Evaluating the role of community awareness on ecosystem services at Tao Dan park

KHUẤT HỒNG TRÚC VY[1], NGUYỄN VĂN AN[1]
TRẦN THÀNH[2,*], ĐỖ VINH DƯƠNG[2,]**
[1]*NTT Institute of International Education (NIIE), Nguyen Tat Thanh University*
[2]*Institute of Interdisciplinary Sciences (IIS), Nguyen Tat Thanh University*

Abstract

Amidst increasing urbanization and climate change, the conservation and expansion of urban green spaces pose significant challenges for cities like Ho Chi Minh City. This study assesses the potential for ecosystem service development at Tao Dan park using direct surveys and statistical analysis to examine public awareness and engagement. The findings indicate that the park plays a crucial role in microclimate regulation (reducing temperatures by 1-2°C), mitigating the urban heat island effect, and serving as an essential communal space, benefiting over 60% of local residents. However, 69% of respondents lack a clear understanding of the concept of ecosystem services, underscoring the need for enhanced awareness campaigns. Notably, 56% of surveyed individuals expressed willingness to contribute financially (20,000-30,000VND per month) for park maintenance, provided that a transparent fee collection mechanism is implemented. This research highlights the park's significance in promoting sustainable urban development and proposes strategies to enhance public awareness, improve management efficiency and implement appropriate policies to safeguard and maximize the benefits of green spaces.

Keywords: *Urban parks; ecosystem services; green spaces; community awareness; Tao Dan.*
JEL Classification: *Q56, Q57, P18.*
Received: *5th January 2025;* ***Revised****: 15th Febuary 2025;* ***Accepted:*** *7th March 2025*

1. INTRODUCTION

Amidst the rapid progression of urbanization and climate change, the conservation and expansion of urban green spaces present significant challenges for cities worldwide, particularly in large metropolitan areas such as Ho Chi Minh City. Urban parks, with Tao Dan park as a prime example, function as the city's "green lungs", enhancing air quality, absorbing CO_2 emissions, mitigating the urban heat island effect, and regulating the microclimate. Additionally, these parks serve as vital community spaces, accommodating cultural, social, and recreational needs of urban residents (Jones, 2022).

Nevertheless, Tao Dan park is currently facing various challenges, including high population density pressures, a shrinking green space area, and inefficient management strategies (Semeraro et al., 2021). These issues not only impact the park's capacity to provide ecosystem services but also diminish its ecological, social, and cultural values within the context of sustainable urban development. The ecosystem services provided by the park are closely aligned with multiple Sustainable Development Goals (SDGs) (Liu et al., 2023). Specifically, Tao Dan park contributes to Goal 11 (Sustainable Cities and Communities) by maintaining and expanding green spaces (Devisscher et al., 2019), Goal 13 (Climate Action) by mitigating the urban heat island effect and absorbing carbon emissions (Pandey & Ghosh, 2023), and Goal 15 (Life on Land) by promoting the conservation and sustainable management of urban ecosystems (Monaco, 2024).

Urban parks provide valuable ecosystem services that enhance urban living conditions and are increasingly recognized as nature-based solutions to address environmental challenges in urban areas (Mexia et al., 2018). Among various urban ecosystems, parks contribute essential services such as air and water purification, noise and wind reduction, carbon sequestration, microclimate regulation, wildlife habitat preservation, and enhancement of psychological and social well-being (Chiesura & planning, 2004). Theoretically, this study contributes to a deeper understanding of the concept and role of ecosystem services in the context of urbanization in developing countries, particularly regarding livability and environmental conservation. Practically, this research provides a scientific foundation for the formulation of sustainable urban park management strategies, catering to the increasing demand for green spaces and their associated benefits (Yoong et al., 2017). Thus, the investigation and enhancement of ecosystem services at Tao Dan park are not only scientifically significant but also serve as a basis for policy recommendations aimed at preserving and promoting the park's long-term sustainability. The novelty of this research lies

in its comprehensive assessment of existing ecosystem services at Tao Dan park, alongside an analysis of public willingness to contribute and the proposal of sustainable utilization models based on current socio-economic and environmental trends.

This study focuses on key research objectives, including evaluating community awareness of ecosystem services in urban parks (Stępniewska, 2021), identifying challenges in maintaining and developing these services, and proposing sustainable strategies to enhance the ecological and economic value of the park. According to (Zhang et al., 2021), a clear understanding of public perceptions regarding ecosystem services is crucial not only for improving urban planning and conservation efforts but also for fostering community engagement in ecological preservation. Moreover, this study employs empirical data analysis to investigate interactions between the community and the park (Zhang et al., 2021). Zhang et al. (2021) highlighted that landscape design elements, such as greenery, water features, and recreational areas, significantly impact psychological and social well-being, emphasizing the importance of optimizing park designs to better accommodate community needs. By referencing these studies, this paper establishes a scientific foundation for formulating specific recommendations on the management and development of ecosystem services.

The primary objective of this research is to examine and evaluate public awareness and satisfaction regarding ecosystem services at Tao Dan park. The study aims to identify factors influencing public perception and satisfaction levels, while also analyzing barriers and opportunities for enhancing the park's ecological, social, and cultural significance. The findings of this study not only offer empirical insights into the relationship between the community and urban green spaces but also contribute to the development of effective management strategies for fostering sustainable urban park development. These insights will provide a scientific foundation to support urban planners and policymakers in designing strategies for the conservation and expansion of sustainable green spaces in Ho Chi Minh City and comparable urban environments.

2. RESEARCH APPROACH AND METHODOLOGY

Study subjects and research location

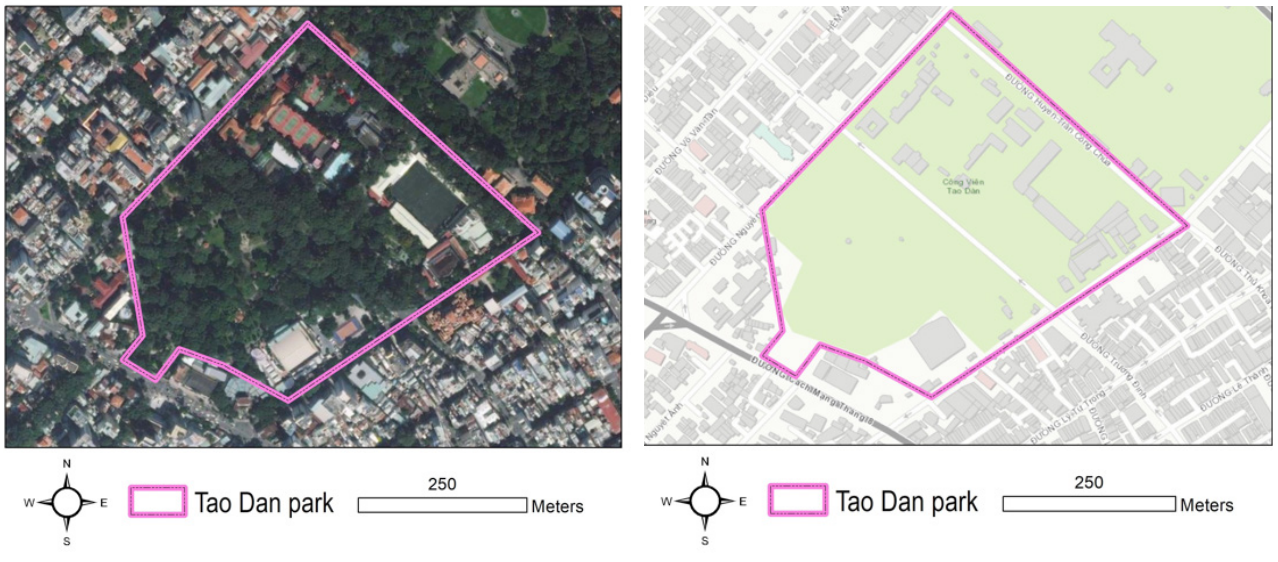
Survey participants: The target respondents of this study are individuals engaging in activities within the park.

Research location: The study was conducted at Tao Dan park, one of the largest and most significant urban parks in District 1, Ho Chi Minh City. The park serves as a key green space, spanning 10 hectares, with over 1,000 trees and a high vegetation density (Tran et al., 2024).

3. RESEARCH METHODOLOGY

Survey on ecosystem services of the park

The questionnaire was structured into four sections: (1) an introductory section outlining the survey objectives and inviting participant engagement, (2) a screening section utilizing a 5-point Likert scale (Tran et al., 2023), (3) a specific question section collecting data on park visit purposes, awareness of ecosystem services, and interest in green spaces, and (4) a concluding section gathering basic demographic information. The survey was conducted in the morning at various locations within Tao Dan park, targeting peak exercise hours to optimize respondent accessibility. Based on the sample size estimation method commonly applied in survey research, with a minimum sample size determined as the number of questions ×5 (Tran et al., 2023), the study successfully collected 240 survey responses, with data recorded through direct interviews.



▲ *Figure 1. Location of Tao Dan park in Ho Chi Minh City.*

Method for assessing public interest in ecosystem services

Descriptive statistics were employed to analyze the collected data, including sample classification based on survey criteria, as well as calculations of mean values, maximum values, and minimum values for responses to the survey questions. The research hypotheses were tested using data obtained from the constructed regression model. The significance of the tests was evaluated through t-statistics and p-value (Sig.), with a confidence level of 95%. The p-value was directly compared to 0.05 to determine whether to accept or reject the research hypotheses (Maneejuk & Yamaka, 2021). To examine differences between subpopulations within the study, T-tests and analysis of variance (ANOVA) were conducted. These statistical tests also relied on the direct comparison of p-values (MacFarland et al., 2016; Mishra et al., 2019).

4. RESULTS AND DISCUSSIONS

Frequency and habits of park visitors at Tao Dan park

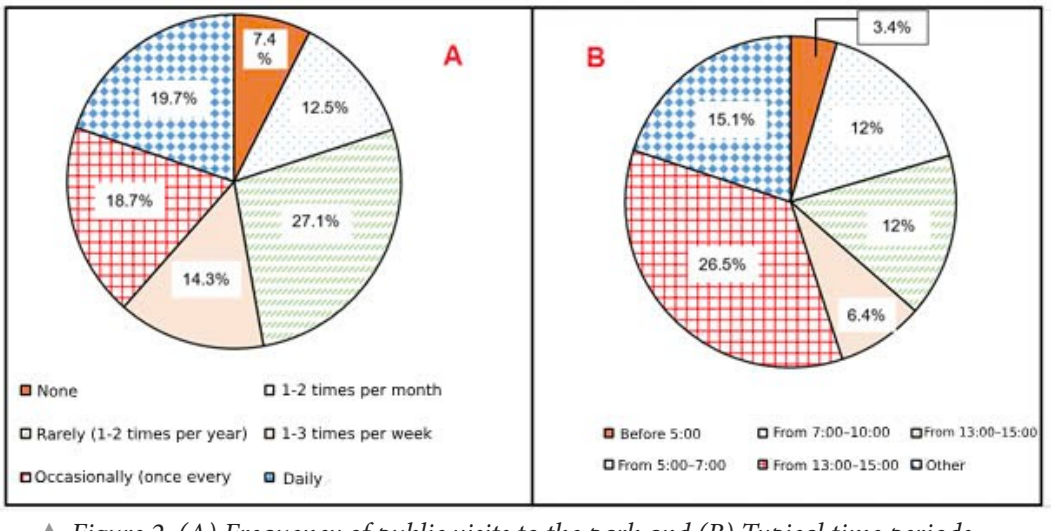
Based on the survey findings presented in Figure 2, the frequency and time frame of visits to Tao Dan park clearly reflect public space utilization patterns. Regarding park visit timing, the majority of respondents preferred the afternoon period from 15:00 to 17:00, likely because this timeframe is suitable for outdoor activities such as exercise, relaxation, or social interactions. While early morning and late morning hours also attracted some visitors, the number of participants was lower. In contrast, noon and pre-5:00 AM periods were the least preferred time slots. These results suggest that the time of day significantly influences park usage, offering insights into optimal survey timing for reaching target respondents.

The survey results indicate that Tao Dan park is a highly accessible public space, catering to the diverse needs of local residents. The majority of respondents reside near the park, with an average travel time ranging from 10 to 20 minutes. This finding underscores the park's significance as a familiar and convenient destination for the surrounding community. Private vehicles, particularly motorcycles, were the most commonly used mode of transportation, while walking and cycling also accounted for a substantial proportion, reflecting the flexibility in park accessibility. In contrast, the use of public transportation was minimal, suggesting the need for improved public transit connectivity to the park.

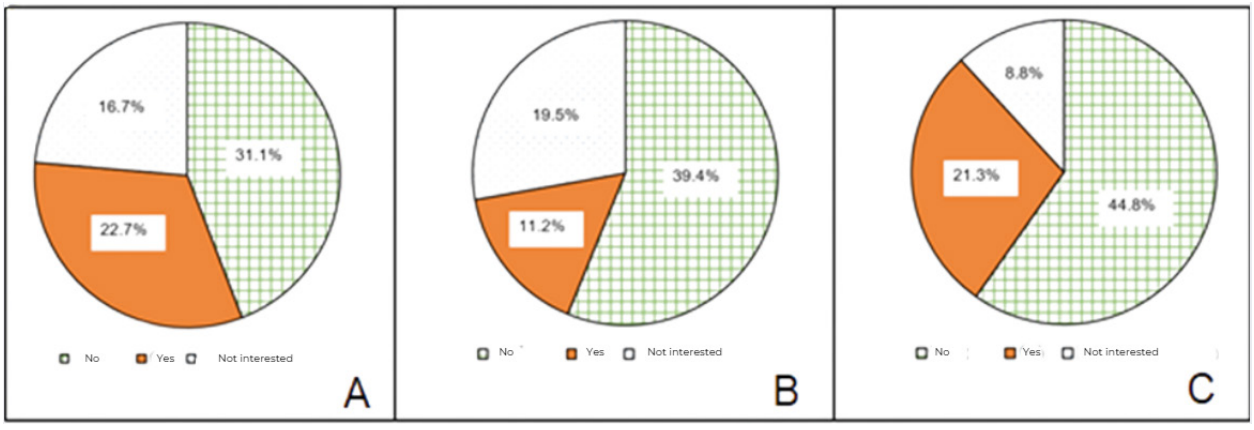
Regarding length of stay, most visitors remained in the park for an extended duration, typically one hour or more, indicating that the park serves not only as a short-term stopover but also as an ideal space for activities such as relaxation, exercise, social interactions and recreation. A small proportion of visitors stayed for less than 30 minutes, potentially due to time constraints or lower park usage needs. The longer stay duration observed among most respondents highlights the park's significant role in enhancing both mental and physical well-being within the community.

Figure 3 illustrates the public's sensitivity to air quality in the park, highlighting the strong correlation between environmental conditions and the frequency of park usage. The results indicate that when the park experiences mild air pollution, the proportion of individuals choosing not to visit exceeds those who continue to use the park, while a small group remains indifferent to the issue. As pollution levels increase to a moderate level, the percentage of non-visitors rises significantly, whereas the number of individuals willing to visit declines sharply. Notably, when air pollution reaches a severe level, the proportion of individuals avoiding the park peaks, underscoring thecommunity's deep concern regarding environmental quality. Simultaneously, the proportion of indifferent individuals decreases to its lowest point, demonstrating widespread public awareness of the critical role of clean air in both recreational experiences and overall health.

These findings are consistent with the study conducted by (Chang & Lee, 2016), in which the authors emphasize that large urban parks not only enhance air quality but also serve as essential habitats for various plant and animal species.



▲ *Figure 2. (A) Frequency of public visits to the park and (B) Typical time periods during which visitors frequent the park*



▲ *Figure 3. Public visitation under different air pollution levels: (A) Mild air pollution, (B) Moderate air pollution, and (C) Severe air pollution*

This further reinforces the notion that green spaces, particularly large parks, contribute not only to microclimate regulation but also to the provision of essential ecosystem services that support and regulate urban life quality. Furthermore, these results align with the conclusions of (Chang & Lee, 2016), who recommend that the design and management of green spaces should incorporate considerations of air quality and public accessibility to maximize the benefits derived from ecosystem services.

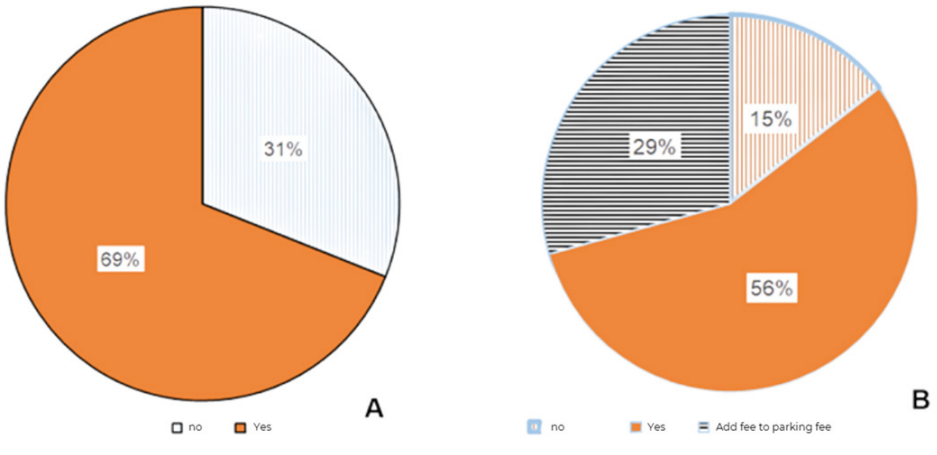
The collected data indicate that air quality is a primary determinant influencing individuals' decisions regarding park usage. This underscores the urgent need to maintain and improve environmental quality within Tao Dan park. The survey results not only provide a comprehensive perspective on how the public interacts with and evaluates the park, but also establish a scientific foundation for formulating sustainable strategies to enhance the value of ecosystem services, ensuring that the park continues to function as a vital "green lung" for the city.

Potential and development orientation of ecosystem services

The data presented in Figure 4 illustrate the current state of public awareness and perspectives on ecosystem services, as well as the willingness to contribute financially to the maintenance and improvement of the park.

The results from Figure 4A indicate that public awareness of ecosystem services at Tao Dan park remains limited. Although 31% of respondents, primarily young individuals, have some understanding of this concept, the majority (69%) still lack a clear perception of the role and significance of ecosystem services. This finding suggests that, despite the increasing availability of information on environmental issues in modern society, the concept of ecosystem services has not yet gained widespread recognition. This reality underscores the necessity of public awareness campaigns, which should not only emphasize environmental aspects but also clarify the social and cultural value of ecosystem services within public spaces such as urban parks.

Additionally, Figure 4B illustrates the public's strong consensus on financial contributions to support the preservation and enhancement of the park. Specifically, 56% of respondents expressed willingness to pay additional fees to support initiatives such as tree maintenance, equipment upgrades, and overall park improvements. This finding reflects the community's sense of responsibility in safeguarding urban green spaces. However, 29% of respondents suggested integrating these fees into parking charges to ensure transparency and convenience, whereas 15% opposed any additional charges, arguing that public funds should be allocated for park maintenance. These diverse perspectives highlight the urgent need for a transparent, rational, and equitable



▲ *Figure 4. (A) Public awareness of ecosystem services; (B) Public agreement on the willingness to pay additional service fees for the park*

management strategy. A well-structured financial policy would not only mobilize community contributions but also enhance public trust, ensuring the efficient allocation of resources for the sustainable development of urban green spaces (Rigolon et al., 2024).

Public satisfaction with the services provided by the park is also evident in Figure 5. The park is highly regarded for its expansive green spaces, which facilitate various outdoor activities, including walking, sports, and relaxation. Notably, its capacity to provide shade, lower ambient temperatures, and improve the microclimate is widely recognized, highlighting its critical role in mitigating the urban heat island effect. The study conducted by (Sarı & Bayraktar, 2023) further emphasizes the significance of park size in influencing the "park cooling island" (PCI) effect, where larger parks with higher vegetation density exhibit superior temperature regulation capabilities.

Beyond its environmental benefits, the park also functions as a dynamic social hub, supporting a wide range of recreational and community activities, from picnics and group gatherings to family interactions, thereby enriching residents' social lives. Additionally, the park serves as an outdoor educational center, fostering greater awareness among younger generations about historical, cultural, and environmental values. These potentials not only reinforce the park's ecological significance but also position it as a key cultural and educational landmark within the urban landscape. Similar findings from (Sarı & Bayraktar, 2023) and (Annerstedt Van Den Bosch et al., 2016) emphasize that large urban parks contribute to increased physical activity and improved psychological and physical well-being.

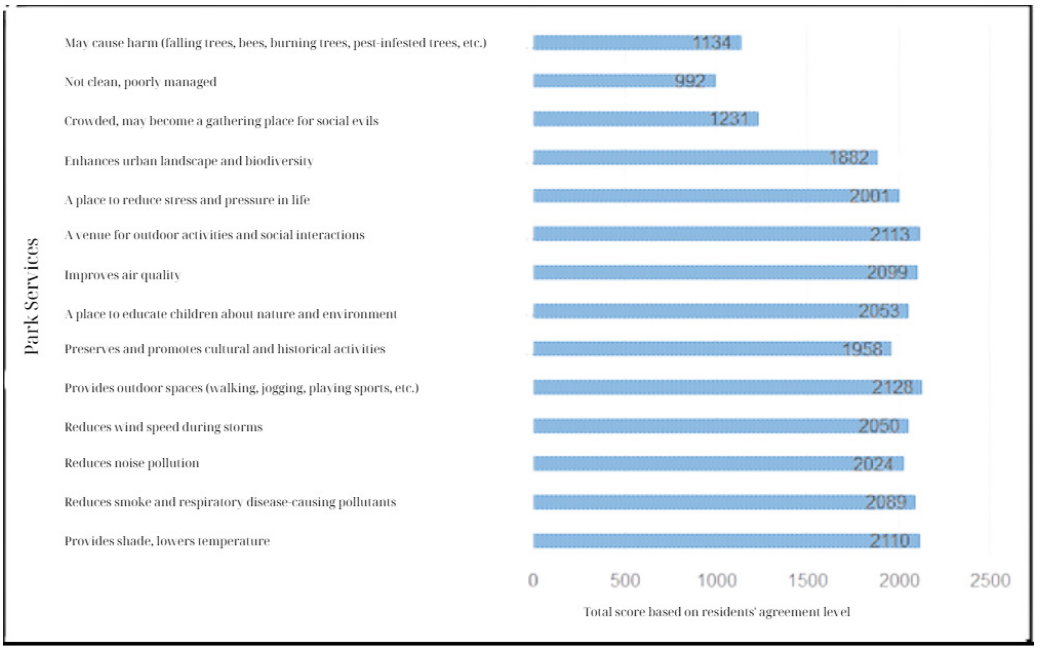
Nevertheless, despite these advantages, the park faces certain risks that require attention. Some residents have reported concerns regarding incidents such as falling trees, bee stings, and the potential for illicit activities in the absence of proper park management. Although these concerns were raised by a relatively small proportion of respondents (approximately 4%–5%), they remain critical issues that must be addressed to ensure that the park remains a safe and sustainable urban space.

The data from Figures 4A, 4B, and 5 provide a comprehensive overview of the current state and potential of the park in delivering ecosystem services. By enhancing public awareness, improving management practices, and promoting its cultural, educational, and social values, the park can continue to serve as a key asset within the urban green space network, provided that existing challenges are addressed through systematic and sustainable solutions.

Challenges and constraints in the development of ecosystem services at Tao Dan park

Tao Dan park is recognized as one of the most significant urban green spaces, playing a crucial role in delivering ecological, social, and cultural benefits. The findings from Figure 6A indicate that the public clearly acknowledges the park's role, considering it the top-priority green space compared to other alternatives, such as residential greenery or zoos. This highlights the park's dual function, not only as a "green lung" that regulates climate and enhances air quality, but also as a provider of essential ecosystem services, including urban cooling, carbon sequestration, and overall improvement of urban community well-being.

However, these ecosystem services are facing major challenges. According to Figure 6B, residents identified environmental pollution (286 responses) and shrinking living spaces (278 responses) due to urbanization as the primary barriers, alongside other factors such as climate change (256 responses). These challenges emphasize the need for more effective management and conservation measures to maintain and enhance the park's essential ecosystem services.



▲ *Figure 5. Public satisfaction with park services.*

The community has also demonstrated a strong sense of responsibility and proposed practical solutions to address these issues. As shown in Figure 6C, a majority of respondents suggested expanding green areas by utilizing rooftop spaces (237 responses) and identifying vacant areas for additional tree planting (311 responses). This underscores the pressing need for increasing green space, not only from a management perspective but also through strong community support. These solutions hold both ecological and social value, reflecting the active role of the public in contributing to sustainable urban development.

Notably, Figure 6D shows that 61% of respondents are willing to pay additional costs to own a home near the park, indicating that ecosystem services provided by the park hold not only environmental value but also economic significance, enhancing real estate value through clean air and health benefits. However, 32% of respondents stated that they would consider additional factors, such as surrounding amenities and transportation connectivity, before making a decision. This underscores that the full value of the park can be optimized when integrated into a comprehensive urban planning strategy.

These findings clearly demonstrate that Tao Dan park is not only crucial in providing ecosystem services but also serves as a core element of sustainable development solutions. However, to fully leverage this potential, more effective management policies and active community participation are required to ensure a balance between urban development and environmental conservation.

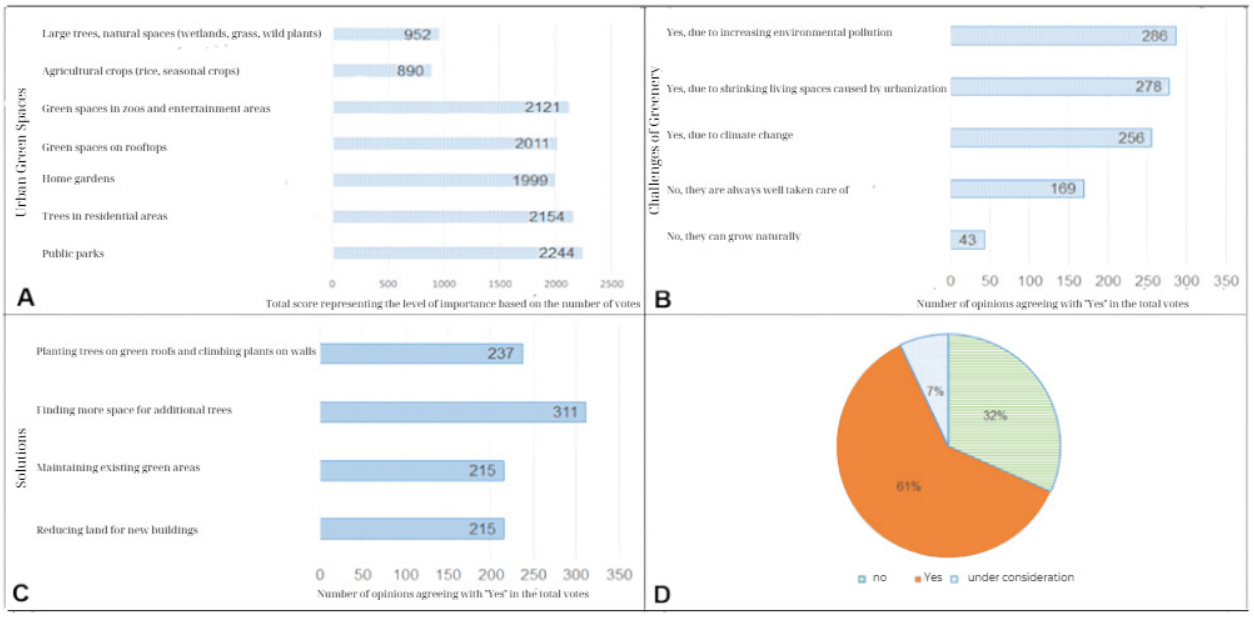
5. CONCLUSION

This study provides a comprehensive analysis of the potential for ecosystem service development at Tao Dan park, encompassing community awareness assessment, impact factor analysis, and the proposal of sustainable solutions. The findings indicate that Tao Dan park serves not only as a critical "green lung" that contributes to air quality improvement, urban temperature reduction, and microclimate regulation, but also as a cultural and social hub, addressing recreational, social, and communal needs. However, public awareness of ecosystem services remains limited, with 69% of surveyed respondents lacking a clear understanding of the concept. This highlights the need for public awareness campaigns and community education programs to enhance understanding of the role and value of ecosystem services.

The existing legal framework, including Decree No. 64/2010/ND-CP on urban green space management and Decision No. 199/2004/QD-UBND issued by the People's Committee of Ho Chi Minh City regarding urban park and tree management, provides a regulatory foundation for the protection and expansion of urban greenery. However, the study reveals that current regulations require modifications and further clarification to better align with practical implementation. Additionally, the Ho Chi Minh City Public Park and Green Space Development Plan (2021-2030) outlines objectives for increasing park areas and urban greenery, but challenges remain in execution, particularly in attracting investment and managing resources effectively.

Based on the findings, the study proposes several key recommendations:

Enhancing public education and communication on ecosystem services through media campaigns,



▲ *Figure 6. Public perspectives on: (A) Awareness of the importance of urban green spaces; (B) Public perception of the relationship between greenery and the environment; (C) Public proposals for urban spaces in response to global climate change; (D) Willingness to pay additional costs for housing near parks.*

workshops, and practical engagement activities, integrating these efforts into the city's green planning strategy.

Developing a transparent, fair, and reasonable fee mechanism, such as incorporating green space usage fees into other service charges (e.g., parking fees or event participation tickets) while ensuring that these revenues are allocated toward park maintenance and quality improvements.

Updating and refining management policies, including establishing clearer urban tree standards within Decree No. 64/2010/ND-CP and Decision No. 199/2004/QD-UBND, to promote effective urban green space planning and conservation.

Encouraging collaboration among government agencies, businesses, and communities to implement smart green park models, integrating urban greenery with public amenities to optimize ecological, economic, and social benefits.

Additionally, this study suggests future research directions focusing on the impact of climate change and environmental pollution on urban ecosystems, leading to the development of integrated models that combine green space planning with smart urban solutions. Such advancements will contribute to the sustainable development goals of Ho Chi Minh City, ensuring not only the protection of Tao Dan park but also the enhancement of urban livability for the entire community.

Acknowledgments: *This research was supported by Nguyen Tat Thanh University, Ho Chi Minh City* ▪

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