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Visitor Preferences for Restorative Landscape Elements in Bogor Urban Parks: A Visitor-Employed Photography Approach

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ABSTRACT

Human health and well-being are affected by the quality of the environment in which an individual lives. Urban spaces must provide restorative experiences to support public mental health. This study aimed to identify visitor preferences for exciting views and stress-relieving features in urban parks. Using visitor-employed photography to capture direct experiences, the study analyzed geotagged photos to identify landscape views, classified restorative landscape elements, and evaluated their effect on urban park visitors. This research employed spatial analysis of photo distribution using QGIS, photo content analysis using Google Cloud Vision API, and assessment of restorative effect through the Perceived Restorativeness Scale (PRS). The photo-taking hotspots were shaded areas with seating, featuring greenery, sculptures, activities, and landmarks. The results showed 2–3 hotspots with the highest photo density in the three parks. The Cloud Vision API classification results identified that the elements of a restorative landscape can be softscape, hardscape, and other factors. The results of the PRS questionnaire test showed that the three parks had a restorative effect on visitors (< 0.05), Sempur Park had the highest fascination (55.13) and compatibility (55.57) effects, and Heulang Park had the highest coherence effect (56.85) than other parks. These findings emphasize the importance of incorporating shaded seating, greenery, and engaging features into urban park designs to enhance visitor health and well-being.

Introduction

Human health and well-being are affected by the quality of the environment in which an individual lives. Urban life, which is bound by long working hours, heavy workloads, tight deadlines, and an unsupportive work environment, is the reason for the increased risk of mental disorders in populations who suffer from psychosocial stressors in the work environment [1]. Severe Mental Illness (SMI), including depression and anxiety, can increase the prevalence, incidence, and mortality from cardiovascular disease, including congestive heart failure, coronary heart disease, and cerebrovascular disease [2].

Maintaining physical health is one of the focuses of urban communities. Walking is one of the most common forms of exercise to maintain heart health [3]. Urban green space is an essential element in supporting urban transformation and sustainability. When there is a reduction in green open space, there is a corresponding rise in thermal discomfort, leading to unfavorable environmental conditions [4]. Urban green space can directly and indirectly improve the quality of life by removing stressors, stimulating physical activity, encouraging social interaction, and improving a person's well-being and mental health [5]. Most of these spaces respond to requests from local communities, including community space requirements and physical inputs to the landscape [6].

Bogor City has various public green open spaces that provide social and ecological functions to the surrounding community, such as Bogor City Square, Sempur Park, and Heulang Park. These three locations are research locations because they are freely accessible to the public and are among the people's favorite

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places to visit. Visitor preferences for therapeutic functions need to be studied to determine the potential, conditions, and solutions that can be taken as well as to provide recommendations for the needs of restorative landscapes in urban environments.

This study uses Visitor-Employed Photography (VEP) to investigate visitor experiences in public parks. VEP is widely used to analyse landscape preferences, outdoor recreation experiences, and site planning [7,8]. Content-Based Image Retrieval (CBIR) is a method of analyzing photo content to determine which landscape elements have a restorative effect on visitors. The classification-based approach to image annotation has excellent performance, but it requires as long as image training. To overcome this problem, analysis of photo content uses the help of the Google Cloud Vision API, which has many training results, to take advantage of previously trained images [9].

The general objective of this study was to evaluate the quality of green open spaces in providing a restorative environment, based on visitor preferences. Specifically, this study aimed to (1) identify impressive landscape views based on visitors' geotagged photos, (2) identify and classify restorative landscape elements, and (3) evaluate the restorative effects felt after activities. The benefit of this research is that it can serve as input and evaluation material for the city government in providing urban parks for restoration needs. The research results can also provide recommendations for managers, planners, and landscape designers in presenting the environment, especially urban parks, to fulfill the function of community restoration.

Materials and Methods

Study Area

The research focuses on three Bogor urban parks as shown in Figure 1: Bogor City Square and Sempur Park in the Central Bogor District and Heulang Park in the Tanah Sareal District, with areas of 1.7, 1.95, and 2.6 ha, respectively. The criteria for selecting the research location were: (1) pedestrian paths with a minimum distance of 400 m, (2) the type of road is relatively flat, (3) dense vegetation around the park, (4) there is a waiting room in the park, and (5) it is in the city centre [10]. The study was conducted over five months, from January to May 2023.

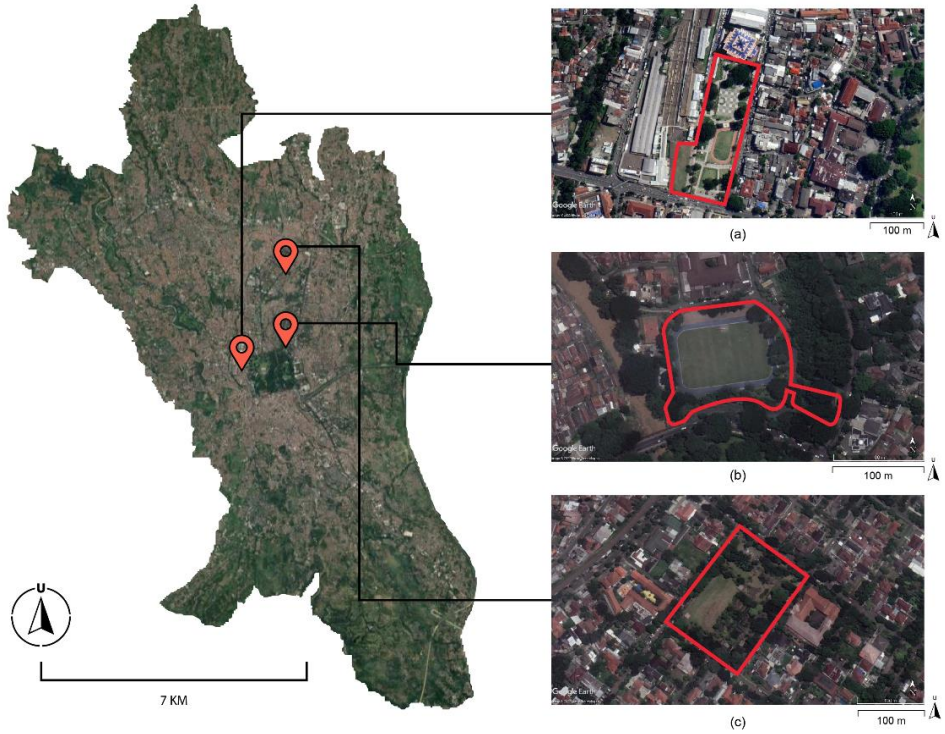

Figure 1. Site location and boundaries: (a) Bogor City Square, (b) Sempur Park, and (c) Heulang Park.

Bogor City Square is a city park with an area of 1.7 ha, which was built on the former land of Ade Irma Suryani Park or Hat Park. Bogor City Square is located at Captain Muslihat Street No. 17A, Pabaton, Central Bogor, Bogor City, with coordinates of 6°35'37.13"S to 6°35'46.04"S and 106°47'27.24"E to 106°47'31.34"E. Heulang

Park is an urban park in Bogor. It is located in a residential complex with an area of 2.6 ha. The park underwent repairs between 2015 and 2016. This park also has an Oreo Garden. Heulang Park is located on Jalan Heulang, Tanah Sareal, Tanah Sareal District, Bogor City, with coordinates of 6°34'6.06"S to 6°34'13.57"S and 106°48'3.88"E to 106°48'11.08"E. Sempur Park is a city park with an area of 1.95 ha. This park has been revitalized several times by adding and improving facilities. This park includes the Sempur Field, Kaulinan Park, and Expression Park. Sempur Park is located in Jalan Sempur, Sempur, Central Bogor, Bogor City, with coordinates of 6°35'28.33"S to 6°35'33.30"S and 106°48'1.17"E to 106°48'7.51"E.

Data Collecting

Accidental sampling was used in this study. Accidental sampling is a non-random sampling based on specific practical criteria, such as willingness at a particular time or willingness to participate for research purposes [11]. This study was approved by the Research Ethics Commission Involving Human Subjects, IPB University (Number: 817/IT3.KEPMSM-IPB/SK/2023).

The number of samples used was 30 people per experimental location. An appropriate sample size in this study is between 30 and 500 [12]. The feasibility of experimental participants in perception studies and criteria in parks and forests [10] includes: (a) visitors to Bogor Urban Parks are 18–35 years old, (b) not currently in the treatment of cardiovascular disease and hypertension, and (c) in good health to walk for 20 minutes or more without problems.

This study used landscape photos taken directly by the respondents from the research location. Photos were taken using a Nikon AW130 digital camera with the activated GPS (geotagging) feature. The photographs taken must meet the criteria to facilitate the data analysis process. The photo-taking technique is as follows: (a) photos are taken with a landscape position (horizontal) and a ratio of 4:3 or 16:9, which is known to be close to the 'golden ratio' [13]; (b) the respondent activated GPS on camera [14]; (c) respondents took ten or more photos of landscapes that provide stress-healing or restorative effects [14]; and (d) photos must meet the criteria, such as eye level [15], focus (not blurry/blurred), and appear whole (without zoom) [16].

Respondents then completed a questionnaire to determine their restorative effect factors. The questionnaire was based on the Perceived Restorativeness Scale (PRS), which was developed from the Attention Restoration Theory (ART). The PRS is a printout questionnaire consisting of four categories: being away, fascination, coherence, and compatibility, with 17 statements translated into Indonesian by Hartig et al. [17].

Microclimate data were obtained through direct measurements using a thermo-hygrometer at the site during the data collection process. The climate data measured were temperature and humidity in the park repeatedly every 15 minutes. In Indonesia, environmental temperatures range from 24 to 34 °C with 60 to 90% humidity. The Temperature Humidity Index (THI) for tropical regions is 21–24 °C (comfortable), 24–27 °C (partially comfortable), and > 27 °C (uncomfortable) [18]. The calculation of THI was expressed in Equation 1.

$$THI = 0.8T\left(Rh\ x\ {}^{T}/_{500}\right) \quad (1)$$

Data Analysis

Density Analysis

Visitor-Employed Photography is a technique that involves giving research participants a camera and asking them to take photos to describe their personal experiences [7]. The results of the photos taken by the participants were then distributed spatially based on the coordinates of the shooting locations via QGIS so that a map of the restorative area was obtained from the user's perspective at each research location. In QGIS v3.28, this technique can be used with the help of the "Density Analysis" plugin. This algorithm uses the QGIS count point in the polygon algorithm, which is time-intensive and significantly outperforms the speed implemented in commercial software. This feature collects adjacent points into a rectangular, rhombus, or hexagonal histogram grid of points that appear in each polygon grid cell. The darker the color, the denser the density.

Photo Content Analysis

This analysis aims to identify elements of a restorative landscape that provide a restorative effect. The technique used was Automated Image Processing (AIP), which uses the Google Cloud Vision API to identify landscape elements in photos. The Google Cloud Vision API was chosen for its advanced image analysis capabilities, including object detection, scene understanding, and classification of elements, such as softscapes and hardscapes. It efficiently processes large datasets, offers cloud-based scalability, and is

practical for analyzing geotagged photos. While it includes a free tier of up to 1,000 units per month, additional usage incurs costs, which should be considered in the research budget. Detection labels in the Google Cloud Vision API provide general and specific labels with a confidence score provided by the machine-learning model. Its accuracy has proven to be the most detailed regarding image classification compared to other APIs, such as IBM Watson and Microsoft Azure [19]. These annotation labels have four main parts: (a) 'mid' = machine-generated identifier with a Google-specific entry, (b) 'description' = description of the label, (c) 'score' = confidence score between 0 and 1, the division of categories is as follows: bad (< 0.40), fair (0.40–0.60), good (0.60–0.75), and excellent (> 0.75), (d) 'topicality' = the relevance of the label to the image which measures how influential the label is to the whole context.

Restorative Perception Analysis

This analysis aimed to determine participants' perceptions of the restorative effects in a landscape. The PRS questionnaire assesses how well an environment supports psychological restoration by measuring the following key restorative factors: being away, fascination, compatibility, and coherence. Each factor was evaluated through statements rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This questionnaire consisted of two statements on being away, six on fascination, four on coherence, and five on compatibility, totalling 17 statement items. Being away measures how well an environment allows mental detachment from stress, whereas fascination captures its ability to hold attention and evoke curiosity effortlessly. Compatibility assesses how well the environment supports personal needs and goals, and coherence examines its sense of organization and clarity [17]. The questionnaire results were analyzed using the Statistical Program for Social Science (SPSS) v.26. The statistical tests used were the validity and reliability tests, normality tests, Kruskal-Wallis tests, and post-hoc Kruskal-Wallis tests. The Kruskal-Wallis test is a rank-based non-parametric statistical test used to determine whether there are statistically significant differences in each PRS subscale at the three sites. The test results indicated statistically significant differences in the PRS subscales among the parks, suggesting that restorative qualities varied by site. For example, Sempur Park had the highest fascination and compatibility scores, whereas Heulang Park excelled in coherence. These findings highlight variations in how each park supports restorative experience.

Results and Discussion

Results

Site Microclimate

The THI calculation for each park shows that Bogor City Square and Heulang Park have THI in the partially comfortable category (26.81 °C and 26.97 °C, respectively). By contrast, Sempur Park had a THI in the uncomfortable category (29.20 °C). This could be because the vegetation cover in Sempur Park is only on the edge of the site; therefore, heat accumulates in parts of the field. In addition, differences in the measurement data can be caused by the weather that occurred during sampling, especially in Bogor City Square, because the weather was cloudy.

Identify Restorative Landscape Hotspots

Park visitors who were willing to become respondents were asked to fill out an informed consent form. Respondents were then asked to take pictures of views of urban parks that were considered attractive and had a restorative effect or healing stress. Shooting was performed using a digital camera provided by Nikon AW130.

The photos collected were sorted according to the criteria. This sorting aims to facilitate the analysis of photo content using Google Cloud Vision API. Photos that did not meet the criteria were not analyzed, leaving 893 photos, with 272 photos of Bogor City Square, 313 photos of Heulang Park, and 308 photos of Sempur Park. The average respondent took photos, i.e., Alun-Alun (9.07 ± 1.76), Heulang Park (10.43 ± 2.80), and Sempur Park (10.27 ± 2.88).

The density map shows interesting places and provides stress-healing effects based on the respondents' perspective by taking photographs of the site (Figure 2). The photos contained metadata, including the coordinate point (geotag). Coordinate data (latitude and longitude) were spatially distributed using GIS software through the geotagged photo import feature. The results of the photo distribution were then used to calculate their density using density analysis. The radius is 5 m, and the categories are divided into five

classes using Natural Breaks (Jenks). The division of class categories: (a) 1.00–1.00 = Very low, (b) 1.00–2.00 = Low, (c) 2.00–3.00 = Moderate, (d) 3.00–5.00 = High, and (e) 5.00–7.00 = Very high.

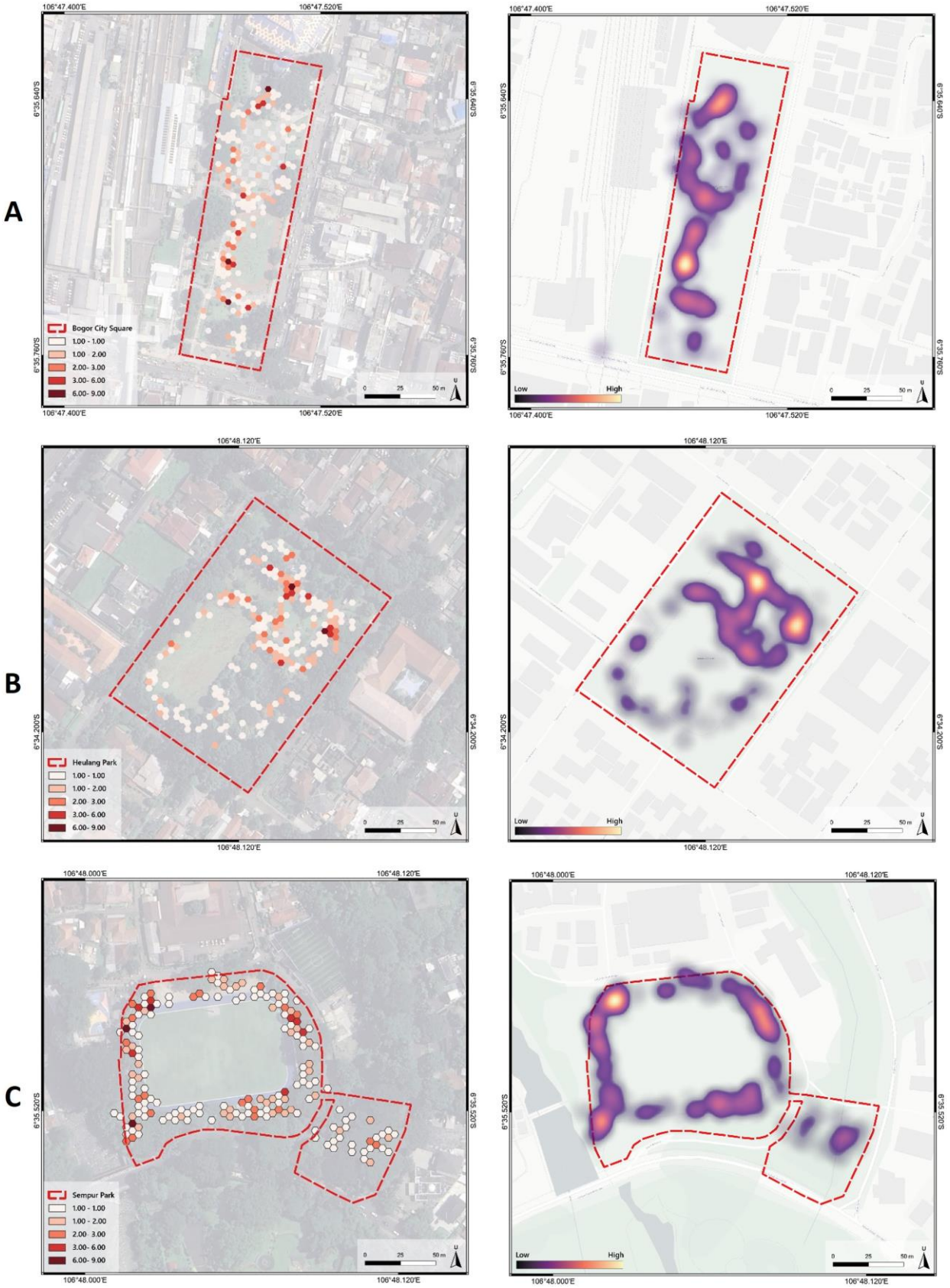

Figure 2. Density map (left) and heat map (right) of geotagged photos for each research location: (A) Bogor City Square, (B) Heulang Park, and (C) Sempur Park.

Bogor City Square had three points with the highest density, with 5–7 photos. In Heulang Park, there were two points with the highest density, with 5–7 photos. Sempur Park had three points with the highest density, with 6–9 photos. The results of the photo density analysis of urban parks are shown in Figure 2. The highest density was shown in dark red (#761925). The shooting points of the respondents were spread over the park area, especially in areas that were easily accessible by circulation.

The density of photos on Bogor City Square captures different views, such as (1) the north side of the Alun-Alun with a focus on the Asmaul Husna sculpture, (2) the running track area with a lawn and outdoor gym, and (3) the green area on the south side of the park. The density of photos in Heulang Park captures two views: (1) the circulation path in the form of the axis and the area around it, and (2) the nodes on the east side of the park with gazebos, fountains, and outdoor gyms. The density of photos in Sempur Park captures three views: (1) the area of the children's playground, (2) the area of the running track with surrounding vegetation, and (3) the area around the plaza on the north side of the park. Geotagged photos help identify locations where respondents prefer restorative landscape elements with stress-reducing effects, consistent with previous studies [20,21].

Restorative Landscape Elements Based on Cloud Vision API

Keyword extraction was performed using the Google Cloud Vision API service with the help of Visual Studio Code software as a text editor. Each landscape photo was analyzed and translated into labels/keywords through a program created using Python. Ten keywords were generated for each photograph. The Google Cloud Vision API confidence score ranges from 0 (no confidence) to 1 (very high confidence). The average confidence score of the Google Cloud Vision API ranges between 0.5 and 1.0 for each image label annotation [22]. This confidence score value aims to measure the accuracy of the keywords extracted from the images. This Confidence Score can be used to weigh the importance of objects to the keywords in question.

The total number of photos obtained by the respondents in Bogor City Square was 272; therefore, 2,720 keywords were obtained. Figure 3 shows the 25 most frequently used keywords in Bogor City Square. Sorting and filtering were performed using several of these keywords, resulting in 131 unique keywords. Elements with the keyword that appear frequently, e.g., "tree" 264, "plant" 259, "sky" 258, "cloud" 179, and "road surface" 172. The highest confidence scores were "plant" with a value of 0.95077. The lowest confidence score on the graph is "city" with a value of 0.76544. All confidence scores were in the excellent category (> 0.75).

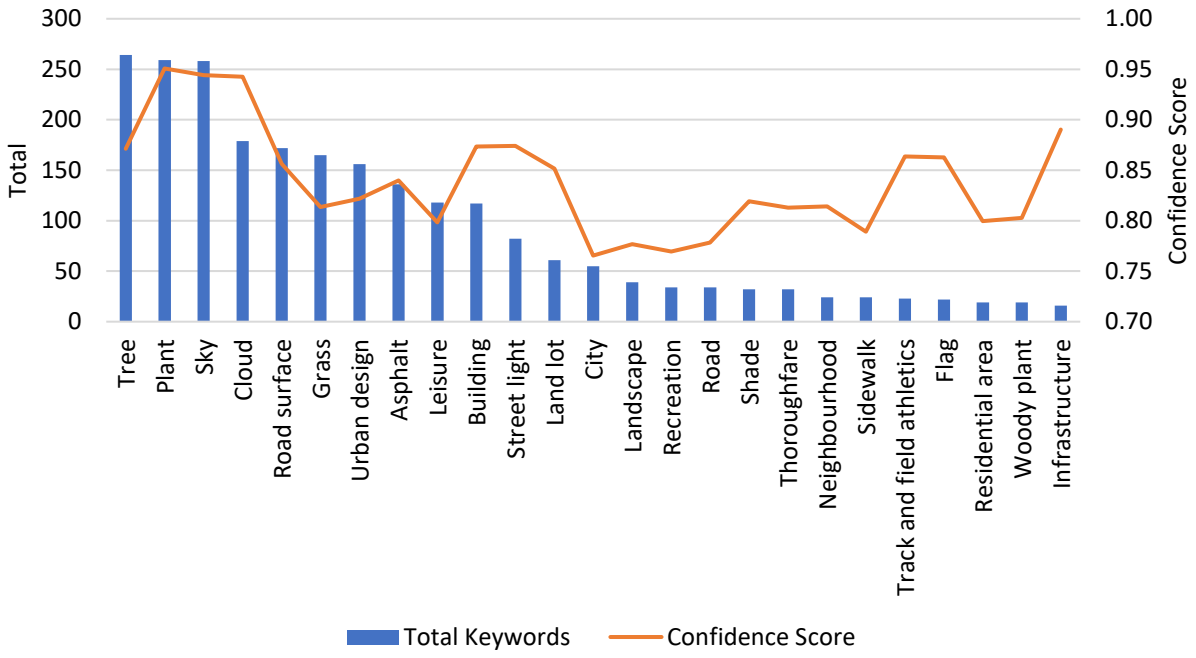

Figure 3. The most frequent landscape elements in Bogor City Square, with confidence scores above 0.75, included trees, plants, and the sky.

The total number of photos obtained by the respondents at Heulang Park was 313; therefore, 3,130 keywords were obtained. Figure 4 shows the 25 most frequently used keywords in Heulang Park. Sorting and filtering were performed using several of these keywords, resulting in 118 unique keywords. Elements with the keyword that appear frequently, e.g., "plant" 311, "tree" 310, "grass" 274, "sky" 266, and "shade" 184. The highest confidence scores were "plant" with a value of 0.96139, and the lowest confidence score on the graph is "recreation," with a value of 0.77034. All confidence scores were in the excellent category (> 0.75).

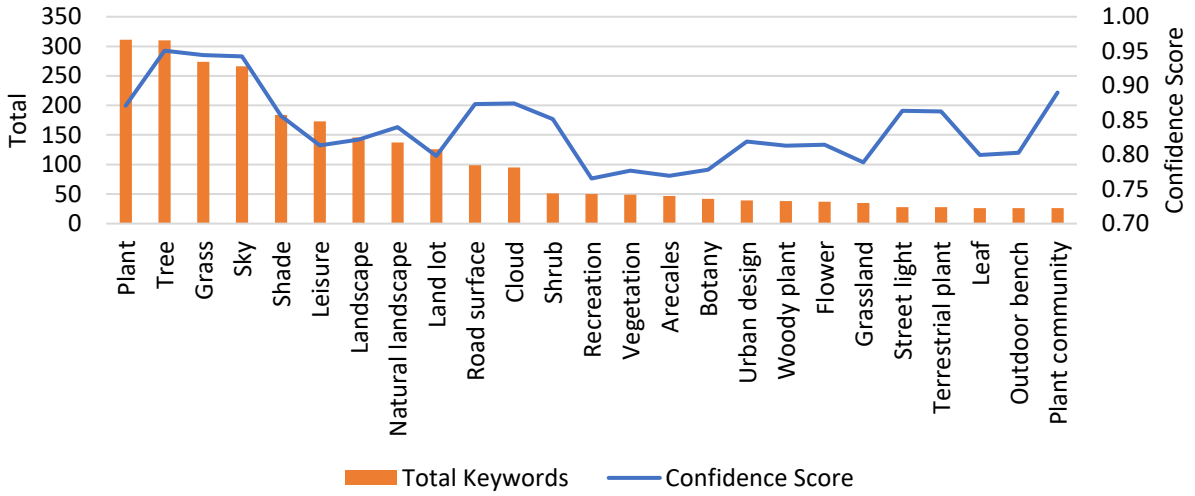

Figure 4. The most frequent landscape elements in Heulang Park, with confidence scores above 0.75, were plants, trees, and grass.

The total number of photos obtained by the respondents in Sempur Park was 308; therefore, 3,080 keywords were obtained. Figure 5 shows the 25 most frequently used keywords in Sempur Park. Sorting and filtering were carried out using several of these keywords, resulting in 124 unique keywords. Elements with the keyword that appear frequently, e.g., "plant" 304, "tree" 304, "grass" 248, "sky" 234, and "road surface" 200. The highest confidence scores were "cloud" with a value of 0.95676. The lowest confidence score on the graph is "groundcover," with a value of 0.78084. All confidence scores were in the excellent category (> 0.75).

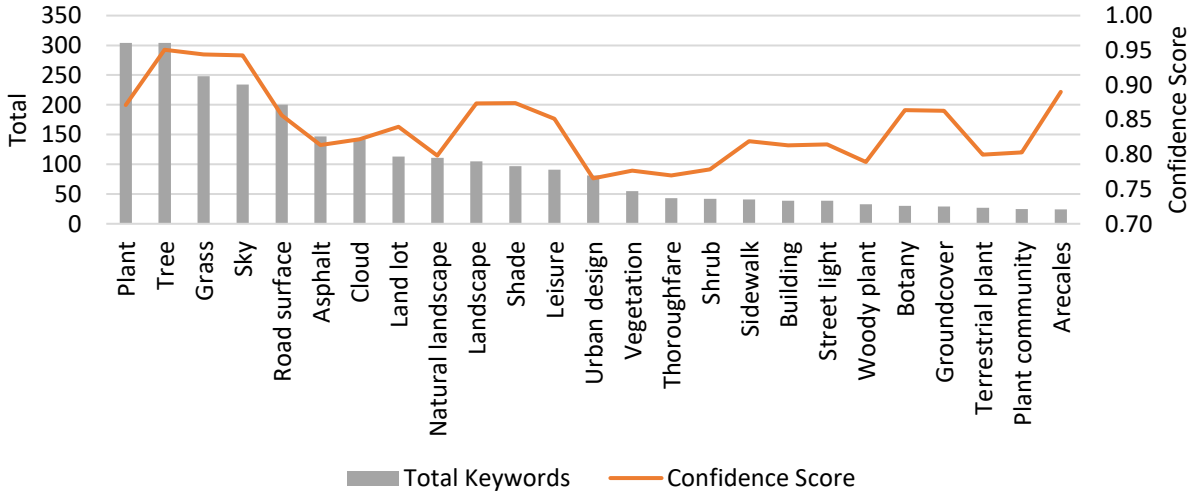

Figure 5. The most frequent landscape elements in Sempur Park, with confidence scores above 0.75, were plants, trees, and grass.

Figures 3–5 show the ranking of the top 25 keywords/elements that often appear in each urban park by the Google Cloud Vision API, followed by a confidence score for each element to summarize the results and efficiency of the discussion. These findings are in line with previous research, which explains that landscape

elements that can influence the level of restoration and tranquillity include open views, the presence of green plants, the presence of water bodies, the presence of people, dominant sky, special atmospheric conditions, topography, fauna, and artificial construction [23]. Unfortunately, the presence of water elements/bodies in City Parks in Bogor is lacking, even though research shows that landscapes with water elements have the highest restoration value and preference. This water element can also increase the attractiveness of the landscape [24].

Assessment of Visitors' Perceived Restoration

Validity and reliability tests were conducted using SPSS with data derived from the PRS questionnaire. All question items at each research location had an $R_{count} > R_{table}$ 5%, indicating that the questionnaire questions were valid. Based on the criteria of several experts [25], it shows that this research instrument has an acceptable level of reliability (> 0.70) with Cronbach's Alpha values of 0.750 and 0.764, as well as good reliability (> 0.80) with a Cronbach's Alpha value of 0.837.

The restorative effect of the park on visitors was tested using the Kruskal-Wallis test. According to Table 1, Asymp. Sig. Kruskal-Wallis test results ($p < 0.05$) showed that there were significant differences in the levels of fascination, coherence, and compatibility at the three sites ($p < 0.05$), while being away was not significantly different ($p > 0.05$). Based on previous studies, the sub-scales of fascination, coherence, and compatibility correlate with visitors' aesthetic preferences, while being away does not correlate with aesthetics [26]. The previous studies explained that the three parks had the effect of increasing positive emotions or decreasing negative emotions [27]. Urban parks are built landscapes with features in the form of open spaces with a clear view of the sky and few barriers (low refuge) that can provide potential benefits for the psychological restoration of visitors [28].

Table 1. Kruskal-Wallis test results.

	Being away	Fascination	Coherence	Compatibility
Kruskal-Wallis H	2.573	6.154	8.866	7.366
Df	2	2	2	2
Asymp. Sig.	0.276	0.046	0.012	0.025

Based on a comparison of the mean rank values from the Kruskal-Wallis test results, the results are shown in Figure 6. This comparison shows the Perceived Restorativeness Scale subscale for each study location. Bogor City Square had the highest mean rank in the being away subscale (51.25). Based on the results of the Kruskal-Wallis test, the subscale being away was not significantly different at the three study locations (p-value = 0.276 > 0.05). This could be because the vegetation cover of Bogor City Square is still not as good as that of the other two parks, and the park will only be revitalized in 2021.

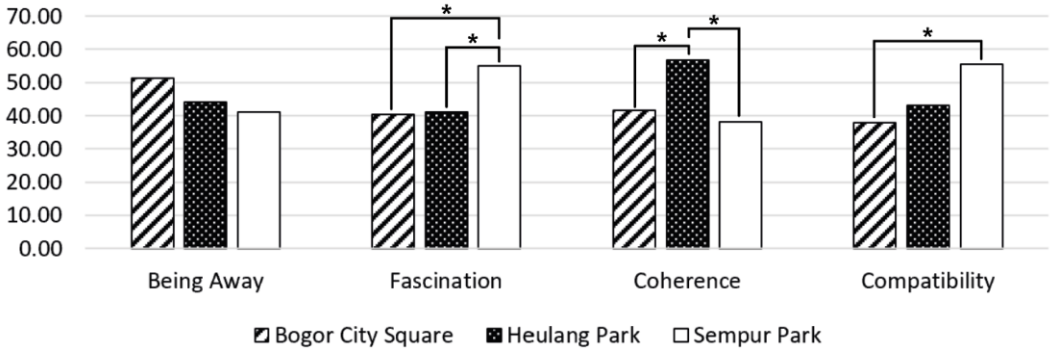

Figure 6. Mean rank comparison of the PRS subscales at each site.

Sempur Park had the highest mean rank on the fascination (55.13) and compatibility (55.57) subscales. Based on the results of the Kruskal-Wallis test, the fascination subscale had significant differences at the three study locations (p-value = 0.046 < 0.05), as well as the compatibility subscale (p-value = 0.025 < 0.05). Sempur Park is the best place to experience fascination and compatibility. The existence of running track facilities with a fairly long track circumference makes Sempur Park an attractive place to exercise and gather even stronger. In addition, the surrounding support facilities also affect the attractiveness of the park. The function of Sempur Park as a place to exercise is to follow the purpose of visitors, and vice versa. Not only are running tracks on the Sempur Field, but also around Sempur Park, there are arena loops for skateboarding, wall

climbing, and basketball courts. People who need a large space to gather or exercise can use the Expression Park Plaza. Children can also play on the children's playgrounds at Kaulinan Park.

Heulang Park has the highest mean rank on the coherence sub-scale (56.85). Based on the results of the Kruskal-Wallis test, the coherence sub-scale had significant differences at the three study locations (p-value = 0.012 < 0.05). Heulang Park is the best place to gain coherence experiences. Visitors can easily organize and arrange activities according to the space and facilities available at Heulang Park.

Discussion

Geotagged Photos Distribution Using Visitors-Employed Photography

The photo density analysis of Bogor City Square, Heulang Park, and Sempur Park highlights spatial preferences and visual focus areas within urban parks. The results indicated that specific features, such as sculptures, green spaces, playgrounds, and outdoor gym areas, act as visual anchors that attract the highest number of photos. These geotagged photos are helpful in showing where the photos were taken based on respondents' perceptions and preferences for restorative landscape elements, as well as the healing stress effect. This research aligns with other geotagged photo-based research [20,21], in which geotagged photos can show the preferred elements at a particular site.

The photo density indicates that respondents gravitated toward easily accessible and visually engaging features in parks. For example, the Asmaul Husna sculpture in Bogor City Square and the playground area in Sempur Park demonstrate the importance of iconic structures and activity-specific spaces. Recent studies, such as those by Shen et al. [29], highlight that visual complexity and focal points in parks significantly influence user attention and preference.

The concentration of photo points near green areas and vegetated surroundings reflects the biophilic preferences of the users. This aligns with studies that highlight how the presence of greenery and well-maintained vegetation boosts psychological well-being and visual comfort [26]. The use of greenery as a design element, combined with hardscape elements, such as circulation paths and plazas, offers a balance that users find visually and functionally appealing.

The spread of photo points along circulation paths and around nodes such as plazas and gazebos demonstrate the importance of connectivity and other areas. Heulang Park's gazebos and fountains exemplify how well-designed nodes can enhance visual and physical engagement. This corresponds with findings by Carmona [30], who state that well-placed nodes enhance user experience by offering pause points for observation and interaction.

Apart from that, other park areas can be revitalized to spread the capacity and carrying capacity of the park so that it does not accumulate in certain areas. One way that can be considered in optimizing the function of open space is through the Perceived Sensory Dimension approach, which consists of eight dimensions: natural, cultural, open, social, cohesive, diverse, sheltered, and serene [31]. These eight dimensions are perceived, regulated, and implemented, consisting of visual, auditory and spatial qualities. This approach also considers previous theories such as Stress Reduction Theory, Attention Restoration Theory, biodiversity theories, and theories of social qualities and naturalness [32].

Visitors' Perception and Preference for Urban Park Features

The use of the Google Cloud Vision API for keyword extraction in this study highlights the potential of AI-based tools for analysing visual data in landscape research. By converting landscape photos into keywords with confidence scores, the method offers a quantifiable approach to identifying landscape elements. This approach enhances the understanding of landscape compositions and user preferences in urban green spaces. It also supports evaluating large sets of landscape images and data-driven design and planning strategies.

The data reveals that natural elements such as "plant," "tree," "sky," and "grass" consistently dominate the visual landscape across Bogor City Square, Heulang Park, and Sempur Park. The high occurrence of keywords like "tree" and "plant" resonates with these preferences, indicating that the respondents' photos naturally focus on restorative elements. Softscape elements, such as plants, trees, and grass, were dominant in the three parks. Studies show that natural landscape components positively correlate with visitor restoration levels [33]. The three parks used various strata and vegetation types to optimize the aesthetic value of the park. Previous research shows that the diversity in landscape types and colours can influence visual preferences [24], views with striking colour changes can attract higher visual focus [34]. In addition, brightly coloured flowers are an essential component for restoration [26]. Vegetation can also stimulate a sense of

smell through aroma therapy. The presence of nectar-producing plants to attract butterflies indirectly affects bird richness, for example, by increasing the diversity of insect species [35]. Paker et al. [36] explained that bird communities in urban green open spaces responded more strongly to shrub species richness than to ground cover. The vegetation type that is significant for the diversity of bird species in Bogor City comes from the tree strata [37]. Trees with dense canopies provide places for birds to rest, nest, and feed [38].

Hardscape elements captured by visitor photos and analyzed, such as buildings, tracks and fields, roads, and pavement, aim to facilitate visitor access and activities. The significantly positive effects of culture-related components (such as corridors, walls, and pavilions) and artistic components (such as statues, monuments, and murals) can stimulate restorative effects. Perceived Sensory Dimensions indicate that cultural dimensions are more easily perceived in mental activities than in other recreational activities. The more cultural elements in the landscape, the more likely it is to stimulate visitors for recreation and spiritual activities [39,40].

Other elements identified in photo content analysis by Cloud Vision API, such as sky, cloud, and shade, are often found in photos taken by park visitors. Bright and open skies, often perceived as indicators of spatial comfort, align with earlier research, suggesting that such visual stimuli evoke positive psychological and physiological responses. For example, studies have shown that brightness levels and open spatial configurations in green spaces are linked to feelings of comfort and safety, influencing the overall satisfaction with urban parks [41]. In addition, maintaining existing vegetation, such as trees, is an alternative for visitors to rest and feel calm in the shade.

Implications and Improvements for the Future

The findings confirm that urban green spaces dominated by natural elements contribute positively to users' visual and psychological well-being. By leveraging AI tools, such as Google Cloud Vision API, landscape analysis becomes more precise, enabling better-informed decisions for urban park design. This aligns with contemporary studies advocating technology integration and human-centered design principles in urban landscape planning [42]. The impact of restoration felt by park visitors varies between parks. Barrier-type vegetation can be used as an alternative to create a feeling of being away, which becomes a buffer between work and traffic flow, with the tranquillity that exists in the park. Being away is the most important in Bogor City Square compared to the other two parks. Like an oasis in the middle of the desert, the Alun-Alun is also an open space amid the hustle and bustle of urban activity. City parks can provide calm conditions in densely populated areas [23]. Tranquillity in urban parks can be provided by separating space in the park for restorative purposes (private/individual) from space for stimulating purposes (communal/public). In addition, the presence of water in the park can be calming. Another factor influencing tranquillity is the dominance of green plants in city parks [43,44].

Parks with clear themes and functions provide fascination and compatibility that suits visitors' needs. Sempur Park has a specific function as an urban park that focuses on a sports facility and can accommodate visitors' needs. Heulang Park has a large area with sufficient facilities and infrastructure, so visitors can also utilize the park area for various activities and restore their psychological/physiological conditions. Creating tourist attractions such as health therapy tours, educational tours, culinary tours, and landscape attractions can contribute to this potential. When developing tourist attractions, it is crucial to consider the microclimatic conditions and urban forest/park biomass. This involves strategically selecting and adding species to mitigate the air temperature, leading to greater biomass and increased absorption of carbon dioxide.

Future research should incorporate physiological indicators (e.g., heart rate variability and galvanic skin response) and eye-tracking technologies that can provide deeper insights into user preferences and emotional responses to different landscape elements. Additionally, studies could examine the role of cultural and demographic differences in shaping landscape perceptions and ensuring inclusivity in urban design. Expanding this approach to various urban settings and climates can help refine guidelines for designing multifunctional, restorative, and culturally adaptive green spaces.

Conclusions

The results of the geotagged photos taken by visitors show that the impressive landscape view from the visitor's perspective spreads over the three parks, especially areas that are easily accessible via existing circulation routes. The highest photo density among the three parks shows that at these points, the views of the park, such as open spaces (fields, lawns, running tracks), art (mural paintings and sculptures), tree stands, and plant communities, give an exciting impression or healing stress. The results of the classification of

landscape elements by the Google Cloud Vision API show that landscape elements that are attractive and provide a restorative/healing stress effect based on a visitor's perspective can be in the form of softscapes, hardscapes, and other factors. Softscape elements included flowers, leaves, meadows, shrubs, woody plants, trees, plant communities, and botanicals. Hardscape elements include park benches, shade, track and field athletics, and pavements. Other factors include the sky, clouds, design, recreation, and leisure. Bogor City's green open spaces (Bogor City Square, Heulang Park, and Sempur Park) had a restorative effect on park visitors (< 0.05). Green open spaces have become a medium for restoring visitors' psychological and physiological conditions from urban stress, and have become a destination to escape from daily routines.

Author Contributions

AAP: Conceptualization, Methodology, Investigation, Formal Analysis, Data Curation, Writing - Original Draft; **PIP:** Conceptualization, Methodology, Supervision, Writing - Review & Editing; **BS:** Conceptualization, Methodology, Supervision, Writing - Review & Editing.

Conflicts of interest

The authors declare no conflicts of interest or financial interests and confirm that ethical approval was obtained for research involving human subjects.

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