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Community Perceptions of Urban Forest Functions in Metropolitan Areas: Evidence from Dukuh City Forest, Jakarta

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ABSTRACT

Purpose of the study: This study aims to evaluate community perceptions regarding the ecological, social, landscape, and aesthetic functions of Dukuh City Forest as an urban green space in a densely populated metropolitan area of Jakarta, Indonesia, and to examine its contribution to sustainable urban environmental management.

Methodology: This study employed a convergent mixed-methods approach integrating quantitative and qualitative techniques. Data were collected through participatory observation, documentation, semi-structured interviews, and Likert-scale questionnaires distributed to 35 respondents selected using random sampling techniques. Quantitative data were analyzed using descriptive statistical and percentage scoring methods, while qualitative data were analyzed thematically and integrated through triangulation.

Main Findings: The findings showed that public perception of Dukuh City Forest functions was categorized as good, with an overall score of 68.91%. The ecological function received the highest score (82.94%), indicating strong public awareness of environmental benefits such as improving air quality, reducing urban heat, and increasing water absorption capacity. In contrast, aesthetic and recreational functions received the lowest scores due to limited public utilization, insufficient environmental outreach, and persistent social stigma associated with the area's previous function as a public cemetery. Limited communication between authorities and communities also affected public participation in urban forest management.

Novelty/Originality of this study: This study strengthens the socio-ecological urban forest approach by integrating ecological and social perspectives in evaluating urban forest functions and linking urban forest management with Sustainable Development Goals (SDGs)-based sustainable urban development.

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1. INTRODUCTION

Rapid urbanization and population growth in metropolitan areas have significantly increased environmental pressures in urban ecosystems worldwide [1], [2]. The expansion of residential areas, transportation infrastructure, and industrial activities continuously reduces the availability of green open spaces in urban environments [3], [4]. As a consequence, many metropolitan cities experience environmental problems

such as increasing urban temperatures, declining air quality, flooding, and reduced ecological balance [5], [6]. Therefore, the existence of urban forests is a crucial element in supporting urban environmental sustainability.

In this regard, urban forests have emerged as a vital element of green infrastructure that contributes to environmental sustainability and enhances the well-being of urban populations [7], [8]. These ecosystems provide a wide range of ecological, social, and economic benefits that support the functioning of modern cities. From an ecological perspective, urban forests help improve air quality, reduce the urban heat island effect, enhance water infiltration, minimize flood risks, and preserve urban biodiversity [9], [10]. In addition to their environmental functions, urban forests offer valuable social benefits by providing spaces for recreation, promoting physical and mental health, and encouraging social interaction among community members [11], [12]. They also play an important role in climate change mitigation through carbon storage and broader environmental conservation efforts [13], [14]. Given these multiple benefits, urban forests are increasingly recognized as a key component of sustainable urban planning and development strategies aimed at creating healthier, more resilient, and environmentally sustainable cities.

Jakarta, as one of the most densely populated metropolitan cities in Southeast Asia, faces serious challenges related to environmental degradation and limited green open spaces [15], [16]. Rapid land conversion and urban expansion have reduced the ecological capacity of the city and increased environmental vulnerability [17], [18]. These conditions emphasize the importance of maintaining and managing urban forests as part of sustainable urban environmental governance. One of the urban forest areas in Jakarta is Dukuh City Forest, located in East Jakarta, which functions as one of the remaining green open spaces within a densely populated settlement area.

The Dukuh City Forest not only serves ecological functions but also has social and environmental importance for surrounding communities. The area provides environmental comfort, improves air circulation, and acts as a water catchment area in the urban landscape. However, the utilization and public appreciation of urban forest functions are influenced by community perceptions, experiences, and social conditions [19], [20]. Public perception plays an important role in determining the effectiveness of urban forest management because community participation and environmental awareness strongly influence the sustainability of urban green spaces [21], [22]. These perceptions influence the level of public utilization and awareness of green spaces. Therefore, understanding public perceptions of urban forests is crucial [20], [23].

The presence of urban forests in densely populated areas can also have a positive impact on public health and well-being [24], [25]. The availability of green spaces can create a more comfortable atmosphere and help reduce stress caused by high urban activity [5], [26]. Furthermore, green spaces can provide a means for people to engage in physical activity and social interaction [27], [28]. The presence of urban forests can also raise public awareness of the importance of preserving the urban environment. Thus, the function of urban forests is not only related to ecological aspects, but also to the social aspects of urban communities.

The gap analysis in this study is based on several previous studies that show that studies on urban forests focus more on ecological aspects than on public perceptions in densely populated areas. Research conducted by Zhang et al., [29] stated that public perception of urban green spaces is influenced by the social and environmental conditions in which people live. Meanwhile, research Zhao et al., [30] explains that urban forests are closely related to spatial experiences and people's preferences for urban green spaces. Another study by Izzati et al., [31] focuses more on public perceptions of urban forest development in riverbank areas, rather than in metropolitan areas with very high population densities. Based on these conditions, there are still limited studies specifically examining public perceptions of the Dukuh City Forest in the Special Capital Region of Jakarta as a green space amidst a dense urban area.

The novelty of this research lies in its socio-ecological approach to understanding urban forest functions within densely populated metropolitan environments. Unlike previous studies that predominantly focused either on ecological performance or community perception separately, this study integrates ecological, social, and environmental governance perspectives in evaluating the role of urban forests in urban sustainability. This research positions Dukuh City Forest not only as ecological infrastructure that supports environmental conservation, climate regulation, and urban resilience, but also as a social space shaped by community perceptions, public participation, historical experiences, and patterns of urban interaction [32], [33]. Furthermore, this study strengthens the socio-ecological urban forest discourse by linking community-based urban forest management with Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land). Through this integrative perspective, the study contributes to the development of more participatory, inclusive, and sustainability-oriented urban forest management frameworks for metropolitan cities.

The scientific contribution of this study lies in expanding the understanding of urban forest management by integrating ecological functions with community perception analysis in a densely populated metropolitan context. Unlike previous studies that mainly focused on ecological performance or urban forest development separately, this research provides empirical evidence regarding how local communities perceive ecological, social, landscape, and aesthetic functions of urban forests within highly urbanized environments. This

study also contributes to the development of participatory urban forestry approaches by highlighting the importance of public awareness, environmental communication, and community engagement in sustaining urban green spaces. Furthermore, the research strengthens the discourse on Sustainable Development Goals (SDGs)-based urban environmental management by demonstrating the relationship between urban forests, environmental quality, and community well-being in metropolitan areas. The findings are expected to provide both theoretical and practical contributions for future urban green space planning and sustainable environmental governance in developing metropolitan cities.

The importance of this study stems from the ongoing reduction of green open spaces in urban areas as a consequence of rapid population growth and continuous urban development. As cities become increasingly dense, the demand for green spaces that enhance environmental quality, provide recreational opportunities, and support residents' well-being continues to rise. Urban communities often have diverse perceptions, expectations, and needs regarding the availability and management of green spaces, particularly in highly populated metropolitan environments [20], [34]. Moreover, the presence of urban green areas plays a significant role in improving environmental comfort, promoting public health, and enhancing the overall quality of life of city residents. Given these conditions, investigating public perceptions of the Dukuh City Forest is essential for supporting the sustainable management and development of urban green spaces in densely populated areas. This study aims to examine the existence and role of the Dukuh City Forest in the Special Capital Region of Jakarta and to explore how local residents perceive its functions and benefits within a highly urbanized setting. By understanding the interactions between the community and the urban forest, the research seeks to provide valuable insights into the social significance of urban green spaces in everyday life. The findings are expected to contribute to future urban planning and green space management strategies, ensuring that the Dukuh City Forest continues to deliver ecological, social, and environmental benefits for both the city and its residents.

2. RESEARCH METHOD

2.1. Study Area

This study was conducted in Dukuh City Forest, located in Dukuh Urban Village, Kramat Jati District, East Jakarta, Indonesia. The study area is situated within a densely populated metropolitan environment characterized by intensive residential development and limited green open spaces. Dukuh City Forest functions as one of the remaining urban green infrastructures that supports environmental quality and ecological balance in the surrounding settlement areas. The urban forest area is managed by the Maritime Affairs, Agriculture, and Food Security Sub-Department of the East Jakarta City Administration.

2.2. Type of Research

This study employed a convergent mixed-methods design integrating quantitative and qualitative approaches to obtain a comprehensive understanding of community perceptions regarding the functions of urban forests [35], [36]. In the convergent design, quantitative data from questionnaires and qualitative data from observations and semi-structured interviews were collected simultaneously during the same research phase, analyzed separately, and then integrated during the interpretation stage to strengthen the overall findings. The quantitative approach was used to measure the level of community perceptions, while the qualitative approach explored deeper experiences, social conditions, and environmental contexts related to Dukuh City Forest [37], [38].

After separate analyses were conducted, both datasets were integrated using triangulation and side-by-side comparison techniques. Quantitative findings were compared and interpreted together with qualitative interview results and field observations to identify areas of convergence, complementarity, and divergence between the two datasets. This integration process enabled the researchers to validate statistical findings using qualitative evidence and to provide a broader interpretation of community perceptions regarding the ecological, social, and aesthetic functions of Dukuh City Forest. The convergent mixed-methods procedure used in this study is illustrated in Figure 1.

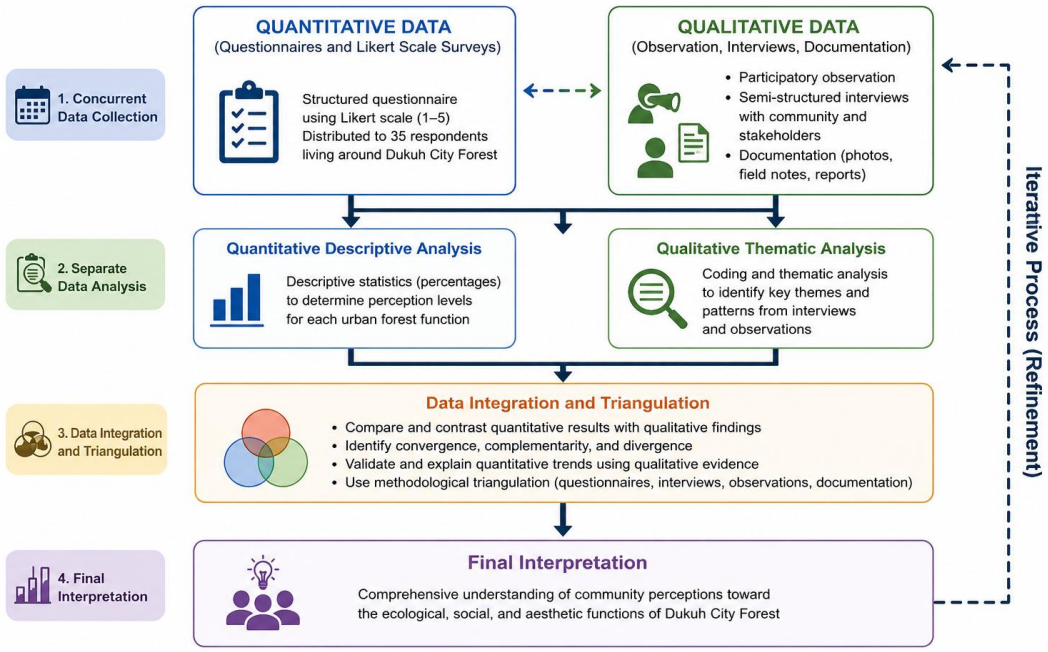

Figure 1. Convergent Mixed-Methods Design

2.3. Data Collection Techniques

Data were collected using multiple methods, including observation, documentation, interviews, and questionnaires [39], [40]. The combination of these techniques was intended to generate comprehensive and in-depth information regarding community perceptions of the presence and role of the Dukuh City Forest within a densely populated urban environment. Each data collection method was selected based on the specific type of information required and its relevance to the research objectives [41], [42]. Observations provided direct insights into the physical condition and utilization of the urban forest, while interviews and questionnaires captured residents' perceptions, experiences, and opinions regarding its functions and benefits. Documentation was used to supplement and verify information obtained from other sources. By integrating these diverse methods, the study was able to obtain both quantitative and qualitative data, thereby enabling a more comprehensive analysis of community perceptions and the significance of the Dukuh City Forest in urban life.

The research instruments employed in this study consisted of questionnaires, interview guides, observation sheets, and documentation records. The questionnaire was designed using a five-point Likert scale ranging from strongly disagree to strongly agree to assess community perceptions of the functions and benefits of the urban forest. The questionnaire items were organized into several dimensions, including the ecological, social, landscape, and aesthetic aspects of urban forests. This instrument enabled the researchers to quantitatively measure residents' views regarding the contribution of the Dukuh City Forest to the urban environment and community well-being.

In addition, semi-structured interview guides were utilized to obtain more detailed information about respondents' experiences, perceptions, environmental awareness, and social interactions associated with the Dukuh City Forest. Observation sheets were used to systematically document environmental conditions, patterns of urban forest utilization, and various community activities occurring within the forest area. Furthermore, documentation records were collected to support and validate the information obtained through observations, interviews, and questionnaires. The use of multiple instruments allowed the researchers to gather both quantitative and qualitative data, providing a more comprehensive understanding of community perceptions and the role of the Dukuh City Forest in a densely populated urban setting.

2.2.1. Participatory Observation

Participatory observation was conducted by directly involving the researcher in the activities of the community being studied [43], [44]. Through this technique, the researcher not only observed but also participated in the activities of the community around the Dukuh City Forest area. The observations used in this study were non-systematic, meaning they were conducted without the use of specific observation instruments. This technique aimed to obtain a realistic picture of the environmental conditions and community activities in the research area. Through participatory observation, the researcher was able to gain a deeper understanding of the social situation [45], [46].

2.2.2. Documentation

Documentation is used as a data collection technique in the form of notes, archives, photographs, and other documents related to the research. The collected documents can be written data, images, or supporting information regarding the Dukuh City Forest. Documentation techniques complement data from observations, interviews, and questionnaires [47], [48]. Furthermore, documentation also helps researchers strengthen research data through written and visual evidence. This ensures that the data obtained is more accurate and accountable.

2.2.3. Interview

The interviews in this study were conducted in an unstructured manner using general guidelines in the form of a question outline. The interview technique was used to obtain information directly from informants regarding their views and experiences regarding the existence of urban forests. During the interview process, researchers were able to develop questions based on the informants' answers, thus gaining more in-depth information [49], [50]. This technique allowed researchers to understand community perceptions more broadly and in more detail. Therefore, interviews are an important technique in supporting qualitative research data.

2.2.4. Questionnaire or Survey

A questionnaire is a data collection technique that involves providing respondents with a series of written questions to answer [51], [52]. The questionnaire in this study used a closed-ended format, allowing respondents to select only from the provided answers. The questionnaire was administered to residents living around the Dukuh City Forest area in East Jakarta. Community perceptions of the city forest's function were measured using a Likert scale with five assessment categories: strongly disagree, disagree, undecided, agree, and strongly agree.

Furthermore, a rating scale was used to measure the quality and frequency of community activities regarding the city forest. The quality assessment consisted of the categories: very bad, bad, undecided, good, and very good. Meanwhile, the frequency assessment consisted of the categories: never, rarely, undecided, often, and very often. Each answer was assigned a score to facilitate quantitative data analysis. The highest score was given to the most positive answer, while the lowest score was given to the most negative answer. Assessment categories were determined based on the percentage of scores obtained from respondents' answers. The assessment categories used in this study were:

Table 1. Assessment Criteria

No.	Category	Rating
1.	81% - 100%	Excellent
2.	61% - 80%	Good
3.	41% - 60%	Fair
4.	21% - 40%	Poor
5.	0% - 20%	Very Poor

The percentage calculation was performed by determining the expected value, calculating the score, and then determining the outcome categories based on the percentage formula used in the study. This method allows for a more systematic and measurable analysis of the public's perception of the Dukuh City Forest.

2.4. Population and Sample

The population refers to the complete group of individuals or subjects that share characteristics relevant to the objectives of a study [53]. It serves as the primary source of research data, providing the basis for obtaining information that reflects the characteristics of the group being investigated. In this research, the population consisted of all residents living within Neighborhood Association 01 and Community Association 02 of Dukuh Village, East Jakarta. A total of 348 residents were included in the study population. This population was selected because the Dukuh City Forest is located within the area, making the local community directly connected to and potentially influenced by the existence and functions of the urban forest. As a result, the residents were considered the most appropriate group for providing information regarding perceptions and experiences related to the Dukuh City Forest.

A sample represents a subset of the population selected to reflect the characteristics of the larger group being studied. In this research, a random sampling technique was employed, allowing respondents to be selected randomly without considering specific strata or categories within the population [54], [55]. This approach ensured that all members of the population had an equal chance of being included in the study, thereby reducing selection bias and enhancing the representativeness of the sample. The respondents were selected from residents of Neighborhood Association 01 and Community Association 02 in Dukuh Village, East Jakarta, where the Dukuh City Forest is located. These residents were considered appropriate participants because of their proximity to and interaction with the urban forest. A total of 35 individuals were included in the sample,

representing approximately 10% of the overall population. This sample size was considered sufficient to provide meaningful insights into community perceptions of the functions and benefits of the Dukuh City Forest within the local urban environment.

The sample size was determined based on the consideration that if the population is large enough, a sample size of between 10% and 25% of the total population can be taken. With this number of respondents, the study is expected to provide a representative picture of the community's perception of the Dukuh City Forest. Furthermore, the use of random sampling techniques is also expected to reduce the possibility of bias in the study. The selected sample is considered to be able to represent the conditions of the community surrounding the city forest area. Therefore, data obtained from respondents can be used to support more accurate research analysis.

The respondents in this study consisted of community members living around Dukuh City Forest, Kramat Jati District, East Jakarta. Respondent characteristics were analyzed descriptively to provide an overview of the demographic background of the participants involved in the study. The characteristics included gender, age, educational background, occupation, and length of residence in the surrounding urban forest area. Understanding respondent characteristics was important to support the interpretation of community perceptions regarding ecological, social, landscape, and aesthetic functions of the urban forest.

2.5. Instrument Validity and Reliability

Before the data collection process began, the questionnaire instrument underwent validity and reliability testing to ensure its accuracy and consistency. Instrument validity was assessed through content validity, involving expert evaluation, as well as empirical validity testing using the Pearson Product Moment correlation technique. The validity assessment was conducted to determine whether each questionnaire item effectively measured community perceptions of urban forest functions. Items with correlation coefficients exceeding the established critical value were considered valid and retained for use in the study. To evaluate the consistency of the instrument, reliability testing was performed using Cronbach's Alpha coefficient. A Cronbach's Alpha value above 0.70 was considered indicative of satisfactory internal consistency, demonstrating that the questionnaire reliably measured respondents' perceptions across its various items. The outcomes of both the validity and reliability assessments confirmed that the instrument met the required standards for research use and could be relied upon to collect accurate and dependable data regarding community perceptions of the Dukuh City Forest.

2.6. Data Processing Techniques

Data processing techniques are implemented after all research data has been successfully collected from the field. This process aims to facilitate researchers in compiling, analyzing, and interpreting the data obtained during the study. Data processing is carried out systematically so that research results can be presented more accurately and structured. The data processing stages in this study include editing, coding, and tabulation. Each stage plays a crucial role in supporting the research data analysis process [56], [57].

Editing is the process of re-examining data obtained from respondents and from field observations. This stage is carried out to ensure that the collected data is complete, clear, and meets the research needs. Through the editing process, researchers can identify errors, deficiencies, or inconsistencies before further analysis. This activity is crucial because data obtained in the field does not always align with researchers' expectations. Thus, the editing process helps improve the quality and accuracy of research data.

Coding is the process of grouping or classifying respondents' answers into specific categories [58]. At this stage, each answer is assigned a numeric code to facilitate data processing and analysis. Coding is done systematically to facilitate data identification. Coding techniques also assist researchers in organizing data based on predetermined categories. The coding process allows research data to become more structured and ready for quantitative analysis.

Tabulation is the process of entering data into tables according to research categories and variables. This stage is carried out to systematically organize the data, making it easier for researchers to see the number, frequency, and distribution of respondents' responses. Furthermore, tabulation helps researchers calculate the data obtained from the research. The tabulated data is then used as the basis for analysis and drawing conclusions. Thus, the tabulation process can provide a clearer picture of the research results.

2.7. Data Analysis Techniques

The data analysis technique used was qualitative descriptive. Qualitative descriptive is used to analyze non-parametric data into a frequency distribution table [59], [60]. This table will be used to draw conclusions about public perceptions of the function of urban forests in densely populated areas. This will be processed using a scoring technique. In this case, the author used the following formula:

$$P = F/N \times 100\% \quad ... (1)$$

The perception score for each variable was calculated by comparing the total actual score obtained from respondents with the maximum possible score for each sub-variable. The maximum possible score was determined based on the number of questionnaire items, the highest Likert scale value, and the total number of respondents. The percentage score was calculated using the following formula:

$$\text{Percentage Score} = (\text{Total Actual Score} / \text{Maximum Possible Score}) \times 100\% \quad \ldots (2)$$

For example, the sub-variable "Public Knowledge Regarding the Function of Urban Forests" consisted of 7 questionnaire items measured using a 5-point Likert scale with 35 respondents. The maximum possible score was calculated as:

$$\text{Maximum Possible Score} = \text{Number of Items} \times \text{Highest Likert Score} \times \text{Number of Respondents} \quad \ldots (3)$$
$$= 7 \times 5 \times 35$$
$$= 1225$$

The total actual score obtained from respondents for this sub-variable was 743. Therefore, the percentage score was calculated as follows: (743 / 1225) × 100% = 60.65%. This percentage value was then interpreted based on the predetermined assessment criteria to determine the category of community perception. The percentage criteria used are detailed as follows:

Table 2. Percentage Assessment Criteria

Presentation	Criteria
100	All
75 – 99	Most
51 – 74	> Half
50	Half
25 – 49	< Half
1 – 24	Small Part
0	None

In the final stage of analysis, quantitative and qualitative findings were integrated using a triangulation approach to examine the consistency and complementarity of the results. The triangulation process was conducted by comparing questionnaire findings with interview results, observational data, and documentation to strengthen the validity and interpretation of the research findings. Areas of convergence between datasets were identified to confirm dominant community perceptions, while discrepancies between quantitative and qualitative findings were interpreted to provide deeper socio-ecological explanations regarding urban forest utilization and community behavior. This integration process strengthened the credibility of the mixed-methods approach and enabled a more holistic interpretation of urban forest functions within metropolitan environments.

2.8. Research Procedures

The research procedure was carried out through several stages, namely preparation, data collection, data processing, data analysis, and drawing conclusions. The preparation stage included problem identification, literature review, and the preparation of research instruments [61], [62]. The data collection stage was carried out through observation, interviews, documentation, and the distribution of questionnaires to the community around Dukuh City Forest. The data obtained were then processed through editing, coding, and tabulation before being analyzed descriptively qualitatively and quantitatively using percentage techniques. The final stage of the research was carried out by drawing conclusions based on the results of the data analysis that had been obtained. The flowchart of this research procedure can be seen in the following Figure 2.

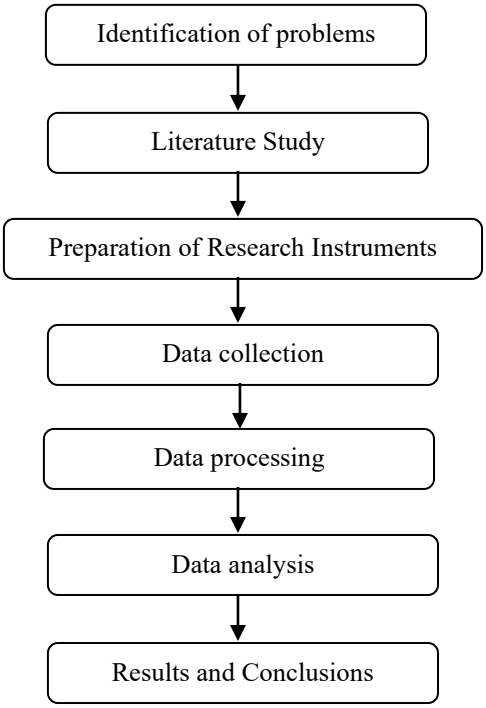

Figure 2. Research Procedure

3. RESULTS AND DISCUSSION

3.1. Community Perceptions of Urban Forest Functions

The results of the questionnaire distribution scores that the researcher has conducted can be seen in the Table 3.

Table 3. Scores per Sub-Variable

Variables	Sub Variables	Number of Items	Score
Public Perception of the Function of Urban Forests in Densely Built Environments	Public Knowledge Regarding the Function of Urban Forests	7	743
	Landscape	11	1195
Functions of Urban Forests	Environmental Conservation	15	2177
	Aesthetics	2	107
Amount		35	4222

After knowing the number and score of each item in each variable and sub-variable, to assess the average score of the research, it can be seen in Table 4.

Table 4. Average Research Score Value

Sub-variables	Score	Expected Value	Score Value	X 100%	Value Category
Public Knowledge Regarding the Function of Urban Forests	743	7 x 5 = 35	743 : 35 = 21.22	60.62%	Fair
Landscaping	1195	11 x 5 = 55	1195 : 35 = 34.11	62.07%	Good
Environmental Conservation	2177	15 x 5 = 75	2177 : 35 = 62.2	82.94%	Very Good
Aesthetics	107	2 x 5 = 10	107 : 35 = 3.05	30.5%	Not Good
Average	4222	35 x 5 = 175	4222 : 35 = 120.6	68.91%	Good

The results of this study indicate that community perceptions regarding the functions of Dukuh City Forest were generally categorized as good. Based on the questionnaire analysis, the overall perception score reached 68.91%, demonstrating that the urban forest is positively perceived by the surrounding community as an important component of urban green open space. The findings suggest that respondents recognized the ecological and social benefits provided by the urban forest within the densely populated metropolitan

environment. The assessment of community perceptions was divided into several functional aspects, including environmental conservation, social function, landscape function, and aesthetic function. Among these aspects, environmental conservation obtained the highest score, while the aesthetic aspect received the lowest evaluation from respondents.

The environmental conservation aspect obtained the highest perception score of 82.94%, categorized as very good. Most respondents agreed that Dukuh City Forest contributes significantly to improving environmental quality in the surrounding urban area. Respondents perceived that the urban forest helps reduce air pollution, provides cooler temperatures, and functions as a water catchment area that may help minimize flooding during the rainy season. The findings also revealed that respondents recognized the importance of urban forests in maintaining ecological balance within metropolitan areas characterized by high population density and intensive land use change. Several respondents stated that the presence of trees and vegetation in the urban forest creates a more comfortable and healthier environment for nearby residents.

The social function aspect obtained a perception score categorized as good. Respondents considered that Dukuh City Forest provides opportunities for community interaction and recreational activities. The urban forest was also perceived as a place for relaxation and informal social gatherings among local residents. However, field observations indicated that the utilization of the urban forest for social and recreational activities remains relatively limited. Some respondents mentioned that public activities within the urban forest are still infrequent due to limited supporting facilities and a lack of organized community programs related to environmental education and public recreation.

The landscape function of Dukuh City Forest was positively perceived by respondents because the presence of green vegetation improves the visual quality of the surrounding settlement environment. Respondents agreed that the urban forest contributes to creating a greener and more environmentally friendly urban landscape amid densely populated residential areas. In addition, the urban forest was perceived as an important environmental buffer that helps reduce the negative visual impacts of urban development. The existence of green open space within the metropolitan area also provides environmental comfort and contributes to the aesthetic value of the urban environment.

The aesthetic aspect obtained the lowest perception score, reaching only 30.5%, which was categorized as poor. The low score indicates that the aesthetic and recreational potential of Dukuh City Forest has not been fully optimized. Several respondents stated that the urban forest area is still rarely visited for recreational purposes and lacks attractive public facilities that could increase community interest in utilizing the space. Interviews with local residents revealed that historical social stigma associated with the previous condition of the area continues to influence public perceptions of the urban forest. In addition, limited environmental communication and promotional activities from local authorities contribute to low public awareness regarding the aesthetic and recreational potential of the urban forest.

The stronger community appreciation of ecological functions compared to aesthetic functions indicates that residents in densely populated metropolitan environments tend to prioritize the direct environmental benefits of urban forests over recreational or visual values. Urban communities living in areas with high environmental pressure are more likely to perceive green spaces as essential ecological infrastructure that improves air quality, reduces heat, minimizes flooding risks, and creates environmental comfort in daily life. These practical environmental benefits are experienced more directly by residents, thereby strengthening ecological awareness and shaping positive perceptions toward the conservation functions of urban forests.

In contrast, the relatively low appreciation of aesthetic and recreational functions demonstrates how urban stigma and historical perceptions can influence ecological behavior and patterns of public space utilization. The previous identity of Dukuh City Forest as a former public cemetery has created a lingering social stigma that affects residents' emotional attachment and willingness to interact with the urban forest area. This condition reflects the socio-ecological complexity of urban green space management, where community behavior toward environmental spaces is influenced not only by ecological quality but also by collective memory, cultural perceptions, and social experiences. As a result, despite recognizing the ecological importance of the urban forest, some residents still avoid using the area for recreation or social activities. These findings indicate that successful urban forest management requires not only ecological restoration but also social transformation through environmental communication, public engagement, and community-based place identity development.

3.2. Community Participation in Urban Forest Management

Based on the results of interviews with the Dukuh Urban Village represented by Mr. MA as the Section of Cleanliness and Environment, Mr. Su as the Secretary of Neighborhood Association 02, and Mr. Sa as the Head of Neighborhood Association 01 of Neighborhood Association 02 of Dukuh Urban Village, information was obtained regarding the existence of the Dukuh City Forest in East Jakarta. The Dukuh City Forest is one of the green open spaces in the form of a city forest located in the Dukuh Urban Village area, Kramat Jati District, East Jakarta. According to the explanation from Mr. Sa:

> *"Dukuh City Forest was once a land recognized by various parties, but no one could prove legal ownership of the land because it was a waqf (endowment) land. Before being developed into a city forest, the land was nearly used as a temporary waste disposal site by the sub-district office, but residents refused due to concerns about its potential negative environmental impacts. Ultimately, the former public cemetery was developed into a city forest by the Maritime Affairs and Agriculture Agency of the Special Capital Region of Jakarta Province."*

A similar opinion was also expressed by Mr. Su who explained that:

> *"Before becoming the city forest it is today, the land was a former public cemetery for local residents and was designated as waqf land. The Dukuh City Forest was only built about two years ago, and its construction was hampered by a corruption case involving the relevant parties."*

Based on the interviews, it was discovered that the Dukuh City Forest area was previously a public cemetery with waqf land status, and its development had encountered administrative obstacles.

The Dukuh City Forest is considered to play a vital role in improving the environmental quality of the surrounding community, although its utilization has not been optimal. According to Mr. Sa:

> "*Many residents of Rukun Warga 02 rarely visit the Dukuh City Forest because they know that the location was previously a public cemetery, so the city forest tends to be left untouched by the community*."

This statement indicates that there is still a public stigma surrounding the historical use of the Dukuh City Forest, which affects the area's utilization rate.

Although it has not been fully utilized by the community, the Dukuh City Forest continues to provide benefits to the surrounding environment. According to Mr. Su:

> *"The existence of the Dukuh City Forest can beautify the Rukun Warga 02 area, especially since the area is well maintained by the Maritime Affairs, Agriculture, and Food Security Sub-Department of the East Jakarta City Administration."* In addition, Mr. Sarmada also said that *"The Dukuh City Forest has a positive impact on the environment, such as making the air fresher and functioning as a water catchment area."*

Based on these two opinions, it can be concluded that the Dukuh City Forest has a significant ecological function for the urban environment. Regarding the management and preservation of the Dukuh City Forest, the local community is considered to be less actively involved. Mr. Sa stated that:

> *"Maintenance of the Dukuh City Forest is carried out by the Maritime Affairs, Agriculture, and Food Security Sub-Department of the East Jakarta City Administration, while local residents are rarely directly involved in maintenance activities."*

Meanwhile, Mr. MA explained that:

> *"Tree planting activities were carried out by Thamrin University students together with the Mayor of East Jakarta to increase vegetation and beautify the Dukuh City Forest area."*

In addition, Mr. Su also added that:

> "*The management of Dukuh City Forest is quite good because it provides various facilities that can be used for sports and recreation*."

From the results of the interview, it can be concluded that the management of Dukuh City Forest has been running well, but communication between the management and the surrounding community still needs to be improved.

Another problem identified relates to a lack of coordination between the government and the community regarding the management of Dukuh City Forest. According to Mr. Su:

> *"The fundamental problem that occurred was the lack of communication between the management of Rukun Warga 02 and the Provincial Government of the Special Capital Region of Jakarta regarding the management of the Dukuh City Forest, even though the area is within the Rukun Warga 02 area."*

Furthermore, the lack of public awareness regarding the functions and benefits of the Dukuh City Forest is also a barrier to increasing community participation. Mr. MA stated that:

> "*So far, there has never been any outreach or outreach regarding the Dukuh City Forest because this falls under the authority of the Maritime Affairs, Agriculture, and Food Security Sub-Department of the East Jakarta City Administration*."

This opinion is strengthened by Mr. Sa statement that:

> "*There has never been any outreach regarding the function of the Dukuh City Forest from the Jakarta Special Capital Region Government, even though such outreach is important to encourage the public to utilize the city forest area for recreation and sports*."

Based on the overall interview results, it can be concluded that the Dukuh City Forest has a positive ecological function for the surrounding environment, such as improving air quality, acting as a water catchment area, and enhancing urban environmental quality. However, the community's utilization of the Dukuh City Forest's social and recreational functions is still suboptimal. This condition is influenced by a lack of government outreach and the public stigma surrounding the area, which was previously a public cemetery. Therefore, improved communication and outreach to the community are needed to maximize the use of the Dukuh City Forest.

The results of interviews and observations showed that community participation in urban forest management remains relatively limited. Most environmental management activities are still dominated by government institutions, while direct involvement of local residents in conservation and maintenance programs is relatively low. Several respondents expressed interest in participating in environmental activities if more community-based programs, educational activities, and public campaigns were organized regularly. This finding indicates that strengthening participatory environmental governance may improve community engagement and increase the social value of urban forests in metropolitan areas.

The existence of the Dukuh City Forest demonstrates that green open spaces play a crucial role in maintaining environmental quality in densely populated urban areas. The public's positive perception of the city forest's function demonstrates that they recognize the importance of green spaces as part of a healthy urban environment [20], [63]. Urban forests serve not only as ecological elements but also as a supporter of environmental sustainability in metropolitan areas like Jakarta. This condition aligns with Sustainable Development Goals point 11, namely Sustainable Cities and Communities, which emphasizes the importance of providing safe, inclusive, and sustainable green public spaces for urban communities. The Dukuh City Forest is one form of implementation of sustainable urban development through the provision of green open spaces amidst high population density.

The environmental preservation function received the highest rating compared to other sub-variables, indicating that the community directly experiences the ecological benefits of urban forests. This function is evident in the city's ability to maintain air quality, increase water absorption, reduce the potential for flooding, and create a cooler environment. Vegetation in urban forest areas can help lower urban temperatures and improve ecological balance [63], [64]. This supports Sustainable Development Goals point 13, Climate Action, as urban forests can be a means of mitigating climate change in urban areas. Furthermore, this ecological function is also related to point 15, Life on Land, through efforts to maintain the sustainability of vegetation and the habitats of flora and fauna in urban areas.

Despite the strong ecological function, research results indicate that the aesthetic aspect is still not optimally utilized by the surrounding community. The low rating for aesthetics indicates that the city forest is not fully viewed as a social and recreational space for the community. This is influenced by the public stigma surrounding the area's history as a public cemetery. This situation has led some residents to remain reluctant to use the city forest area for social or recreational activities [65], [66]. In fact, urban green spaces play a crucial role in improving the physical and mental health of the community, as stated in Sustainable Development Goals

point 3, "Good Health and Well-being." Therefore, optimizing the social and aesthetic functions of urban forests needs to be enhanced so that their benefits can be more widely enjoyed by the community.

Urban forest management in various countries demonstrates different approaches according to the social, economic, and environmental characteristics of each city. In developing countries like Indonesia, the main challenges in managing green open spaces are generally related to high population growth, land conversion, and limited green space in metropolitan areas. This situation is similar to several large cities in Malaysia, which are also facing high urbanization pressures, prompting the government to develop a sustainability-based urban green space concept to improve environmental quality and public welfare [67], [68]. Meanwhile, European countries like Slovakia emphasize ecologically based urban forest management and community participation through integrated urban planning with environmental conservation [69], [70]. These differences in approach demonstrate that urban forests function not only as ecological elements but also as an essential part of sustainable urban development. Therefore, the management of Dukuh City Forest can be developed through a combination of ecological, social, and participatory approaches to address the challenges of densely populated metropolitan areas in the future.

The lack of outreach and communication between the government and the community is one factor contributing to the low level of public participation in the use and management of the Dukuh City Forest. This lack of education regarding the functions and benefits of urban forests has resulted in the community lacking a comprehensive understanding of the importance of maintaining and sustainably utilizing green spaces [20], [71]. This situation demonstrates that urban forest management requires not only physical development but also a social approach through education and community empowerment. This relates to Sustainable Development Goals point 17, "Partnerships for the Goals," which emphasizes the importance of collaboration between the government, the community, and various stakeholders in supporting sustainable development [72], [73]. Effective collaboration can enhance the community's sense of ownership of the urban forest, thereby increasing participation in preserving it.

The local government's management of the Dukuh City Forest has demonstrated its efforts to maintain the quality of the urban environment through the provision of facilities and vegetation maintenance. The presence of sports and recreational facilities demonstrates that the city forest not only functions ecologically but also has a social function for the surrounding community. However, the utilization of these facilities remains suboptimal due to limited community interaction with the city forest area. Therefore, programs are needed to increase community involvement, such as joint reforestation activities, environmental education, and community-based recreational activities. These efforts can support the creation of a more inclusive, healthy, and sustainable urban environment in accordance with the concept of sustainable development within the Sustainable Development Goals.

The results of this study are supported by various recent studies showing that urban green spaces play a significant role in improving environmental quality and the well-being of urban communities. Research by Haq et al., [20] explains that public perception of urban green spaces is closely related to the ecological, social, and health benefits directly experienced by urban residents. Furthermore, Zhang et al., [29] state that green spaces can support urban sustainability by improving environmental quality and the comfort of urban residents. Research by Giannico et al., [74] also found that the presence of urban green spaces has a positive effect on people's perceptions of quality of life, especially in cities with high levels of density and environmental pressure. These findings strengthen the results of this study that the Dukuh City Forest has important ecological and social functions in supporting environmental quality and comfort of residents in densely populated metropolitan areas.

The findings of this study demonstrate that urban forests play an important role in supporting sustainable urban development in densely populated metropolitan environments. The ecological functions of Dukuh City Forest contribute to environmental conservation, urban climate regulation, and improvement of environmental quality. Meanwhile, the social and landscape functions support community well-being and environmental comfort. However, the relatively low perception of aesthetic and recreational functions indicates that urban forest management should not only focus on ecological conservation but also prioritize community accessibility, environmental education, and public engagement. Improving the multifunctional role of urban forests may strengthen their contribution toward Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).

From a theoretical perspective, the findings of this study have important implications for urban planning policy, particularly in the management and development of green open spaces in densely populated metropolitan areas. The positive public perception toward the ecological functions of Dukuh City Forest indicates that urban forests should be integrated as essential components of sustainable urban infrastructure within city spatial planning policies. Urban planning authorities need to prioritize the preservation and expansion of urban green spaces to improve environmental quality, reduce urban heat, strengthen flood mitigation capacity, and enhance public well-being. Furthermore, the relatively low perception of aesthetic and recreational functions suggests the need for more inclusive planning policies that incorporate community participation, environmental education programs, and accessible public facilities within urban forest areas. The findings also imply that effective urban

forest governance requires stronger collaboration between local governments, communities, and environmental institutions to ensure sustainable and participatory management of urban green infrastructure in metropolitan cities.

This research contributes to the development of urban forest management concepts that are not only ecologically oriented but also consider the perceptions and social needs of urban communities. The research results can serve as a basis for local governments in designing more inclusive and sustainable green open space policies in densely populated metropolitan areas [75], [76]. Furthermore, this research has the potential to raise public awareness of the importance of maintaining urban forests as part of climate change mitigation efforts and improving the quality of life for urban communities. In an academic context, this research expands the study of the relationship between urban forestry, public perception, and sustainable urban development based on the Sustainable Development Goals.

This study has several limitations that should be considered when interpreting the results. First, the study was conducted in only one urban forest area, thus not being able to comprehensively describe the condition of urban forests in other metropolitan areas. Second, the study focused more on community perceptions without supporting biophysical environmental measurements such as air pollution levels, humidity, or micro-temperature changes in the urban forest area. Furthermore, the relatively limited number of respondents allows for variations in community perceptions that are not fully represented. Therefore, the results of this study still require further development through a multidisciplinary approach and a broader research area.

4. CONCLUSION

findingThis study concludes that urban forests play significant ecological and social roles in supporting environmental sustainability within densely populated metropolitan areas. Community perceptions indicate strong recognition of the environmental conservation functions of Dukuh City Forest, particularly in improving air quality, reducing urban heat, supporting water infiltration, and maintaining urban ecological balance. However, the relatively low perception of aesthetic and recreational functions demonstrates that the social utilization of urban forests has not been fully optimized due to limited community engagement, environmental communication, and supporting public facilities.

The findings imply that urban forests should be positioned as strategic components of sustainable urban development and integrated into urban planning policies aimed at improving environmental resilience and community well-being. Sustainable urban management policies should prioritize the preservation, expansion, and inclusive utilization of green open spaces as part of climate adaptation and environmental conservation strategies in metropolitan areas. Strengthening participatory governance, environmental education, and collaboration between local governments and communities is essential to increase public awareness and long-term sustainability of urban forests.

This study also provides scientific contributions to the field of urban forestry and sustainable urban studies by integrating ecological and social perspectives in evaluating urban forest functions within a metropolitan context. The research expands previous studies by demonstrating how community perceptions influence the effectiveness of urban forest management and sustainable green space utilization. Furthermore, this study contributes empirical evidence supporting the implementation of Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land), within urban environmental governance. Future studies are recommended to combine community perception analysis with ecological measurements and broader comparative studies across multiple urban forest areas to provide a more comprehensive understanding of sustainable urban forest management.

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AUTHOR CONTRIBUTIONS

Conceptualization, F. and N.F.Z.; Methodology, F.; Software, F.; Validation, F., N.F.Z., and J.N.; Formal Analysis, F.; Investigation, F.; Resources, N.F.Z.; Data Curation, F.; Writing – Original Draft Preparation, F.; Writing – Review & Editing, N.F.Z. and J.N.; Visualization, F.; Supervision, J.N.; Project Administration, F.; Funding Acquisition, N.F.Z.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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