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# DYNAMICS IN HARMONIOUS HUMAN-NATURE URBAN ECOSYSTEM MODEL FOR ENVIRONMENT SUSTAINABILITY: A REVIEW

**Yuting WU[1], *Athira[2], Rahinah[3], Sarah[4], Azmiah[5]**
***Corresponding Author**
*[1,2,3,4,5]Faculty of Design And Architecture, Universiti Putra Malaysia, Persiaran Universiti 2, 43400 Seri Kembangan, Selangor*

wuyuting1985@gmail.com, athira.azmi@upm.edu.my, rahinah@upm.edu.my, sarah_salih@upm.edu.my, azmiah@upm.edu.my
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## ABSTRACT

*Abstract: In the face of growing urbanization, conflicts between human activities and the natural environment have resulted in increasingly evident problems, such as ecological degradation, excessive resource depletion, loss of biodiversity, and pollution. These issues pose a growing threat to the achievement of global sustainable development goals. This study is part of a larger study to create a liveable and sustainable urban environment. It aims to develop an urban ecosystem model for promoting harmony with nature by analyzing the latest literature research from 2019 to 2023 using the Systematic Literature Review method. This paper elucidates the newest research developments in urban design, urban ecosystems, and the pursuit of enhanced synergy harmonious humans with nature. Subsequently, from the cross-analysis method it presents a synthesized model proposing a harmonious human-nature ecosystem for urban design. This model advocates the cultivation of human natural identity, providing a framework to adapt, modify, and preserve the urban environment in harmony with nature. Such an approach is expected to enhance urban vitality, which is harmonious between humans and nature while maintaining ecological functions and biodiversity and ensuring efficiency, equity, socio-cultural, and aesthetic values. This study contributes to identifying, understanding, and resolving ecological imbalances arising from urbanization. The results*

*are expected to benefit authorities in maintaining a healthy standard of living in rapidly urbanizing areas. Future research will combine methods such as field investigations and design practices to further refine this urban design proposal, providing support and guidance for a more comprehensive sustainable urban environmental development.*

**Keywords:** *System dynamics and sustainability, Urban environment Sustainability, Urban design, Urban ecosystem, Human-nature harmony*

## INTRODUCTION

The global trend toward urbanization, as highlighted by UN-Habitat (2022), has emerged as a pivotal force in contemporary society. Although urbanization provides opportunities for economic growth and social progress, it has undeniably exacerbated the conflict between humans and nature, including encroachment on natural habitats through land use, overconsumption of natural resources, and the emission of waste, sewage, and greenhouse gases, all of which disrupt the ecological balance of cities. This leads to environmental challenges such as declining air quality, loss of biodiversity, climate change, and ecological fragility, negatively impacting the safety and physical and mental health of residents and even threatening the achievement of the 2030 global sustainable development goals (Mohd et al. 2021; Bonilla-Bedoya et al., 2021; Ghosh & Pal, 2024; Li et al., 2024; C. Liu et al., 2023; Mbandi et al., 2023; Wei et al., 2022). Therefore, it is imperative to advocate for harmony with nature as an essential step towards designing urban environments that are not only sustainable, but also conducive to a high quality of life.

In the context of sustainable development, achieving harmony with nature involves exploring a new relationship with nature in harmony beyond human concerns to ensure the sustainability of the development of humanity and ecosystems (WCED, 1987; UN, 2015; UN, 2023). The integral relationship between urban ecosystems and sustainable urban development has been underscored in recent literature (Shi et al., 2022). A significant amount of research has conducted detailed assessments and analyses of urban ecosystems from various aspects such as quantity and quality, function, services, and biodiversity (J. Chen et al., 2022; Hou et al.,

2023; Ren et al., 2023; Tang et al., 2023). However, these studies primarily focus on various ecological indicators of urban ecosystems (Kowarik, 2023; Lin et al., 2023; Luo et al., 2023; Pukowiec-Kurda, 2022), research on the reciprocal influence of human interactions with nature in the construction of urban ecosystems remains underrepresented.

Urban space is a shared environment between humans and nature. As the main practical process of shaping urban space, urban design could serve as a strategic entry point for creating sustainable urban environments in harmony with nature. The research and practice of urban design traditionally emphasize human-centered (Cozzolino et al., 2020). However, focusing solely on human interests cannot achieve the sustainable development of humans and nature in urban environments (UNEP, 2021; UN, 2023). This study emphasizes the need to consider the relationship between humanity, urban form, and the natural environment through innovative and reasoned urban design to improve environmental sustainability.

By analyzing the latest research perspectives, this study seeks to identify design methods contributing to the sustainable development of urban environments, assess the key components of sustainable urban ecosystems, explore the harmonious interaction between humans and nature in urban environments, and propose a model for a harmonious human-nature urban ecosystem. The expected results will contribute to authorities in maintaining sustainable development and healthy living standards in rapidly urbanizing areas.

## METHODOLOGY

This study uses a systematic literature review synthesis method by Luo et al. (2022) and Masiran et al. (2020). Figure 1 illustrates the procedure to present a synthesized model proposing a harmonious human-nature ecosystem for urban design.

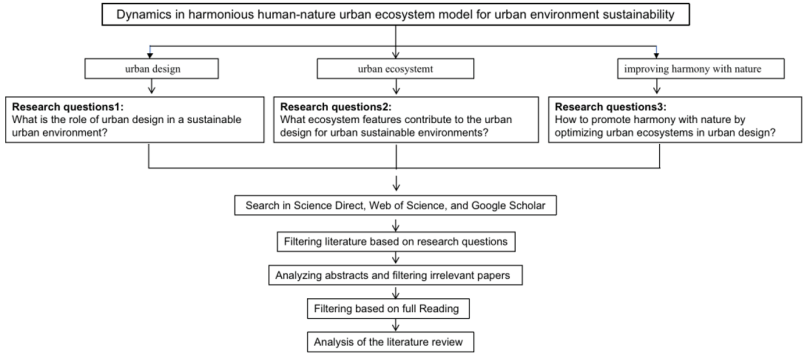


**Figure 1. Flowchart of the Literature Review Methodology**

Source: Author

The first step is to define the research question. This study used Ibrahim's (2011) research question construct (or RQ construct) categorization technique for identifying 3 different RQ constructs. This technique classifies research questions into three categories: 'Who' (elements influenced by the research), 'What' (information or knowledge system required to address the problem), and 'How' (the intended impact of the study). Three themes were identified: Urban design (Who), Urban ecosystems (What), and improving harmony with nature (How). The research questions corresponding to each theme are shown in Figure 1.

The second step is to search for literature. Based on the research questions, this study searched literature on the themes of "urban design," "urban ecosystems," and "harmony with nature" in Science Direct, Web of Science, and Google Scholar. The keywords were combined using 'OR' operators. A total of 1147 articles were initially retrieved.

The third step is to screen and classify the literature. The following inclusion and exclusion criteria were used to screen the literature: (1) all literature was in English and from flagship journals; (2) studies unrelated to the relationship between humans and nature in the sustainable urban environment, such as discussions on harmony in education, music, and engineering technology, were excluded; (3) excluding articles unrelated to urban design; and (4) focus was placed on journals published in the last 5 years (2019–2023). As some articles were difficult to judge based solely on their titles, a secondary screening was performed through abstract reading.

The snowball technique was used to find new sources by looking at the references to existing articles. Ultimately, 72 articles were included in this study and categorized into the corresponding themes.

The final step is the analysis of the literature. This study systematically reviews key contributions from previous scholars within each identified topic, delineates how their research lays a foundation for future studies and critically assesses areas requiring further refinement and enhancement within each chosen domain. The outcomes of this exercise would produce synthesized information geared towards highly probable solutions that could satisfy the desire to improve harmony with nature. This study concludes with a proposal for potential integrated solutions for the future development of urban design for harmonious ecosystems and an ecosystem model for supporting them to create a liveable and sustainable urban environment. Figure 1 shows the flowchart of the systematic literature review methodology.

## RESULTS AND ANALYSES

### The Role of Urban Design for Sustainable Urban Environments

Urban design is a multidisciplinary field with a primary focus on designing, creating, and managing urban spaces and places that meet both the objective and social-emotional needs of the public (Bahrainy & Bakhtiar, 2016; Cozzolino et al., 2020; Townshend, 2020). Following the UNEP (2018), sustainable urban environments require the reorganization and the design of physical environmental elements such as urban spaces and infrastructures, as well as promoting sustainable behaviors. This necessitates urban design not only focusing on optimizing natural resource consumption while ensuring access to services for the less privileged. Additionally, it should focus on fostering subjective initiative in natural conservation among residents.

Creating an efficient and equitable built environment is one of the key directions for sustainable urban environments (Nederhand et al., 2023). Environmental justice focuses on the accessibility and affordability of the

urban environment for all urban residents, especially vulnerable groups, as well as cultural inclusivity (Chaudhry, 2024; Nederhand et al., 2023). Environmental efficiency concerns people's management, protection, and efficient use of natural resources, thereby helping to curb adverse impacts on the environment, such as avoiding unnecessary resource consumption (H. Wang & Guo, 2024). A high-efficiency and fair urban environment considers the sustainability of the urban ecological environment and the diverse needs of urban residents, and it has a positive impact on promoting residents' health and subjective well-being, enhancing urban liveability (Huang et al., 2023; Shao et al., 2024; J. Zhang & Xu, 2023). For example, enhancing the walkability and greenery in communities and enriching the visibility, accessibility, availability, and variability of the urban natural environment can provide more opportunities for urban residents to experience nature, strengthen their connection with nature, and promote their physical health and psychological resilience (Brito et al., 2022; Ma et al., 2023; H. Zhang, Nijhuis, et al., 2023). However, previous research has mainly focused on assessing ecological equity and efficiency primarily from the perspective of economics and society and exploring policies and technologies that help promote environmentally, socially, and economically sustainable development (Cui et al., 2022; Naime et al., 2022; Sun & Gao, 2023; Y. Zhang & Dilanchiev, 2022), and did not explore methods to enhance ecological equity and efficiency from the perspective of urban space shaping. Therefore, based on Doll et al. (2023), this study suggests designing ecological landscapes on marginal and underutilized urban lands to promote the efficiency and equity of urban natural resources. Moreover, according to Zhao et al. (2023) and Zhang and Xu (2023), this study will explore effective urban design strategies for zoning different urban ecosystems and optimizing their spatial patterns to enhance the connectivity of ecological spaces and the multifunctionality of landscapes, thereby improving the efficiency and equity of urban ecosystems.

Additionally, existing studies have demonstrated that human behavioral patterns are significant factors influencing the harmonious relationship between humans and nature (Dong & Huang, 2023). Encouraging individuals' pro-environmental behaviors, defined as a pattern of actions that benefit the natural environment, improve environmental quality, or promote the sustainable use of natural resources, could help protect nature (Jiao et al., 2023). However, current research on pro-environmental behaviors is

mainly in the field of psychology, intending to explore various psychological factors related to human pro-environmental behaviors (Hogg et al., 2023; Udall et al., 2021), and there is a lack of research on the promotion of pro-environmental behaviors through urban design. Therefore, this study will further focus on the characteristics of urban environments associated with the promotion of pro-environment behaviors to explore ecological urban design strategies that promote harmony with nature.

This section aims to explore the role of urban designs in fostering sustainable development within urban environments. The results conclude that to develop sustainable urban environments, urban design should enhance the efficiency and equity of the urban environment and foster pro-environment behaviors of residents by improving the eco-use of urban land, zoning different urban ecosystems, optimizing landscape spaces and urban infrastructures (ecological infrastructures, streets, buildings, and neighborhoods). Figure 2 shows a conceptual framework for the role of urban design in sustainable urban environments.

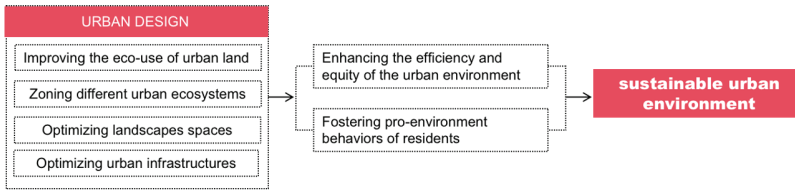


**Figure 2. The Role of Urban Design for Sustainable Urban Environments**
Source: Author

## Ecosystem Features for Urban Sustainable Environments

The Millennium Ecosystem Assessment defines the ecosystem as a dynamic complex of plant, animal, and microorganism communities and the non-living environment interacting as a functional unit, wherein urban ecosystems are defined as ecosystems managed and modified by human beings, consisting of natural or semi-natural areas (MEA, 2005). By analyzing the recent literature on urban ecosystems, this study summarizes three urban ecosystem indexes and their features that influence the sustainability of urban environments.

## Biodiversity

Biodiversity is defined as the variety of life on earth, a concept that involves all living organisms, species, populations, genetic variation among them, and complex assemblages of communities. Ecosystems genetic diversity, species diversity, and ecosystem diversity are three levels of biodiversity (Secretariat of the Convention on Biological Diversity, 2000).

Biodiversity plays a significant role in promoting a sustainable supply of urban ecosystem services, as it enhances the functioning and stability of urban ecosystems even under changing environmental conditions (R. Zhang et al., 2023). Additionally, utilizing knowledge of biodiversity to guide urban design can promote efficient use of urban energy, improve urban biocultural landscapes, and enhance the psychological resilience of urban residents (Marull et al., 2023; Mitchell & Devisscher, 2022). However, current research on biodiversity has focused only on assessing and analyzing different regional biodiversity and its importance for sustainable urban development without delving into exploring urban design methods for conserving and integrating biodiversity.

According to Doll et al. (2023), this study proposes to explore design strategies for urban spatial patterns to create more biocultural landscape spaces to provide more habitat for wildlife and thus conserve biodiversity. Moreover, based on Prévot et al. (2018) and Riva & Fahrig (2022), this study will explore the strategies and methods of protecting, restoring, and creating urban habitat patches from the aspects of urban space and landscape patterns to provide habitats for wildlife and provide more opportunities for urban residents to interact with nature.

## Balancing Ecosystem Service Potential, Biological Carrying Capacity, and Resident Consumption

Balancing the potential supply of ecosystem services, the biological carrying capacity, and the consumption of urban residents' demands are crucial for realizing justice and equity in urban ecosystems, thereby ensuring urban ecological security (Zhu et al., 2023). However, the uneven distribution of urban landscape patterns and the development of social systems have led to differences in the provision of ecological space in

different urban areas, hindering the realization of urban ecological equity (Ran et al., 2023; Zhao et al., 2023). Therefore, there is a need to optimize the urban spatial structure, weigh the benefits of ecological compensation among stakeholders, and pay attention to the intensity and abundance of services provided by different ecosystems, to provide urban residents with environmental conditions for equitable access to ecosystem services (Su & Liu, 2023). Meanwhile, according to Fan et al. (2023) and Pukowiec-Kurda (2022), this study proposes to explore spatial design methods to improve the connectivity of different ecosystems to strengthen ecological processes in urban ecosystems and contribute to the creation of synergies between different ecosystems, thereby enriching urban ecosystem functions and services (Fan et al., 2023; Pukowiec-Kurda, 2022).

## Cultural Ecosystem Serveries

The internationally recognized CICES categorizes the spiritual benefits provided by ecosystems to humans, such as aesthetics, education, and entertainment, as cultural ecosystem services (Márquez et al., 2023). Recent studies have shown that urban natural environments can enhance the emotional connection between humans and nature through cultural ecosystem services, which helps improve the psychological resilience and subjective well-being of urban residents as well as cultivate their emotional attachment to nature and pro-environmental behaviors (Jiang et al., 2022; Noe & Stolte, 2023; Nowak-Olejnik et al., 2022; H. Zhang, Cai, et al., 2023). However, the studies mentioned above have focused only on analyzing and assessing human well-being from cultural ecosystem services and did not specifically explore urban design methods that could help promote the diversity of urban ecosystem services.

According to Pukowiec-Kurda (2022), Hansen et al. (2023), and Ramyar et al. (2021), this study suggests optimizing human-created ecosystems through the design of appropriate infrastructure and rich visual elements, such as parks and green infrastructure. This could enhance ecosystem functions, integrate local or alien species, and provide diverse ecosystem services for urban residents, including entertainment, aesthetics, and social interaction while encouraging public participation in environmental issues. Furthermore, based on Garrett et al. (2023) and Grzyb (2024), this study proposes to explore effective urban design methods

for utilizing and transforming human-managed ecosystems, such as forest fragments, streams, residual hills, and urban natural heritage, in order to provide more natural and wild activity spaces for urban residents, promoting public activities in nature while protecting the urban natural environment and local species, enhancing humans' perception of nature.

## Conceptual Framework Development

This section analyses the ecosystem features that contribute to urban design for sustainable environments in urban areas. The key findings are presented in Table 1.

**Table 1. Key Findings of Ecosystem Features for Urban Sustainable Environments**

| Key Findings | | Resources |
|---|---|---|
| Biodiversity | 1. Enhancing the functionality and stability of urban ecosystems<br>2. Optimizing urban ecosystems could maintain biodiversity<br>3. Integrating biodiversity into urban design not only helps maintain biodiversity in cities but also can enrich urban ecosystem services. | 1. R. Zhang et al. (2023)<br>2. Marull et al. (2023)<br>3. Mitchell & Devisscher (2022)<br>4. Prévot et al. (2018)<br>5. Riva & Fahrig (2022) |
| Balance in urban ecosystem services | 1. Realizing ecological justice and equity and ensuring urban ecological security<br>2. Optimizing the spatial structure and paying attention to the intensity and abundance of services provided by different ecosystems contribute to balancing urban ecosystem services<br>3. Improving the connectivity of different ecosystems could enrich urban ecosystem functions and services | 1.Zhu et al. (2023)<br>2.Pukowiec-Kurda (2022)<br>3.Su & Liu (2023)<br>4.Fan et al. (2023) |
| Cultural ecosystem services | 1. Enhancing the emotional connection between humans and nature<br>2. Preserving the original natural environment and local species and providing direct spaces for natural perception and activities<br>3. Engaging the public in environmental issues | 1. Márquez et al. (2023)<br>2.Garrett et al. (2023)<br>3.Jiang et al. (2022)<br>4 Pukowiec-Kurda (2022)<br>5.Hansen et al. (2023)<br>6. Ramyar et al. (2021)<br>7.Grzyb (2024) |

Based on Table 1, this study recommends that the integration of ecological indicators such as optimizing landscape patterns, ecological space, and connectivity, preserving ecological function and biodiversity, and balancing availability and carrying capacity with cultural eco-services (encompassing socio-cultural perceptions, recreational, aesthetic, and social interaction value) holds promise for establishing a thriving urban ecosystem conducive to sustainability. Figure 3 delineates a conceptual framework depicting the ecosystem features for urban sustainable environments.

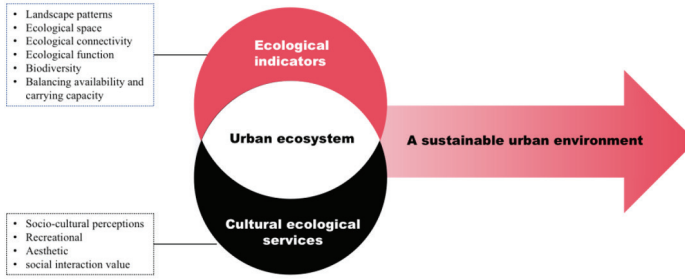


**Figure 3. Conceptual Framework of Ecosystem Features for Urban Sustainable Environments**

Source: Author

## Foster Natural Identity to Promote Living in Harmony with Nature

Human perception of the natural environment is critical in fostering harmony with nature (Hung & Chang, 2022). Aligning with this, the 2030 Agenda for Sustainable Development explicitly states that by 2030, it is imperative to ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature (UN, 2015). Environmental psychology theories explain how human consciousness, behavior, and the environment interact with each other. Specifically, environmental factors influence human behavior, feelings, and thoughts, and individuals' behavior, feelings, and thoughts in turn shape the way they influence the environment. These theories provide a non-anthropocentric way for urban design to create sustainable urban environments (Udall et al., 2021).

## Formation of Natural Identity

The concept of natural identity represents individuals' subjective perceptions of harmony with nature (Schmitt et al., 2019), and it is an integrated manifestation of individuals' cognitive, emotional, and identity connection to nature (Kunchamboo et al., 2021). Mackay et al. (2021) believe that humans can identify with nature as they do with human social groups. When individuals perceive themselves as integral components of nature or align with a collective identity characterized by values, beliefs, or norms that prioritize environmental stewardship, they exhibit an increased propensity to cultivate subjective awareness of harmony with nature and actively participate in pro-environmental behaviors. According to Kunchamboo et al. (2021), the formation of natural identity is a process of cognitive, emotional, and behavioral development, which is significantly influenced by two subjective consciousnesses which are natural values and place attachment.

Natural values represent human cognition, evaluation, and judgment of nature (Sage & Schwartz, 2022). This involves how humans view the benefits from nature (instrumental value), the value of nature itself (intrinsic value), and meaningful interactions between nature and humans (relational value) (IPBES, 2022). Different perceptions of the three dimensions of natural value affect individuals' attitudes and behaviors toward nature (Ghijselinck, 2023). For example, individuals who focus on the instrumental value of nature are more likely to emphasize dependence on and utilization of nature, while those who recognize the relational value of nature are more likely to form a values system of living in harmony with nature and achieve a better life by maintaining a good relationship with nature (Mackay et al., 2021). Furthermore, from a collective perspective, the societal-level broad natural values reflect the shared beliefs, actions, and norms towards the nature of the entire society (Sagiv & Schwartz, 2022; Schaubroeck, 2018).

Place attachment refers to the emotional and cognitive bonds formed by individuals with a specific place (Lu et al., 2024). Attachment to a place can not only activate an individual's sense of environmental responsibility but also encourage pro-environmental behaviors among urban residents through the influence on social subjective norms (Soopramanien et al., 2023). For instance, Jiao et al. (2023) found that individuals who place

attachment can stimulate a sense of local pride, thereby prompting people to desire to create a better living environment.

The above studies provide psychological references for understanding the factors that promote human pro-environmental behaviors. However, these studies (Gould et al., 2023; Irani et al., 2023; Schmitt et al., 2019) did not focus on how to shape human subjective awareness of living in harmony with nature. Therefore, this study will further explore this topic by analyzing the relationship between urban environmental features and individual subjective awareness.

## Connection to Nature

Numerous studies have confirmed that the physical connection with nature is a necessary condition for nurturing the human subjective consciousness of living in harmony with nature (Q. Liu et al., 2020; Teixeira et al., 2022). For example, natural spaces near residential areas provide frequent opportunities for humans to access nature, thereby fostering a sense of ownership and environmental responsibility (Ramli et al., 2023; Noe & Stolte, 2023). Pukowiec-Kurda, (2022) emphasizes the importance of urban natural spaces that combine ecological, social, and cultural functions in promoting living in harmony with nature. These spaces maintain natural values such as ecological functionality, enhanced biodiversity, and habitat maintenance, while also providing prosperity for people, such as psychological restoration, social entertainment, and health. They are all encompassed in the concept of ecosystem services. Additionally, through direct experiences in nature, individuals can establish a psychological connection with nature, such as love for nature, possessing special memories about nature, and subsequently assigning symbolic meanings, thus forming an individual's natural values and developing an emotional attachment to nature, activating the individual's natural identity (Chen & Hsieh, 2023; H. Zhang et al., 2023).

The above study demonstrates the significant role of urban environments in promoting connections with nature. The cultural ecosystem services provided by urban natural areas, such as recreational, aesthetic, and biological values, are crucial for forming residents' natural identity (Jayakody et al., 2024; H. Zhang, et al., 2023). Therefore, this study

believes that urban design should consider providing more opportunities for humans to have contact with nature and enriching interaction modes with nature to meet the diverse interests and needs of urban residents. Additionally, according to (Hung & Chang, 2022), this study recommends that urban design should focus on combining natural, local, and visual aesthetic attributes with built environments to promote humans' harmonious perception of nature in urban environments.

## Conceptual Framework Development

This section aims to delve into strategies for optimizing urban ecosystems to foster harmony with nature in urban design. The key findings are summarized in Table 2.

**Table 2. Key Findings on Promoting Harmony with Nature**

| | Key Findings | Resources |
|---|---|---|
| Natural identity | 1. Individuals' subjective perceptions of harmony with nature<br>2. An integrated manifestation of individuals' cognitive, emotional, and identity connection to nature.<br>3. The formation of natural identity is significantly influenced by two subjective consciousnesses which are natural values and place attachment | 1.Schmitt et al. (2019)<br>2.Kunchamboo et al. (2021)<br>3.Mackay et al. (2021) |
| Natural values | 1. Different perceptions of natural instrumental value, intrinsic value, and relational value affect individuals' attitudes and behaviors toward nature<br>2. The broad natural values reflect the shared beliefs, actions, and norms towards the nature of the entire society | 1.Sagiv & Schwartz (2022)<br>2.Schaubroeck (2018)<br>3.IPBES (2022)<br>4.Ghijselinck (2023) |
| Place attachment | 1. Place attachment refers to the emotional and cognitive bonds formed by individuals with a specific place<br>2. Place attachment could influence subjective social norms<br>3. Place attachment can not only activate an individual's sense of environmental responsibility but also encourage pro-environmental behaviors | 1. Lu et al. (2024)<br>2. Soopramanien et al. (2023)<br>3. Jiao et al. (2023) |

| | | |
|---|---|---|
| Connection to nature | 1.Physical connection with nature is necessary to develop a subjective sense of human harmony with nature<br>2. Urban natural spaces that combine ecological, social, and cultural functions could promote a connection to nature. They are included in the cultural ecosystem services.<br>3. Built environments that combine natural and local attributes, visual aesthetic qualities, and the compatibility of natural and human-made amenities are more likely to promote living in harmony with nature. | 1.Q. Liu et al. (2020)<br>2.Noe & Stolte (2023)<br>3.Pukowiec-Kurda (2022)<br>4.Kunchamboo et al. (2021)<br>5.Jayakody et al. (2024)<br>6.H. Zhang et al. (2023)<br>7. Hung & Chang (2022) |

Building upon the aforementioned analysis, this section suggests that to promote harmony with nature, urban design could optimize the urban ecosystem (ecological, social, and cultural functions) by integrating natural, aesthetic, cultural, and local characteristic elements into the built environment to foster human natural identity (including natural values, place attachment, environmental responsibility), thereby promoting pro-environmental behaviors among humans. Figure 4 illustrates a conceptual framework for fostering natural identity to promote harmony with nature.

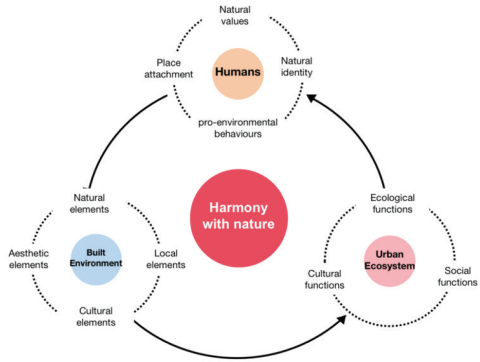


**Figure 4. Conceptual Framework for Fostering Natural Identity to Promote Harmony with Nature**

Source: Author

## DISCUSSION

This research conducted a cross-analysis and discussion of the preliminary literature review through six independent steps. This included selecting

keywords for each analytical result and prioritizing them, evaluating the advantages and disadvantages of different perspective combinations, and suggesting the most suitable directions for further research. Concerning the point of departure tree diagram in Figure 5, this section discusses how to further integrate the preliminary results to form potential theoretical propositions for future research.

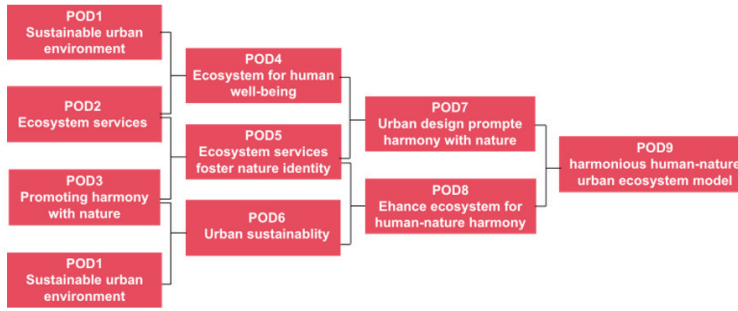


**Figure 5. Point of Departure (POD) Tree Diagram for Developing an Urban Ecosystem Model for Improving Harmony with Nature in Urban Design.**
(Adapted from Templates for Thinking; Unpublished Literary, by Ibrahim and Mustafa Kamal, 2018)

This study recommends that to develop sustainable urban environments, urban design should improve the eco-use of urban land, zoning different urban ecosystems, optimizing landscape spaces, and urban infrastructures to support sustainable urban ecosystems, including conservating biodiversity, balancing availability and carrying capacity, enhancing the efficiency and equity of the urban environment, while optimizing the urban ecosystem functions (ecological, social, and cultural functions). In addition, this study believes that integrating natural, aesthetic, cultural, and local characteristic elements into the built environment could provide more cultural ecosystem services (including socio-cultural perceptual, recreational, aesthetic, and social interaction values) for fostering human natural identity (including natural values, sense of place, environmental responsibility) to promote pro-environmental behaviors among humans, that could create a sustainable urban environment in harmony with nature (dependence, adaptation, transformation, and preservation).

Through further cross-analysis of the above conclusions, this paper presents a dynamic harmonious human-nature urban ecosystem model for environmental sustainability. The model emphasizes urban design could

adapt, transform, and protect the urban natural environment by optimizing urban spaces such as green and blue areas, biocultural landscapes, and urban infrastructure. This approach has the potential to optimize the urban ecosystem and help foster human natural identity, including fostering human natural values, place attachment, and pro-environmental behavior. Hence, it could play a pivotal role in sustaining ecological functions and biodiversity within urban ecosystems, ensuring ecological efficiency and equity, and realizing the social, cultural, and aesthetic values of urban ecosystems. Figure 6 illustrates a harmonious human-nature urban ecosystem model for environmental sustainability.

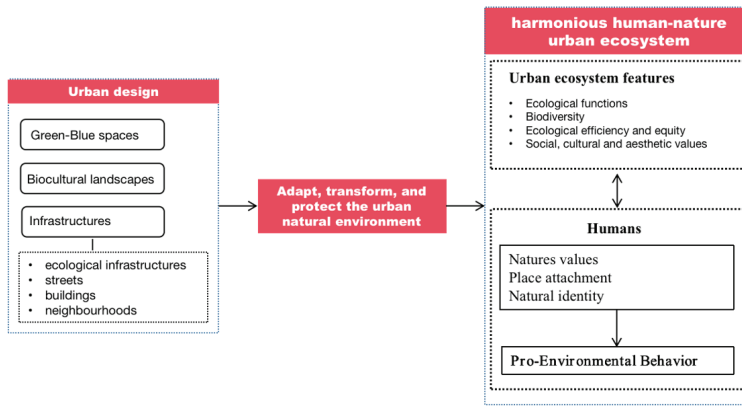


**Figure 6. Harmonious Human-nature Urban Ecosystem Model**
Source: Author

## CONCLUSION

This paper presented an approach to develop an urban ecosystem model for improving harmony with nature in urban design. Through a systematic literature review syntheses selected literature on urban design, urban ecosystems, and improving harmony with nature were analyzed. The results proposed a potential harmonious human-nature ecosystem model for urban design where a combination of nature-based solutions and shaping humans' natural values could adapt, modify, and preserve nature to promote urban inclusion and resilience. Such an approach is expected to enhance urban vitality that is in harmony between humans and nature while maintaining ecological functions and biodiversity, ensuring efficiency, equity, socio-

cultural, and aesthetic values. The study not only contributes to the development of a harmonious urban ecosystem model but also addresses ecological imbalances arising from rapid urbanization. The outcomes are anticipated to offer valuable guidance for authorities striving to maintain a healthy standard of living in rapidly urbanizing areas. Future research will combine methods such as field investigations and design practices to further refine this urban design proposal, providing support and guidance for a more comprehensive sustainable urban environmental development.

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There is no funding for this research.

## AUTHOR CONTRIBUTIONS

All authors contributed to the design of the research. All authors have read and approved the final manuscript.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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