

Review Article

## A Systematic Review of Eco-Comfort Criteria in Urban Planning and Their Evaluation Using the Delphi Method\*

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### Abstract

**Problem statement:** The concept of “city” and the relationship between cities and their environment remain contentious issues within the current body of research. The introduction of the concept of “eco-comfort”, which simultaneously addresses both subjective and objective dimensions, has offered a novel avenue for advancing environmental knowledge, particularly in the realm of urban planning. The present study seeks to address the following question: How can we achieve “eco-comfort” criteria by differentiating between the concepts of “eco-comfort” and “livability” in the fields of environmental sciences, urban planning, and urban development? What insights do experts in this area provide?

**Research objective:** This research aims to define and distinguish between the concepts of “livability” and “eco-comfort,” while systematically reviewing and reformulating eco-comfort criteria based on expert opinions. The goal is to establish a conceptual framework that can be integrated with other novel concepts related to urban development.

**Research method:** The research is based on Highperformance Architecture Theory to outline a concept for future cities, the present study used a systematic review, three-round Delphi method, and Shannon technique to formulate, scrutinize, and refine eco-comfort criteria, taking into account the conceptual hierarchy, which includes goal, approach, strategy, structure, component, criterion, and indicator.

**Conclusion:** The results reveal that eco-comfort, encompassing 16 criteria developed, is a multifaceted concept that is not limited to the notion of livability. The weighting of these criteria using Shannon entropy indicates that criteria such as spatial justice, green transportation network, and efficient governance substantially influence the eco-comfort structure of a city. This suggests that achieving eco-comfort in urban spaces necessitates an alignment between physical components and socio-cultural values, supported by effective governance. The findings not only offer an operational model for assessing the eco-comfort of cities but also create opportunities for thoughtfully developing political and physical interventions to enhance it.

**Keywords:** *Urban Planning, Highperformance Architecture Theory, Livability, Eco-Comfort, Environmental Sustainability.*

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## Introduction

Urbanization, one of the most significant social developments of the modern era, has experienced remarkable growth over time. Since the mid-18th century, both the global population and the rate of urbanization have seen substantial increases. In 1750, the world population stood at approximately 790 million, with less than 10 percent residing in urban areas. By 1900, this number had risen to 1.65 billion people, with urbanization reaching 15 percent. In 2000, the world population grew to 6.12 billion, with 47 percent living in urban environments. As of 2023, the global population is around 8.05 billion, with 57 percent living in cities. Projections suggest that by 2050, the population will reach 9.7 billion people, with 68 percent of them residing in urban areas, and by 2100, the global population is expected to be about 10.4 billion, with 85 percent living in cities (Department of Economic and Social Affairs, Population Division, 2022). This rapid transformation in settlement patterns is a distinctive characteristic that sets the human species apart from others.

In large cities, urban centers face numerous challenges, including heightened crime and delinquency, corruption, bribery, organized crime, drug trafficking, and prostitution (Latifi et al., 2024; World Development Report, 2011). These issues are likely to escalate and become unmanageable, particularly when cities confront natural or man-made disasters. The urban environment has the capacity to destabilize and undermine both individual and social well-being. The COVID-19 pandemic has placed a significant strain on cities, raising critical questions about their preparedness to deliver services during crises beyond the "normal" circumstances. It has deepened existing urban challenges, leading to increased social isolation, inequality, deprivation, and limited access to essential facilities (Buffel et al., 2023). Unlike other species that seek livable environments, humans uniquely pursue comfort within constructed spaces.

Traditional interpretations of urban livability have often overlooked the quality of life and the effects of unexpected shocks and disturbances on cities. In 2010, urban researchers noted that despite various definitions of livability, none had provided a clear

and unified explanation (Leby & Hashim, 2010). Livability is a complex, multidimensional concept that varies from region to region, and thus far, no comprehensive model has been presented that encapsulates all dimensions of urban livability and their interrelationships (Aliakbari & Akbari, 2017). Despite numerous efforts to define livability, there is still no consensus on its definition (Ahmed et al., 2019). Generally, there is contention about whether to consider livability as a component, criterion, indicator, or metric. The differing and ambiguous interpretations of urban livability may be attempts to justify its importance. If this is the case, it may be necessary to replace this vague notion with a more precise and qualitative understanding in urban planning.

While any place on Earth, including mountain peaks and seabeds, may be livable for some species, humans cannot inhabit just anywhere and achieve their desired level of comfort. The urban fabric refers to an organized physical and spatial structure, shaped through urban planning, architectural design, and spatial organization, aimed at responding to human needs and enhancing their comfort and well-being. This city body must provide both mental and physical comfort, especially during natural or man-made crises. Recently, urban planning and policy-making have focused more intently on enhancing health, welfare, and quality of life, as well as ensuring the comfort of citizens.

Urban planners have concluded that "what makes a city livable" is to provide an environment conducive to healthy living and sustainable urban infrastructure (Mahdavinjad et al., 2025), and the environment should be considered a fundamental issue in urban development. Therefore, coordinated planning should strive to ensure mental and objective comfort simultaneously (Al-Kazee et al., 2025). This dual focus is crucial for enhancing the resilience of cities (Van Vliet, 2008). Spot conservation refers to protecting specific environmental areas while neglecting the protection of other regions within the biosphere. However, do the indicators currently used to measure urban livability accurately reflect its true meaning and the needs of citizens? Addressing

this question necessitates a scientific discussion on the underlying concepts.

Accordingly, the city body necessitates new criteria and indicators that can ensure the comfort derived from development measures and urban planning (Wagner, 2018). A pertinent example in this context is the security indicator. In a livable city, security is reflected not only in the presence of urban and local supervisory and judicial institutions but, more crucially, in the level of social trust, which serves as a key indicator of civil security. A lack of social trust leads to diminished social participation and social capital, causing citizens to feel insecure. Consequently, even in the presence of security-maintaining institutions within the city, active and effective participation in urban affairs becomes elusive. Currently, increasing population density due to excessive physical development has allowed certain individuals to maintain their grip on wealth and power by exploiting their property positions. This trend not only exacerbates class differences in the short term but also intensifies urban challenges, such as diminished security and comfort. These issues arise from the initial poor planning and design of urban structures, compounded by their unrestrained continuation. The relevant literature highlights the significance of a healthy living environment, both from mental and objective perspectives.

The concept of eco-comfort also encompasses mental aspects. Research indicates a substantial relationship between participation in urban governance and the mental and objective comfort of citizens (Pojani & Alidoust, 2023; Mc Arthur & Robin, 2019; Grodach, 2020). Hence, from a methodological standpoint, this research aims to define a new type of comfort-based, private, and productive urban body with defined boundaries—essentially, a comfortable space for human society.

In his critique of the dominance of modern urbanism thoughts, Durkheim believes that in the transition period of societies, a moral crisis occurs due to the weakening of religious and traditional foundations that in the past caused social cohesion and moral order. He sees the solution to this crisis in creating a new morality based on scientific knowledge, sociology, and humanitarian and altruistic

ideas. In his opinion, the only way to overcome this crisis is to develop civic ethics through voluntary membership of individuals in social groups and professional and civic associations, which leads to commitment and adherence to moral rules (Gonzales et al., 2024). Population density and capitalist economic crises (such as stagnation and accumulation of goods) have led to the creation or promotion of new indicators for new city models in each period (Duranton & Puga, 2020). Although all urban models and human settlements are livable, the degree of comfort in them varies greatly (Safari et al., 2024). Hence, the concepts of "livability" and "eco-comfort" become important. The literature shows that mere livability indicators are not enough for living in the city (Islam et al., 2018).

Considering the abovementioned and the limitation of "livability" in the inclusion of "comfort-based indicators", this research seeks to identify index-forming criteria for social comfort and eco-comfort in the city body. Therefore, it is necessary to surpass the term "livability" and move towards a more comprehensive vocabulary. The main research question is: How can we achieve "eco-comfort" criteria by differentiating between the concepts of "eco-comfort" and "livability" in the fields of environmental sciences, urban planning, and urban development?

## Research Background

Environment and eco-comfort have a special position in indigenous literature and Islamic and Iranian thoughts. In the relevant literature, civilization has been associated with the concepts of well-being and comfort. "Madan" (in Arabic) means residence, and therefore, the term city is translated into "Medina". The word "Madani" (in Persian) is also specific to humans. "Tamaddon" (civilization, in English) means becoming accustomed to urban ethics (Mohammadi & Tajik, 2020, 56). Also, in Arabic, the word tamaddon is associated with the concept of abundant life and well-being (Al-Bustani, 1979). For this reason, the word eco-comfort means living under standards that provide comfort.

This study seeks to outline a model of a city that values the environment both subjectively and objectively, and in which a balance is maintained between the material

comfort and the psychological peace of citizens. The proposed model links physical development with ethical considerations and socio-environmental needs to ensure both objective well-being and inner security. In this framework, comfort refers to tangible and external aspects of life such as adequate housing, sufficient income, efficient transportation, and physical security; while peace is a more internal concept that includes a sense of psychological security, mental satisfaction, and emotional stability.

In the proposed model, these two concepts complement each other: comfort provides the basis for peace, and peace is considered the ultimate and meaningful goal of comfort. The ideal city of this study is a city whose physical development simultaneously focuses on improving the material conditions and enhancing the sense of psychological peace of citizens.

#### • Eco-comfort vs. livability

There is a broad consensus regarding the significance of urban livability, though this concept encompasses a diverse range of definitions and interpretations (Soleimani Mehrenjani et al., 2016). Many researchers have highlighted the challenges associated with its operational definition and assessment. Southworth (2003), for instance, characterizes livability as a relatively ambiguous yet widely accepted term that can be understood in multiple ways.

When we refer to something as "livable," we imply that it is suitable for habitation. Livability, therefore, pertains to the habitability of a location, which includes essential characteristics that make it hospitable for various species. For a place to be viable for any living organism, it must provide four critical resources: water, oxygen, nutrition, and energy, all of which are essential for survival and the continuity of life (Ghozi et al., 2023). Much like the notions of tourist-friendliness and hospitality, livability reflects the "population level in a particular area over time," which can vary according to these essential factors.

Research (Mc Arthur & Robin, 2019; Pojani & Alidoust, 2023) indicates that effective governance, social participation, and public trust play vital roles in enhancing urban eco-comfort. Nevertheless, in certain

countries, despite high livability metrics, citizens may still feel less secure and calm due to deficiencies in participatory governance. These findings highlight the necessity of considering factors such as social participation, efficient governance, and spatial justice in urban studies.

The term "eco-comfort" not only encompasses comfort and well-being but also highlights environmental sustainability and the reduction of ecological impacts. This study introduces the concept of "eco-comfortable" as a defining characteristic of an optimal urban environment. A review of both domestic and international literature reveals that the notion of comfort has been defined in various studies through differing criteria and indicators. While international research (Yu et al., 2024; Wang & Gu, 2023), tends to emphasize physical and economic aspects, studies rooted in Islamic-Iranian contexts (Pourjafar et al., 2015; Jahanbakhsh & Shokouhbidhendi, 2022), have also prioritized social and cultural dimensions, particularly the preservation of individual privacy and Islamic identity within Islamic cities. Furthermore, recent studies (Alzaim et al., 2024; Higgs et al., 2023), underscore the significance of indicators related to physical comfort, social stability, spatial justice, and green transportation in enhancing urban quality of life. These findings have been thoroughly examined and incorporated into the framework of the present research (Table 1).

An examination of existing research indicates that the concept of eco-comfort in domestic studies largely aligns with Islamic urban planning criteria and approaches to city development within an Islamic context. However, eco-comfort has been explored less frequently as an independent research area. Additionally, living with comfort has been characterized by a variety of indicators across physical, social, and economic dimensions in the literature. Most studies have emphasized the physical and economic aspects of urban environments as determinants of eco-comfort, while the social and cultural dimensions—particularly those relating to social relationships and individual privacy—have received comparatively little attention. Nonetheless, these social and cultural factors hold significant

Table 1. Review of domestic and international research background on urban eco-comfort (comfort-based structure). Source: Authors.

References	Title	Results
Vlasova et al. (2020)	The development of a comfortable urban environment on the example of Ekaterinburg City	Criteria and indicators extracted: Security, accessibility, ecological sustainability, urban identity, up-to-dateness of facilities, and urban management performance are used as key indicators for assessing the quality of the urban environment in Russia.
Koç (2022)	Determining the near-future biocomfort zones in Samsun province by the global climate change scenarios	The main criteria of a comfortable city include appropriate temperature and humidity, air quality, natural ventilation, energy efficiency, ecological sustainability, and climate change adaptation. These factors play a crucial role in optimizing the urban environment, reducing energy consumption, and improving the quality of life.
Jahanbakhsh & Shokouhibidhendi (2022)	The pattern of productive Zistshahr (Livable city): a drive toward Islamic urban planning	The “livable city” model emphasizes productive homes, interaction with nature, brotherhood-based social system, reduced land prices, spatial justice, family-centeredness, mosque-centeredness, horizontal development, sustainable economy, and home-nature connection. This model, in line with Islamic urbanism, strengthens social, economic, and environmental sustainability.
Kondrat’eva et al. (2020)	The formation of a comfortable urban environment	The following criteria have been taken into account: efficient access to public transportation, reduction of traffic congestion, and easy access to health, educational, and recreational services, as well as the provision of facilities for all demographic groups. Creating organized public spaces for social and recreational activities, designing a well-planned street network, and improving the overall quality of life are also critical. Ensuring the physical and mental health and safety of citizens, along with increasing security levels, are key indicators for development. These criteria collectively contribute to the creation of a comfortable and satisfying urban environment.

importance in urban planning. For instance, according to Pourmohammadi et al. (2019), key characteristics of an ideal city include affordable and plentiful livelihoods, safety, human dignity and respect, accessible infrastructure services, a healthy ecosystem, social justice, freedom of expression and belief, halal business, the presence of the pious and scholars, wise governance, spatial justice, organized planning, the expansion of public spaces, the exercise of citizenship rights, and the construction of mosques for both religious and secular purposes, as well as local employment opportunities.

• **Coordination of physical structure with theoretical foundations**

Devall (2021) and Berg (2009) have highlighted that new urban planning paradigms are shifting towards eco-centric and holistic approaches. Their findings indicate a convergence of recent research with the principles of Islamic urban planning, which emphasizes the balance between humans, nature, and urban environments. This research has examined the preservation of ecological balance in cities through dynamic and sustainable urban perspectives and criteria that assess the compatibility of all city components with their surroundings. The advancements in urban planning and architecture, along with their impact on individual

and social life, have led to increased attention to issues related to Islamic urban planning (Bokhari et al., 2020). Various studies suggest that Islamic cities possess distinct characteristics in terms of their physical structure, spatial distribution, and sociocultural order, setting them apart from other urban environments (Jahanbakhsh & Shokouhibidhendi, 2022).

Efforts to preserve the central cores of certain historical cities—amid the influence of modern and postmodern ideas in urban planning—aim to draw lessons from historical traditions and retain the identity of these cities. Research, such as the work by Gholam & Fekry (2023), underscores the importance of mosques, which served as vital centers in Islamic-era cities, in shaping sociocultural dynamics. These findings align with the aims of the present study, which considers eco-comfort as a concept extending beyond mere livability to incorporate social and spiritual dimensions. Aljawder & El-Wakeel (2022) have suggested that urban master plans must prioritize factors such as natural conditions, climate, the preservation of individual and collective privacy, and the creation of a harmonious environment that fosters eco-comfort for residents. This study also seeks to integrate these principles into the framework of eco-comfort indicators.

## Research Method

The present study employs a mixed-methods approach, combining both qualitative and quantitative methods to develop a conceptual and customized eco-comfort framework for Iranian cities. The study follows these steps:

**Formulating the research question:** An exploratory question was posed to identify effective indicators: “What are the criteria and indicators of eco-comfort in the city?”

**Extracting and classifying criteria:** The study employed a combination of three key stages to extract criteria: systematic review (to extract concepts), Delphi technique (to reach a consensus and refine the criteria), and Shannon entropy (to prioritize criteria).

**Stage 1 (systematic review):** To establish a theoretical foundation and identify primary criteria and indicators of urban eco-comfort, a systematic review of scientific literature was conducted. This stage followed the PRISMA framework and included studies published between 2019 and 2024, using databases such as Google Scholar, Emerald, Scopus, and Web of Science, with keywords including comfort, eco-comfortable, and eco-comfort. Keywords including bio comfort and livability were also included due to the previous lack of distinction between the concepts of livability and eco-comfort. **Inclusion criteria:** Studies must have a specific theoretical framework, relevant findings, and quantitative or qualitative indicators related to comfort and eco-comfort. **Exclusion criteria:** Research that had no direct connection to human society and urban eco-comfort, lacked citation data, was repetitive, or inconsistent with the research goals was excluded. Out of 396 studies identified through relevant keyword searches and recorded in an Excel spreadsheet, 90 were initially deemed relevant. After thorough evaluation according to the inclusion and exclusion criteria, 40 studies were found eligible. Data were extracted through qualitative content analysis and categorized using open, axial, and selective coding methods.

**Stage 2 (Delphi method):** The Delphi technique was utilized to validate, enhance, and refine the extracted criteria. A consensus process was conducted based on the targeted opinions of selected experts in related fields

(urban development, architecture, urban sociology, environment, and urban planning). Criteria that did not achieve an appropriate consensus score were eliminated. **Stage 3 (Shannon entropy):** The Shannon entropy was used to analyze the quantitative data obtained from the Delphi process. This method identifies the discriminative power and information significance of each criterion based on the distribution of expert judgments and extracts the weight of each criterion. The process involves standardizing the decision matrix, calculating the information entropy ( $E_j$ ), determining the degree of uncertainty ( $d_j$ ), and calculating the final weight ( $W_j$ ). These weights formed the basis for the final prioritization of the eco-comfort criteria in the conceptual research framework.

## Findings

[Table 2](#) distinguishes between the concepts of “livability” and “eco-comfort.” In [Table 3](#), the findings from the systematic review, which include the criteria and indicators related to “eco-comfort,” are presented.

According to most studies, in evaluating the urban fabric with the aim of enhancing quality of life (eco-comfort), two components—security and health—are recognized as fundamental and shared elements that encompass a wide range of indicators and criteria. As shown in [Table 2](#), place livability is also considered one of the components of eco-comfort. In other words, achieving “eco-comfort” in the urban environment requires the presence of all three components: security, health, and place livability that encompass dozens and even hundreds of criteria and indicators.

### • Identifying the final eco-comfort criteria using the Delphi methodology

In this study, after conducting a systematic review of existing literature on the research subject, 12 key criteria related to “eco-comfort” were initially extracted. Next, the Delphi method was utilized to validate, scrutinize, refine, and complete these criteria by leveraging the collective expertise of experts. This approach is recognized as an effective means of developing a local, interdisciplinary, and reliable framework for city quality criteria, ultimately seeking to achieve both scientific and

Table 2. Comparison of the two concepts: Eco-comfort and livability. Source: Authors.

Number	Eco-comfort	Livability
1	It includes the human species in human settlements (human-centered).	It includes all species in their habitats (species-centered).
2	It is defined in the field of urban planning.	It is defined in the field of environmental sciences, typology, and ecology.
3	Its driver is the indicators involved in the comfort of human society.	Its driver includes survival measures (water, oxygen, nutrition, energy) in the time-place dimensions.
4	It is a qualitative dimension with a set of criteria and indicators.	It is an indicator and sometimes a measure. It is often quantitative.
5	It is a man-made in his settlement.	It is a developmental characteristic of habitats.
6	Aim: to enhance individuals' comfort and quality of life	Aim: to survive species
7	Measurement method: Questionnaire, criteria, and mental indicators	Measurement method: ecological data (e.g., minimum resources)
8	Measurement scale: Human settlements (city, neighborhood, village, etc.)	Measurement scale: ecosystem, habitat, etc.

practical consensus. In this section, it is outlined how the final eco-comfort criteria were determined using the Delphi method, which involved the participation of 10 experts from the fields of environmental sciences, urban planning, and urban development. Fig. 1 illustrates the process of implementing the Delphi technique. The following steps were taken to implement the Delphi method and extract the final criteria:

Step 1 (Problem statement and research feasibility): The research problem was defined as “Development of Urban Eco-Comfort Criteria.” After conducting the necessary investigations, we confirmed the feasibility of using the Delphi method for this research.

Step 2 (Identification and selection of expert panel members): Experts with at least 10 years of educational, research, or executive experience in environmental sciences, urban planning, and urban development were selected using the snowball sampling method. Initially, two experts in the relevant fields were identified and asked to recommend additional experts familiar with the research area. Ultimately, a total of 10 experts agreed to participate in the study.

Step 3: Development of the initial questionnaire and pilot testing: In this step, the initial questionnaire was developed based on the 12 key eco-comfort criteria identified from the systematic review of literature. This questionnaire was then implemented in a pilot study.

Round 1 of the Delphi technique: After designing the

initial questionnaire, it was pilot-tested by a group of experts. The results indicated that the experts shared a common understanding of the subject and the questions posed in the questionnaire, demonstrating the construct validity of the tool. In other words, the questions were crafted based on criteria approved by the experts, which also confirmed the content validity of the questionnaire. To assess the reliability of the questionnaire, the Cronbach’s alpha coefficient was calculated for each variable using SPSS software. Each variable yielded a Cronbach’s alpha value above 0.7, suggesting acceptable reliability.

The questionnaire designed for Round 1 was then distributed to the experts. After collecting the filled-out questionnaires, the average responses from the experts were analyzed. In this study, criteria (questions) that received an average value greater than 3 were deemed

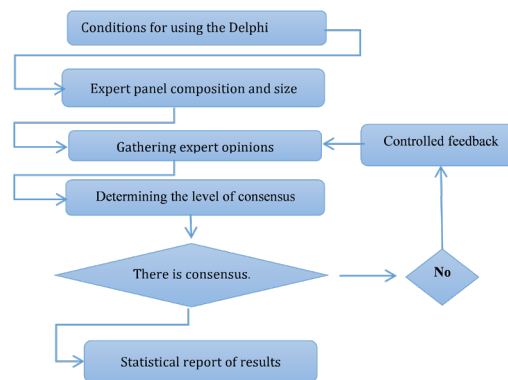


Fig. 1. Delphi technique process. Source: Authors.

Table 3. Urban eco-comfort criteria and indicators. Source: Authors.

Structure dimensions	Criteria	Indicators	References
City body Eco-comfort	Efficient urban governance	Online services available to citizens/ Access to integrated services provided by institutional centers/ Citizens using online services/ Delay in handling citizen complaints/ Tax collected as a percentage of declared tax/ Refund rate in water supply services/ Capital expenditures as a percentage of total expenditures/ Population covered by relief committees/ District councils	Yu et al, 2024; Alzaim et al., 2024; Wang & Gu, 2023
	Urban culture dynamics and social freedom	Reconstruction and reuse of historical monuments/ Coverage of significant environmental areas within reconstruction plans/ Allocation of funds for cultural and sports activities/ Organizing cultural and sports competitions with the attendance of city officials/ Extent of social or religious restrictions/ Level of censorship/ Freedom to hold gatherings and events	Baptista et al., 2024; Valcárcel-Aguiar & Murias, 2019; Higgs et al., 2023; Yekeen & Misnan, 2024; Koeberl et al, 2024
	All-inclusive quality education	Enrollment rates of male students in schools/ Enrollment rates of female students in schools/Student-teacher ratios in primary education/ Access to digital education in schools/ Primary education completion rates among students/ Availability of private education options/ Quality of private education/Coverage of public education/ Quality of public education	Thanoon & Haykal, 2020; Paul & Sen, 2020; Abd-Elkawy & Ahmed, 2024
	Health-promoting urban form (Urban salutogenesis)	Number of hospital beds per 10,000 population/Number of health professionals in various fields per 10,000 population/ Average response time for health service emergencies/ Occurrences of epidemic outbreaks of waterborne diseases/ Occurrences of epidemic outbreaks of communicable diseases/ Availability of healthcare services/ Quality of private healthcare/ Quality of public healthcare/ Availability of over-the-counter medications	Eicker, 2023; Xu, 2019; Abd-Elkawy & Ahmed, 2024
	Dynamic circular economy	Increase in VAT collection/ Goods and Services Tax/ Increase in professional tax collection/ Increase in issuance of construction permits/ Unemployment rate/ Increase in registration of informal jobs in the formal economy/ Increase in entrepreneurship and employment training courses	Chen et al., 2023; Jayanandini & Kathiravan, 2023
	Inclusive standard housing	Coverage of marginalized households under formal and affordable housing/ Marginalized areas covered by basic services/ Availability of affordable housing for low-income groups/ The share of mixed land use in the city's overall uses, especially housing/ Preventing the conversion of agricultural lands to residential use.	Obayomi et al., 2023; Thrat et al., 2023; Abd-Elkawy & Ahmed, 2024
	Public open spaces	Per capita access to green space/ Per capita access to public and recreational places/ Facilitating access for people with disabilities to recreational and open spaces/ Existence of diverse and combined recreational-green spaces	Ekhaese & Asinobi, 2023; Biswas, 2022; Pricope, 2022; Saeed et al., 2022; Vlasova et al., 2020
	Secure energy quality and adequacy management	Urban population with access to licensed electricity services/ Number of electrical connections equipped with smart meters/ Average number of power outages experienced per customer each year/Average duration of power outages experienced per customer each year/ Total energy sourced from renewable sources/ Energy consumption per unit for water and sewage supply/ Energy consumption per unit for street lighting/ Number of new and renovated buildings designed with green space principles/Total energy consumption per capita	Kirdar & Cagdas, 2022; Oviedo et al., 2022; Yekeen & Misnan, 2024
	Green transportation	Geographic coverage of public transport/ Availability of public transport services/Proportion of public transport usage/ Road network featuring dedicated bicycle paths/ Provision of bicycle parking facilities/ Share of non-motorized transportation/ Utilization of clean vehicles/ Availability of passenger information systems/ Access to paid parking spaces/ Coverage of sidewalks wider than 1.2 meters/ Traffic intersections equipped with pedestrian crossing facilities/Level of public access to rights-of-way	Vidovszky & Pintér, 2020; Wang & Gu, 2023; Baptista et al., 2024
	Water quality and adequacy management	Household coverage of direct water supply connections/ per capita water supply/ Quality of water supplied/ Amount of renewable water/ Coverage of water supply networks through meters/ Land with rainwater harvesting facilities	Benita et al., 2021; Chi & Mak, 2021; Yekeen & Misnan, 2024

Rest of Table 3.

Structure dimensions	Criteria	Indicators	References
City body Eco-comfort	Pollutant cycle management	Comprehensive coverage of toilets/ Comprehensive coverage of the sewage network/ Efficiency in the collection of sewage/ Amount of wastewater reuse and recycling/ Coverage of stormwater drainage systems/ Comprehensive collection of municipal solid waste at the household level/ Efficiency of municipal solid waste collection/ Recycling of municipal solid waste through reuse/ Source separation of collected waste/ Reduction of sulfur dioxide gas pollution levels/Reduction of nitrogen dioxide gas pollution levels/Reduction of pollutant particle concentration/ Reduction of noise pollution levels/ Water quality in public surface water bodies/ Reduction of noise pollution, especially on busy roads/ Reduction of soil pollution, particularly in urban areas	Browne & Lowe, 2021; Cleland et al., 2021; Alderton et al., 2021; Xu, 2019; Baptista et al., 2024; Ye et al., 2024; Zellmer & Goto, 2022
	Security (and its various types) and Stability	Petty crime rate/ Violent crime rate/ Risk of assassination targeting individuals, public figures, and social groups/ Risk of conflict among social groups/ Risk of civil unrest/ Number of recorded crimes per hundred thousand people/ Annual rate of recorded crimes against women, children, and the elderly/ Frequency of territorial disasters (such as floods and earthquakes)/ Resilience of urban buildings, structures, public spaces, and intersections/ Effectiveness of surveillance systems/ Deaths from transportation incidents per hundred thousand people	Kasim et al., 2021; Xiao et al., 2022 ; Khorrami et al., 2020; Sochacka et al., 2021; Koç, 2022; Kondrat’eva et al., 2020

important and approved, while those with an average value below 3 were considered less important and discarded.

In Round 1, all 12 questions (criteria) received average values exceeding 3, leading to their approval. Additionally, during the open-ended section of the Delphi questionnaire, the experts proposed 7 new criteria: spatial justice, socio-physical resilience against crises, land use balance and structural livability, respect for intercity limits and biodiversity, legibility and spatial identity, physical continuity and fabric coherence, landscape quality and spatial aesthetics of space. A new questionnaire was subsequently designed incorporating these proposed criteria, allowing the Delphi process to continue into Round 2.

Round 2 of the Delphi technique: Based on the analysis from Round 1, the Round 2 questionnaire was developed. It presented a total of 19 criteria, which included the initial criteria along with the new ones proposed, as well as the results and average scores from Round 1. The goal was to reach a consensus regarding the addition of new criteria, prioritization of the criteria, and removal of those that were less effective.

After analyzing the questionnaires collected in Round 2, certain criteria were eliminated due to weak quantitative

scores (average below 3) or qualitative concerns (overlap with existing criteria or insufficient conceptual independence). The five criteria that were removed were:

1. Physical continuity and fabric coherence (integrated into “physical governance” and “physical health”)
2. Legibility and spatial identity (integrated into “urban culture”)
3. Landscape quality and aesthetics of space (overlapping with several criteria, including physical health, culture, and energy)
4. Socio-physical resilience against crises
5. Land use balance and structural livability

As a consequence, the total number of criteria was refined to 14 following Round 2. Additionally, to highlight the forward-looking dimensions of sustainable development, two new criteria were incorporated into the final framework: long-term adaptation to climate and natural hazards, and the management of localized mass production (utilizing nearby resources). These criteria were designed to address gaps in structural sustainability, urban adaptability, and resilience against environmental changes.

Round 3 of the Delphi technique. For Round 3, a questionnaire was designed featuring the 14 criteria

from earlier, along with the two newly proposed criteria, resulting in a total of 16 criteria. The experts received the results from Round 2 and the average scores for each criterion. By the conclusion of Round 3, all average scores were above 3, leading to the approval of all criteria. No new criteria were suggested by the experts, confirming the end of the Delphi process. Consequently, all criteria established during this round were accepted as the final criteria for urban eco-comfort (Table 4).

• **Ranking of the final eco-comfort criteria using the Delphi method**

The Shannon entropy technique is a prominent objective weighting method that assesses the distribution of information corresponding to each criterion (variable) among experts. Criteria characterized by lower disagreement (i.e., minimal distribution) are deemed less significant, whereas those with greater variability and a wider range of scores are considered more important. Generally, the weights derived from Shannon entropy offer a more accurate representation of the relevance and influence of various factors. This is because they account not only for the average significance but also for the variability and distribution of opinions. Such a characteristic enables a sharper focus and more precise prioritization in the development of urban planning

initiatives and the design of eco-comfortable spaces. Consequently, the weights obtained through this method are regarded as a reliable and scientifically grounded basis for informing related policies and decisions. In this section, the Shannon entropy approach was employed to evaluate and rank the final eco-comfort criteria established in the preceding section. The implementation of this technique involves several key steps:

Step 1: Interview with experts to evaluate the final eco-comfort criteria based on the decision matrix (experts were asked to give their opinions on the evaluation using a 5-point Likert scale (from 1: very low to 5: very high)).

Step 2: Calculation of  $P_{ij}$

In this step, each score is divided by the total score of the corresponding criterion to obtain the probability matrix ( $P_{ij}$ ). According to Table 5 and Eq. 1,  $P_{ij}$  is calculated, as listed in Table 4.

Where  $a_{ij}$  denotes the score given by the  $j$ -th expert to the  $i$ -th criterion from the decision matrix of the final eco-comfort criteria based on expert opinion.

Step 3: Calculation of the entropy value ( $E_i$ ): The entropy of the  $i$ -th criterion is obtained according to Eq. 2 and the data listed in Table 4. The entropy values of the criteria are presented in Table 6.

Step 4: Calculation of uncertainty value ( $d_i$ ): The

Table 4. Standardized decision matrix ( $P_{ij}$ ) of the final eco-comfort criteria. Source: Authors.

Criteria	A	B	C	D	E	F	G	H	I	J
C1	1	1	1	1	1	1	1	1	1	1
C2	0.088	0.088	0.111	0.111	0.111	0.088	0.111	0.089	0.089	0.111
C3	0.114	0.091	0.068	0.091	0.114	0.114	0.114	0.113	0.113	0.068
C4	0.111	0.111	0.089	0.089	0.111	0.067	0.111	0.089	0.111	0.111
C5	0.098	0.122	0.098	0.098	0.098	0.073	0.122	0.098	0.112	0.073
C6	0.119	0.095	0.095	0.119	0.095	0.119	0.071	0.119	0.071	0.095
C7	0.103	0.128	0.128	0.103	0.103	0.051	0.077	0.077	0.128	0.103
C8	0.109	0.087	0.087	0.109	0.087	0.109	0.109	0.109	0.087	0.109
C9	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C10	0.109	0.087	0.109	0.087	0.109	0.109	0.109	0.087	0.087	0.109
C11	0.109	0.109	0.065	0.109	0.109	0.109	0.109	0.087	0.087	0.109
C12	0.106	0.106	0.106	0.106	0.106	0.106	0.085	0.085	0.106	0.085
C13	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C14	0.098	0.122	0.122	0.098	0.073	0.098	0.073	0.122	0.073	0.122
C15	0.125	0.125	0.1	0.075	0.075	0.1	0.075	0.125	0.075	0.125
C16	0.081	0.108	0.081	0.108	0.108	0.081	0.108	0.108	0.081	0.135

uncertainty or degree of deviation  $d_i$  is calculated from the information obtained for the  $i$ -th criterion using Eq. 3 and considering the entropy values obtained in the previous step. These values are listed in Table 6.

Step 5: Calculation of the weights ( $w_j$ ): The weight of each criterion is obtained according to its uncertainty value using Eq. 4. The weight of each criterion is presented in Table 6.

$$P_{ij} = \frac{a_{ij}}{\sum_{j=1}^m a_{ij}} ; \quad \forall i, j \quad \text{Eq. 1}$$

$$E_i = -k \sum_{j=1}^m [P_{ij} \ln(P_{ij})] ; \quad \forall i \quad \text{Eq. 2}$$

$$d_i = 1 - E_j ; \quad \forall i \quad \text{Eq. 3}$$

$$w_i = \frac{d_j}{\sum_{i=1}^m d_j} ; \quad \forall i \quad \text{Eq. 4}$$

## Discussion

### • Based on the systematic review

As listed in Table 3, in the present study, 12 eco-comfort criteria encompassing 104 indicators were extracted initially, the number of which increased to 16 criteria after the formation of the expert panel and their consensus. These criteria are as follows:

**Efficient urban governance:** Urban management is responsible for fully developing the city's structure towards an ideal vision, similar to current urban governance efforts that aim to provide 24-hour services and enhance citizen comfort through technology and public participation. Increased social involvement leads to improved access to services, while a vibrant urban culture deepens residents' connection to history and promotes the use of cultural and sporting facilities. These concepts align with the research conducted by Ghazi et al. (2023).

**Urban culture dynamics and social freedom:** Various indicators show that social freedom and eco-comfort enable residents to cultivate citizenship through gatherings and community engagement. This distinction between participatory and irresponsible urbanization is crucial. In an eco-comfortable urban environment,

individuals and groups are free to express their needs and advocate for their rights without conflict. This finding is supported by the study conducted by Higgs et al. (2023). **Health-promoting urban form:** Hankey & Marshall (2017) found that compact urban design, green spaces, and public areas positively affect both physical and mental health. Specifically, green spaces and walkable pathways are essential in reducing air pollution's adverse effects and promoting overall well-being. The authors emphasize that urban design can serve as a powerful tool for creating clean and health-promoting cities.

**All-inclusive Quality Education:** Equitable access to quality education at all levels, whether public or private, reduces the incentive for families to migrate to other cities. This comprehensive education system not only enhances urban dynamism but also forms the foundation for sustainable urban development by fostering responsible citizenship. This approach transforms education from merely a social right into a crucial factor for stability, public participation, and urban progress, in line with the findings of Xiao et al. (2022) and Kasim et al. (2021).

**Spatial justice:** Effective distribution of health facilities, equipment, and human resources across various city areas reduces the need for residents to migrate in search of better services. Key issues in this regard include the availability of hospital beds, health professionals, and the overall quality of healthcare. These findings align with the research conducted by Xiao et al. (2022).

**Dynamic circular economy:** Various indicators suggest that reducing unemployment and creating jobs for all socio-economic classes enhances citizen responsibility and improves tax revenues. This, in turn, reduces informal employment and fosters a thriving formal economy, contributing to a vibrant urban environment. This conclusion is consistent with the study by Ghazi et al. (2023).

**Inclusive standard housing:** This criterion emphasizes the creation of platforms for producing affordable housing within a dynamic economic framework that promotes balanced development. Such housing should cater to the needs of all societal classes, especially low-income groups, to enhance urban identity, stability,

Table 5. Decision matrix of the final eco-comfort criteria based on expert opinion. Source: Authors.

Symbol	Criteria (a set of indicators)	Expert									
		A	B	C	D	E	F	G	H	I	J
C1	Efficient urban governance	5	5	5	5	5	5	5	5	5	5
C2	Urban culture dynamics and social freedom	4	4	5	5	5	4	5	4	4	5
C3	All-inclusive quality education	5	4	3	4	5	5	5	5	5	3
C4	Health-promoting urban form (Urban salutogenesis)	5	5	4	4	5	3	5	4	5	5
C5	Dynamic circular economy	4	5	4	4	4	3	5	4	5	3
C6	Inclusive standard housing	5	4	4	5	4	5	3	5	3	4
C7	Public open spaces	4	5	5	4	4	2	3	3	5	4
C8	Secure energy quality and adequacy management	5	4	4	5	4	5	5	5	4	5
C9	Green transportation	5	5	5	5	5	5	5	5	5	5
C10	Water quality and adequacy management	5	4	5	4	5	5	5	4	4	5
C11	Pollutant cycle management	5	5	3	5	5	5	5	4	4	5
C12	Security (and its various types) and stability	5	5	5	5	5	5	4	4	5	4
C13	Spatial justice	5	5	5	5	5	5	5	5	5	5
C14	Long-term adaptation to climate and natural hazards	4	5	5	4	3	4	3	5	3	5
C15	Management of localized mass production (utilizing nearby resources)	5	5	4	3	3	4	3	5	3	5
C16	Respecting biodiversity	3	4	3	4	4	3	4	4	3	5

Table 6. Determining the weights of the final eco-comfort criteria. Source: Authors.

Symbol	Criterion	E <sub>j</sub>	d <sub>j</sub>	w <sub>j</sub>
C1	Efficient urban governance	1	0	0.0628
C2	Urban culture dynamics and social freedom	0.997	0.0027	0.0626
C3	All-inclusive quality education	0.992	0.0076	0.0623
C4	Health-promoting urban form (Urban salutogenesis)	0.995	0.0051	0.0625
C5	Dynamic circular economy	0.994	0.0064	0.0624
C6	Inclusive standard housing	0.993	0.0071	0.0624
C7	Public open spaces	0.986	0.0136	0.0620
C8	Secure energy quality and adequacy management	0.997	0.0025	0.0627
C9	Green transportation	1	0	0.0628
C10	Water quality and adequacy management	0.997	0.0025	0.0627
C11	Pollutant cycle management	0.995	0.0049	0.0625
C12	Security (and its various types) and Stability	0.998	0.0021	0.0627
C13	Spatial justice	1	0	0.0628
C14	Long-term adaptation to climate and natural hazards	0.991	0.0091	0.0622
C15	Management of localized mass production (utilizing nearby resources)	0.989	0.0110	0.0621
C16	Respecting biodiversity	0.994	0.0064	0.0624

and quality of life. Additionally, it is important to prevent construction practices that harm the urban environment. This approach is supported by the findings of Rezaei et al. (2019).

Public open spaces: Numerous indicators highlight the crucial role of public open spaces—particularly green areas—in contributing to urban eco-comfort. These spaces reinforce citizens’ connection to the city and

foster social capital. Ensuring access to these areas for various groups, including individuals with disabilities, is essential for promoting inclusivity and accessibility. This finding aligns with the research conducted by Higgs et al. (2023).

Secure energy quality and adequacy management: Access to sustainable electricity services and the utilization of renewable energy sources are crucial.

Frequent power outages or excessive electricity consumption pose significant challenges for cities. Moreover, urban water facilities should be equipped with advanced technologies that place the water supply process within a renewable cycle. In light of global warming and frequent droughts, it is essential to adopt smart and renewable water management practices. This aligns with the findings of research conducted by Ghazi et al. (2023) and Higgs et al. (2023).

**Green transportation networks:** Public transportation systems should be designed with inclusivity and accessibility in mind, prioritizing clean and renewable energy sources. These systems should consist of separable networks to accommodate different modes of travel, such as pedestrian pathways, bicycle lanes, motorcycle routes, and options for single-person and double-person transportation. This finding is supported by the research of Ghazi et al. (2023) and Higgs et al. (2023).

**Pollution cycle management:** Effective pollution management begins with minimizing pollutant production (solid, liquid, and gas) within urban areas and extends to the implementation of highly efficient recycling processes. By improving water and solid waste management practices, urban environments can be kept clean and free from various pollutants. This conclusion is supported by studies conducted by Xiao et al. (2022), and Kasim et al. (2021).

**Urban security and stability:** Urban security and stability are closely linked to the physical layout of a city and are crucial for human-centered design. Initiatives such as building retrofitting, safe street design, and the creation of standardized public spaces enhance urban resilience, decrease crime rates and traffic accidents, and promote greater social participation. The organization of neighborhoods and the strategic placement of service centers contribute significantly to fostering a sense of security and ensuring an effective response to crises. Cities like Adelaide and Leipzig serve as successful examples of integrating safe construction practices with cultural and economic policies to cultivate a secure environment for their residents. These observations align with the research findings of Ghazi et al. (2023).

#### • **Based on the results of the Delphi method and the Shannon entropy technique**

The weights derived from the Shannon entropy technique highlight the significance and role of each of the 16 eco-comfort criteria, which were identified based on the distribution and diversity of expert opinions. Rather than relying solely on the average score, this method assesses the information contribution of each criterion in the decision-making process by analyzing data uncertainty. As a result, the weights reflect the practical role of each criterion in enhancing the quality of urban life.

One of the key criteria, “Efficient urban governance,” received a high weight, indicating a general consensus on its importance for establishing effective management infrastructure and policy-making related to urban resources and services. This criterion is crucial for facilitating decision-making processes, promoting citizen participation, and ensuring accountability in urban institutions. Its high weight also suggests varying perspectives on priorities and implementation methods.

Another significant criterion, “Green transport networks,” also holds considerable weight, underscoring its importance in reducing pollution, improving accessibility, and enhancing the sustainability of urban environments. The distribution of opinions reflects diverse approaches and varying priorities in the implementation of transport technologies and policies, further emphasizing this criterion’s significance.

“Spatial justice,” which also carries a high weight, underscores the necessity of achieving a fair distribution of urban services and facilities to improve citizen satisfaction and quality of life. This criterion is essential given the challenges posed by social and spatial inequality, and the variety of perspectives on how to achieve it has contributed to its elevated weight.

The criterion of “health-promoting urban form” carries significant weight due to the direct impact of the built environment on both the physical and mental health of citizens. The variety of opinions regarding the design of spaces and the provision of health-oriented infrastructure has made this criterion particularly noteworthy.

Criteria such as “secure energy quality and adequacy

management” and “water quality and adequacy management” hold medium to high importance, underscoring the necessity of providing sustainable and safe resources within urban areas. Disagreements among experts concerning technologies, policies, and the prioritization of resource consumption have further highlighted the relevance of these criteria.

The criteria “dynamic circular economy” and “all-inclusive quality education” also hold considerable weight, reflecting their significance in sustainable development and the enhancement of human capital. These weights illustrate the differing perspectives on the prioritization and implementation methods of these concepts within urban settings.

On the other hand, “inclusive standard housing” and “public open spaces” received relatively lower weights, possibly due to a greater consensus among experts about their necessity and a reduction in the diversity of opinions regarding them. Nonetheless, these elements are still fundamental in promoting eco-comfort.

The criterion “dynamic urban culture and social freedom” carries moderate weight, indicating its importance as a socio-cultural dimension, though there is somewhat limited variation in opinions on its scope and realization.

“Pollutant cycle management” and “security and stability” carry high weights, reflecting experts’ sensitivity to the need for maintaining environmental health and ensuring stability and security within the city. The diversity of opinions regarding methods of pollutant management and aspects of security has increased the significance of these criteria.

“Spatial justice” ranks among the highest weighted criteria, emphasizing the necessity for fair distribution of opportunities and resources within the urban framework. This reflects experts’ deep concern for addressing spatial and social inequalities.

Criteria such as “long-term adaptation to climate and natural hazards” and “management of localized mass production (utilizing nearby resources)” present moderate to low weights. This distribution may suggest varying expert views on the relative importance of these factors in urban development, as well as divergence in

opinions regarding the sustainable exploitation of natural resources.

Lastly, “respect for intercity limits and biodiversity” holds the lowest weight among the criteria, indicating a broad consensus among experts about its importance and fewer differences of opinion in this respect. While this issue is recognized as a fundamental principle, it may occupy a lower priority in urban decision-making compared to other criteria.

Overall, the weights calculated using the Shannon entropy technique provide a clear representation of the relative importance of each criterion based on the distribution of expert opinions. These insights can serve as scientific, data-driven guidance in policymaking, urban planning, and design, promoting eco-comfort and facilitating the optimal allocation of resources while focusing on genuine priorities.

## Conclusion

The research results highlight the significance of livability and eco-comfort in urban planning. Livability serves as the foundation for eco-comfort, while adaptation forms the basis for sustainability. Eco-comfort goes beyond livability, concentrating on both the overall and specific quality of life within human societies. Adaptive-sustainable development refers to sustainability that emerges from adaptation, ensuring long-term eco-comfort and reinforcing it through principles of environmental protection, social justice, and effective governance.

A comparative analysis of criteria and indicators for eco-comfort and livability reveals that many aspects traditionally studied under the umbrella of livability actually align more closely with eco-comfort. For instance, while livability emphasizes physical access to essential resources, eco-comfort examines the quality of these resources’ usage and its effects on health and social well-being.

The final results indicate that the concept of “eco-comfort” in an urban context extends, comprising a set of interdisciplinary and value-based criteria. To develop a practical theoretical framework that is both conceptually rich and operationally applicable in urban planning, a

combination of systematic review, a three-round Delphi method, and Shannon entropy was employed.

Initially, a systematic review of authentic scientific literature identified 12 initial criteria spanning governance, health, transportation, environment, economy, and urban fabric. These criteria included 104 initial indicators, which served as the foundation for the Delphi process.

The Delphi method was then carried out in three consecutive rounds, engaging 10 academic and professional experts from the fields of urban planning, architecture, environment, and social sciences. In Round 1, seven new criteria were integrated into the framework, including “spatial justice,” “climate change adaptation,” “local resource management,” “biodiversity,” “security,” “green transportation network,” and “pollutant management.” In Round 2, five criteria with low consensus were eliminated. Finally, Round 3 introduced two additional criteria, leading to a total of 16 criteria.

Analysis of the Delphi results demonstrated that the highest consensus levels were associated with the criteria of “efficient urban governance,” “spatial justice,” “security and stability,” and “green transport network.” Conversely, criteria such as “respect for intercity limits” and “local resource management” were approved with relatively lower consensus but remained in the final framework due to their conceptual importance.

In the final stage, the Shannon entropy technique revealed a significant correlation between experts’ subjective considerations and the information distribution of the criteria. Criteria such as spatial justice, green transport network, efficient urban governance, and security and stability received the highest information weights, emphasizing their importance in differentiating the quality of biosecurity within the urban context. In contrast, criteria like local resource management, respect for intercity limits, and biodiversity, despite their conceptual significance, exhibited lower weights, indicating the necessity for complementary policies to enhance their prominence in planning initiatives. Based on this analysis, the physical structure of most cities—due to weaknesses in configuration and development in unsuitable locations—acts as a factor that reduces the

livability of regions, which in turn leads to a general decline in the environmental comfort of human society (eco-comfort).

This research yields two primary outcomes: first, it offers a conceptual, methodological, and tailored model for analyzing “eco-comfort” in urban settings, surpassing conventional approaches and achieving coherence between cultural values, spatial structures, and sustainability principles. Second, it provides practical tools for policymakers and urban designers to evaluate the current situation and optimize the design and planning process, ultimately improving the quality of life for citizens. It is recommended that future research explore the organization of planning based on a hierarchical structure: goal, approach, strategy, structure, dimension, component, criterion, indicator, and metric. Additionally, continuous evaluation and updating of Eco-Comfort criteria and indicators should be examined through the use of technology and the active participation of citizens and civil society organizations.

### Conflict of Interest

The research findings have been reported impartially, in compliance with ethical standards; the authors have no conflicts of interest to declare.

### References list

- Abd-Elkawy, M., & Ahmed, A. (2024). Using the integrated residential land use intensity index for more liveable, new Egyptian compound projects. *Journal of Urban Regeneration & Renewal*, 17(3), 295-324. <https://doi.org/10.69554/ZHEC3485>
- Ahmed, N. O., El-Halafawy, A. M., & Amin, A. M. (2019). A critical review of urban livability. *European Journal of Sustainable Development*, 8(1), 165-165. <https://doi.org/10.14207/ejsd.2019.v8n1p165>
- Al-Bustani, B. (1979). *Muhit-ul-muhit: an Arabic-Arabic dictionary*. Librairie du Liban.
- Alderton, A., Higgs, C., Davern, M., Butterworth, I., Correia, J., Nitvimol, K., & Badland, H. (2021). Measuring and monitoring liveability in a low-to-middle income country: A proof-of-concept for Bangkok, Thailand and lessons from an international partnership. *Cities & Health*, 5(3), 320-328. <https://doi.org/10.1080/23748834.2020.1813537>
- Aliakbari, E., & Akbari, M. (2017). Interpretive-structural modeling of the factors that affect the viability of Tehran Metropolis. *Spatial Planning*, 21(1), 1-31. <http://hsmasp.modares.ac.ir/article-21-3785-fa.html>
- Al-Kazee, M. F., Taji, S. N., Nasr, T., Mansoori, R., & Mahdavejad,

- M. (2025). Reframing the early-stage design process of residential buildings based on an energy-efficient, designerly decision support system (DDSS). *Future Technology*, 4(2), 30-40. <http://dx.doi.org/10.55670/fpll.futech.4.2.4>
- Alzaim, M. A., AlAli, M., Mattar, Y., & Samara, F. (2024). Integrated framework for enhancing liveability and ecological sustainability in UAE communities. *Sustainability*, 16(22), 9872. <https://doi.org/10.3390/su16229872>
  - Aljawder, H., & El-Wakeel, H. A. (2022). Architecture and privacy in Islam: an analytical review. *WIT Transactions on The Built Environment*, 211, 129-139. <http://dx.doi.org/10.2495/IHA220101>
  - Baptista, A. C., Morgado, P., Matias Dias, C., Ribeiro, A. I., & Sousa Uva, M. (2024). Advancing urban health in Portugal: exploring liveability and its association with mental morbidity. *European Journal of Public Health*, 34(3), 144-1360. <https://doi.org/10.1093/eurpub/ckae144.1360>
  - Benita, F., Kalashnikov, V., & Tunçer, B. (2021). A spatial livability index for dense urban centers. *Environment and Planning B: Urban Analytics and City Science*, 48(7), 2006-2022. <https://doi.org/10.1177/2399808320960151>
  - Berg, P. (2009). *Envisioning sustainability*. Subculture Books.
  - Bokhari, A., Hammad, M. T. M., & Beggas, D. (2020). Impact of Islamic values and concepts in architecture: A case study of Islamic communities. *Proceedings of Sustainable Development and Planning XI*, 241, 383-396. <https://www.witpress.com/Secure/elibRARY/papers/SDP20/SDP20031FU1.pdf>
  - Biswas, A. (2022). A conceptual Framework to visualise liveability. *International Journal of Community Well-Being*, 5(4), 793-817. <https://doi.org/10.1007/s42413-022-00178-2>
  - Browne, G. R., & Lowe, M. (2021). Liveability as determinant of health: testing a new approach for health impact assessment of major infrastructure. *Environmental Impact Assessment Review*, 87, 106546. <https://doi.org/10.1016/j.eiar.2020.106546>
  - Buffel, T., Yarker, S., Phillipson, C., Lang, L., Lewis, C., Doran, P., & Goff, M. (2023). Locked down by inequality: Older people and the COVID-19 pandemic. *Urban Studies*, 60(8), 1465-1482. <https://doi.org/10.1177/00420980211041018>
  - Chen, J., Zhai, S., Song, G., Huang, S., Liu, H., Jiang, X., ... & Wu, W. (2023). Evaluation and determinants of satisfaction with the urban-rural interface area liveability toward "15-min city": A case study in Henan Province, China. *Ecological Economics*, 214, 107994. <https://doi.org/10.1016/j.ecolecon.2023.107994>
  - Chi, Y. L., & Mak, H. W. L. (2021). From comparative and statistical assessments of liveability and health conditions of districts in Hong Kong towards future city development. *Sustainability*, 13(16), 8781. <https://doi.org/10.3390/su13168781>
  - Cleland, C. L., Ferguson, S., Kee, F., Kelly, P., Williams, A. J., Nightingale, G., ... & Hunter, R. F. (2021). Adaptation and testing of a microscale audit tool to assess liveability using google street view: MAPS-liveability. *Journal of Transport & Health*, 22, 101226. <https://doi.org/10.1016/j.jth.2021.101226>
  - Devall, B. (2021). *Living deep ecology: A bioregional journey*. Lexington Books.
  - Department of Economic and Social Affairs, Population Division. (2022). *United Nations*. Retrieved July 7, 2024, from <https://population.un.org/wpp>
  - Duranton, G., & Puga, D. (2020). The economics of urban density. *Journal of Economic Perspectives*, 34(3), 3-26. <https://doi.org/10.1257/jep.34.3.3>
  - Eicker, B. N. (2023). *A livable life index: A study about the potentials for participation in slum upgrading (Case study Bhubaneswar/India)* [Ph.D. thesis, Hamburg university]. Hafencity universitst hamburg. [https://repos.hcu-hamburg.de/bitstream/hcu/881/2/2023-04-25\\_eicker-berrit-neeel\\_dissertation.pdf](https://repos.hcu-hamburg.de/bitstream/hcu/881/2/2023-04-25_eicker-berrit-neeel_dissertation.pdf)
  - Ekhaese, E. N., & Asinobi, A. A. (2023). Go-ahead urban liveability indicators (ULI) influence on residents' well-being: a case for Lekki-Lagos, Nigeria. *GeoJournal*, 88(2), 2345-2364. <https://doi.org/10.1007/s10708-022-10751-z>
  - Ghozi, S., Dharmawan, I. B., Sari, D. H., Bijaksana, T. M., & Devi, S. M. (2023). An analysis of the perceived liveability index with the use of adjusted and weighted aspects based on a multi-stakeholder perspective in the Indonesian city of Balikpapan. *Acta Scientiarum Polonorum Administratio Locorum*, 22(2), 131-151. <http://dx.doi.org/10.31648/aspal.7829>
  - Gholam, D. E., & Fekry, M. (2023). Urbanism of the neighborhood mosque. in mosque architecture: a transdisciplinary debate (pp. 157-166). *Springer International Publishing*. [https://doi.org/10.1007/978-3-031-24751-4\\_16](https://doi.org/10.1007/978-3-031-24751-4_16)
  - Grodach, C. (2020). Why coronavirus will deepen the inequality of our suburbs. *Planning News*, 46(9), 14-15. <https://theconversation.com/why-coronavirus-will-deepen-the-inequality-of-our-suburbs-143432>
  - Gonzales, D. M., Feenstra, P., & Argando, D. (2024). Moral anomie from Emile Durkheim's point of view. *Int J Ethics Soc*, 6(3), 9-16. <http://dx.doi.org/10.22034/ijethics.6.3.9>
  - Hankey, S., & Marshall, J. D. (2017). Urban form, air pollution, and health. *Current Environmental Health Reports*, 4(4), 491-503. <https://doi.org/10.1007/s40572-017-0167-7>
  - Higgs, C., Lowe, M., Hooper, P., Mavoia, S., Arundel, J., Gunn, L., ... & Giles-Corti, B. (2023). Policy relevant health related liveability indicator datasets for addresses in Australia's 21 largest cities. *Scientific Data*, 10(113). <https://doi.org/10.1038/s41597-023-02013-5>
  - Islam, R., Dali, N. M., & Abdullah, A. (2018). Prioritization of the indicators and sub-indicators of Maqasid Al-Shariah in measuring liveability of cities. *International Journal of the Analytic Hierarchy Process*, 10(3). <https://doi.org/10.13033/ijahp.v10i3.597>
  - Jayanandini, G., & Kathiravan, P. (2023). Evaluating the urban

- livability index with data-driven insights of smart cities using smart innovative solutions. In *2023 Annual International Conference on Emerging Research Areas: International Conference on Intelligent Systems (AICERA/ICIS)* (pp. 1–7). IEEE. <https://doi.org/10.1109/AICERA/ICIS59538.2023.10420047>
- Jahanbakhsh, A., & Shokouhbidhendi, M. (2022). The pattern of productive Zistshahr (Livable city): A drive toward Islamic urban planning. *Journal of Research in Islamic Architecture*, *10*(2), 124–145. <https://doi.org/10.52547/jria.10.2.8>
  - Kasim, O. F., Wahab, B., & Olayide, O. E. (2021). Assessing urban liveability in Africa: Challenges and interventions. In W. Leal Filho, A. M. Azul, L. Brandli, A. Lange Salvia, & T. Wall (Eds.), *Industry, innovation and infrastructure* (pp. 1–14). Springer International Publishing. <https://doi.org/10.1007/978-3-319-95873-670>
  - Khorrami, Z., Ye, T., Sadatmoosavi, A., Mirzaee, M., Fadakar Davarani, M. M., & Khanjani, N. (2021). The indicators and methods used for measuring urban liveability: a scoping review. *Reviews on Environmental Health*, *36*(3), 397–441. <http://doi.org/10.21203/rs.3.rs-26287/v1>
  - Kirdar, G., & Cagdas, G. (2022). A decision support model to evaluate liveability in the context of urban vibrancy. *International Journal of Architectural Computing*, *20*(3), 528–552. <https://doi.org/10.1177/14780771221121500>
  - Koeberl, M., Wurm, M., Droin, A., Garbasevschi, O. M., Dolls, M., & Taubenboeck, H. (2024). Liveability in large housing estates in Germany—Identifying differences based on a novel concept for a walkable city. *Landscape and Urban Planning*, *251*, 105150. <https://doi.org/10.1016/j.landurbplan.2024.105150>
  - Koç, İ. (2022). Determining the near-future biocomfort zones in Samsun province by the global climate change scenarios. *Kastamonu University Journal of Forestry Faculty*, *22*(2), 181–192. <https://doi.org/10.17475/kastorman.1179080>
  - Kondrat'eva, L. N., Stepanova, N. R., & Bochkov, P. V. (2020). The formation of a comfortable urban environment. In *IOP Conference Series: Materials Science and Engineering*. IOP Publishing. <https://doi.org/10.1088/1757-899X/972/1/012021>
  - Latifi, M., Mahdavejad, M., Iannaccone, G., & Pimenta Do Vale, C. (2024). The model of future Islamic architecture: Adapting the basics of design in native Qajar housing. *Islamic Art Studies*, *18*(42), 327–342. <https://doi.org/10.22034/ias.2021.296807.1673>
  - Leby, J. L., & Hashim, A. H. (2010). Liveability dimensions and attributes: Their relative importance in the eyes of neighbourhood residents. *Journal of Construction in Developing Countries*, *15*(1), 67–91.
  - Mahdavejad, M., Gharaati, F., & Galil, M. I. Z. M. (2025). Anticipating the future of iranian cities: high-tech versus nature-based solutions. In S. González-Arellano & B. Gandlgruber (Eds.), *Cities as Anticipatory Systems* (pp. 103–125). Springer. [https://doi.org/10.1007/978-3-031-78162-9\\_7](https://doi.org/10.1007/978-3-031-78162-9_7)
  - Mc Arthur, J., & Robin, E. (2019). Victims of their own (definition of) success: Urban discourse and expert knowledge production in the Liveable City. *Urban Studies*, *56*(9), 1711–1728. <https://doi.org/10.1177/0042098018804759>
  - Mohammadi, M., & Tajik, A. (2020). بررسی مفهوم مدینه، قریه، بادیه [A study of the concepts of Medina, village, wilderness, and Rastaq in verses and narrations]. *Scientific Journal Science and Civilization in Islam*, *2*(5), 56–75. [in Persian] <https://dor.isc.ac/dor/20.1001.1.26764830.1399.2.5.3.8>
  - Obayomi, A., Popoola, A., Medayese, S., & Wahab, B. (2023). Examining liveability in the informal community of Kabawa, Nigeria. *Town and Regional Planning*, *82*, 18–33. <https://doi.org/10.38140/trp.v82i.5661>
  - Oviedo, D., Sabogal, O., Duarte, N. V., & Chong, A. Z. (2022). Perceived liveability, transport, and mental health: A story of overlying inequalities. *Journal of Transport & Health*, *27*, 101513. <https://doi.org/10.1016/j.jth.2022.101513>
  - Paul, A., & Sen, J. (2020). A critical review of liveability approaches and their dimensions. *Geoforum*, *117*, 90–92. <https://doi.org/10.1016/j.geoforum.2020.09.008>
  - Pourjafar, M. R., Pourjafar, A., & Safdari, S. (2015). Various types of Islamic city and pointing out to defining the major aspects of ideal Islamic city. *Journal of Researches in Islamic Architecture*, *3*(3), 1–17. <http://jria.iust.ac.ir/article-1-269-en.html>
  - Pourmohammadi, M., Bahrainy, S. H., & Davoudpour, Z. (2019). Islamic city: Imagination or reality. *Urban Planning Knowledge*, *3*(2), 33–47. <https://doi.org/10.22124/upk.2019.13124.1184>
  - Pricope, L. N. (2022). The global liveability index and smart cities across Europe. *Annals of the University Dunarea de Jos of Galati: Fascicle: I, Economics & Applied Informatics*, *28*(3). <https://doi.org/10.35219/eai15840409291>
  - Pojani, D., & Alidoust, S. (2023). Lest we forget: media predictions of a post-Covid-19 urban future. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, *16*(2), 125–141. <https://doi.org/10.1080/17549175.2021.1944283>
  - Rezaei, M., Sheikhi, Sh., & Panrafkan, M. (2019). بررسی شاخص‌های مسکن در شهر اسلامی از منظر قرآن و حدیث [Studying housing indicators in Islamic cities (from the perspective of the Quran and Hadith)]. *The 6th International Conference on Architectural studies and Urbanism in the Islamic World*. [in Persian] <https://civilica.com/doc/1179016/>
  - Saeed, U., Ahmad, S. R., Mohey-ud-din, G., Butt, H. J., & Ashraf, U. (2022). An integrated approach for developing an urban livability composite index—a cities' ranking road map to achieve urban sustainability. *Sustainability*, *14*(14), 8755. <https://doi.org/10.3390/su14148755>
  - Safari, A., Salaripour, A., & Azimi, N. (2024). A practical framework for ranking-based analysis of livability in urban-rural contexts: a case

study of Qazvin city-region, Iran. *International Journal of the Analytic Hierarchy Process*, 16(2). <https://doi.org/10.13033/ijahp.v16i2.1151>

- Sochacka, B. A., Kenway, S. J., & Renouf, M. A. (2021). Liveability and its interpretation in urban water management: Systematic literature review. *Cities*, 113, 103154. <https://doi.org/10.1016/j.cities.2021.103154>
- Soleimani Mehrenjani, M., Tavallai, S., Rafieian, M., Zanganeh, A., & Khazaei Nezhad, F. (2016). Urban livability: the concept, principles, aspects and parameters. *Geographical Urban Planning Research (GUPR)*, 4(1), 27-50. <https://doi.org/10.22059/jurbangeo.2016.58120>
- Southworth, M. (2003). Measuring the liveable city. *Built Environment*, 343-354.
- Thanoon, M. G., & Haykal, H. T. (2020). Influences of the accessibility and availability of green spaces on the liveability of residential complexes in Erbil city. *American Journal of Civil Engineering and Architecture*, 8(2), 25-36. <http://dx.doi.org/10.12691/ajcea-8-2-1>
- Thrat, SH., Pathak, S., & Raisoni, H. (2023). Analyzing liveability index parameters for formulating assessment model at the zone level -a case of Pune city. *International Journal of Progressive Research in Science and Engineering*, 4(9). <http://dx.doi.org/10.5281/zenodo.8397977>
- Valcárcel-Aguilar, B., & Murias, P. (2019). Evaluation and management of urban liveability: A goal programming based composite indicator. *Social Indicators Research*, 142(2), 689-712. <https://doi.org/10.1007/s11205-018-1861-z>
- Van Vliet, W. (2008). *Broad-based partnerships as a strategy for urban livability: An examination of best practices*. Human Settlements Global Dialogue Series.
- Vidovszky, I., & Pintér, F. (2020). An investigation of the application and material characteristics of early 20th-century Portland cement-based structures from the historical Campus of the Budapest university of technology and economics. *International Journal of Architectural Heritage*, 14(3), 358-375. <https://doi.org/10.1080/15583058.2018.1545059>
- Vlasova, M. F., Larionova, V. A., & Stepanova, N. R. (2020). The development of a comfortable urban environment on the example of Ekaterinburg city. In *IOP Conference Series: Materials Science and Engineering*. IOP Publishing. <https://doi.org/10.1088/1757-899X/753/5/052031>
- Wagner, F. (2018). *Livable cities from a global perspective*. Routledge.
- Wang, S., & Gu, K. (2023). *Spatial justice and planning: Reshaping social housing communities in a changing society*. Springer Nature.
- World Development Report. (2011). *The World Bank*. Retrieved July 7, 2024, from <https://doi.org/10.1596/978-0-8213-8439-8>
- Xiao, Y., Chai, J., Wang, R., & Huang, H. (2022). Assessment and key factors of urban liveability in underdeveloped regions: A case study of the Loess Plateau, China. *Sustainable Cities and Society*, 79, 103674. <https://doi.org/10.1016/j.scs.2022.103674>
- Xu, J. (2019). From walking buffers to active places: An activity-based approach to measure human-scale urban form. *Landscape and Urban Planning*, 191, 103452. <https://doi.org/10.1016/j.landurbplan.2018.10.008>
- Ye, Y., Jia, C., & Winter, S. (2024). Measuring perceived walkability at the city scale using open data. *Land*, 13(2), 261. <https://doi.org/10.3390/land13020261>
- Yekeen, A. Y., & Misnan, S. H. (2024). Understanding the social drivers of liveability in Osogbo, Nigeria. *Built Environment Journal*, 21(2), 127-140. <https://doi.org/10.24191/bej.v21i2.946>
- Yu, J., Li, X., Guan, X., & Shen, H. (2024). A remote sensing assessment index for urban ecological livability and its application. *Geo-Spatial Information Science*, 27(2), 289-310. <https://doi.org/10.1080/10095020.2022.2072775>
- Zellmer, A. J., & Goto, B. S. (2022). Urban wildlife corridors: Building bridges for wildlife and people. *Frontiers in Sustainable Cities*, 4, 954089. <https://doi.org/10.3389/frsc.2022.954089>

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