilient urban development, enhancing the overall quality of life for residents.

In summary, this study contributes to the field of urban studies by identifying critical gaps in the current approach to open spaces in Kerala and proposing a detailed framework to address these issues. The research highlights the importance of both quantity and quality in open space planning, offering a balanced approach that can be adapted to various typologies. By focusing on the unique cultural and geographical context of Kerala, this study provides a foundation for future research and practical applications in urban planning and policy development.

Conflicts of Interest
The author(s) declare(s) no conflicts of interest.

Data availability statement
The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

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