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Preferences for Restorative Landscape Elements among the University Students in Bogor City Parks by Using Visitor - Employed Photography

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ABSTRAK

Taman kota didesain untuk melayani berbagai kebutuhan masyarakat mulai dari fungsi sosial dan budaya, ekonomi, bahkan berpotensi pada peningkatan kesehatan fisik dan mental. Masalah kesehatan mental menjadi perhatian yang dialami kelompok umur di atas 75 tahun dan 15-24 tahun di Jawa Barat. Tingkat gangguan kesehatan mental di kalangan mahasiswa tergolong tinggi, khususnya kecemasan akademik. Penelitian ini bertujuan untuk (1) mengidentifikasi pemandangan lanskap di Alun-alun Kota Bogor, Taman Sempur, dan Taman Heulang berdasarkan foto yang diberi geotag, (2) mengklasifikasikan elemen lanskap restoratif, dan (3) mengevaluasi efek restorasi terhadap mahasiswa. Penelitian ini menggunakan metode eksperimen melalui observasi langsung dan pengisian kuesioner Perceived Restorativeness Scale (PRS). Parameter yang diobservasi meliputi pemandangan lanskap, elemen taman, dan efek restoratif. Eksperimen diikuti oleh 30 mahasiswa dimana subjek berjalan kaki mengelilingi taman selama 15 menit. Analisis yang dilakukan yaitu analisis spasial sebaran foto dengan QGIS, analisis konten foto dengan Google Cloud Vision API, dan analisis efek restoratif. Hasil penelitian menunjukkan: 1) terdapat 1 hingga 3 *hotspots* dengan kepadatan foto tertinggi di ketiga taman, 2) elemen lanskap restoratif mencakup tanaman (1445 kata kunci), pohon (1099 kata kunci), dan rumput (853 kata kunci), dan 3) Taman Heulang memiliki skor restoratif tertinggi dibanding kedua taman lainnya (being away=4.3, fascination=4.3, coherence=3.3, compatibility=4). Penelitian dengan penggunaan teknologi cloud ini menjadi penelitian pendahuluan untuk mengkaji efek restoratif bagi pengguna di taman-taman kota Bogor dengan informasi geotag.

***Kata kunci*:** Google Cloud API, Perceived Restorativeness Scale, Relaksasi Fisiologis, Relaksasi Psikologis, Ruang Terbuka Hijau

ABSTRACT

City parks are designed to serve various community needs, ranging from social and cultural functions to economic purposes, and they can even improve physical and mental health. In West Java, mental health issues are a concern experienced by age groups over 75 years as well as those between 15 and 24 years. Among these, university students face a particularly high level of mental health disorders, especially academic anxiety. To address this, the present study aims to: (1) identify landscape views in Bogor City Square, Sempur Park, and Heulang Park based on geotagged photos; (2) classify restorative landscape elements; and (3) evaluate the effects of restoration on university students. This was accomplished through an experimental method involving direct observation and the completion of the Perceived Restorativeness Scale (PRS) questionnaire. Parameters observed included landscape views, park elements, and restorative effects. For the experiment, 30 university students walked around the park for 15 minutes. Analyses included spatial analysis of photo distribution in QGIS, content analysis of photos using the Google Cloud Vision API, and analysis of restorative effects. The results indicate the following: first, there are 1 to 3 hotspots with the highest photo density in the three parks; second, restorative landscape elements include plants (1445 keywords), trees (1099 keywords), and grass (853 keywords); and third, Heulang Park achieves the highest restorative scores compared to the other two parks (being away = 4.3, fascination = 4.3, coherence = 3.3, compatibility = 4). Overall, this study uses cloud technology to conduct a preliminary research of the restorative effects for the users in Bogor city parks analyzing geotag information.

***Keywords*:** Google Cloud API, Green Space, Perceived Restorativeness Scale, Physiological Relaxation, Psychological Relaxation

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1. INTRODUCTION

Human health and well-being are fundamentally connected to the quality of the environment in which individuals reside. In city contexts, long working hours, heavy workloads, time constraints, and unsupportive work environments increase the risk of mental disorders caused by psychosocial stressors (Tost et al., 2015). Urban living has been shown to exacerbate social evaluative stress processing and elevate the risk of anxiety and depression disorders compared to rural environments (Lederbogen et al., 2011). Severe mental health conditions, including depression and anxiety, have been identified as significant factors contributing to the increased prevalence and mortality associated with cardiovascular diseases, such as coronary heart disease and stroke (Cunningham, 2019).

Post-pandemic global economic instability has increased student concerns about job prospects, leading to anxiety and fear of failure. Most young people aged 12-25 worldwide experience poor mental health, with 1 in 2 young people under 25 experiencing a mental disorder, and 75% of mental illnesses beginning before the age of 25 (Orygen, 2020). In the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), the most common illnesses are depression and anxiety disorders. The rate of anxiety disorders among students is high (86.8%), with academic anxiety often experienced by first- and final-semester students causing psychological distress (Setyanto, 2023).

Prioritizing physical health and mental well-being has emerged as a key concern in urban communities. As of 2017, only five countries in the Region—Bhutan, India, Indonesia, Sri Lanka, and Thailand—had implemented specific national policies or guidelines to promote physical activity. Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure and is widely recognized for its beneficial effects on health (WHO, 2018). Walking, a widely accessible form of physical activity, is frequently utilized to support cardiovascular health (Hill et al., 2015). Evidence from the World Health Organization indicates that physical activity reduces the risk of mortality from noncommunicable diseases (NCDs), which remain the leading cause of death in many countries (WHO, 2018). Urban green spaces (UGS) are essential for promoting physical activity and enhancing the overall quality of life in urban environments. Research indicates that UGS effectively mitigate stress, encourage physical engagement, facilitate social interactions, and enhance mental health and well-being (Ugolini et al., 2020). Furthermore, passive activities, such as sitting and relaxing in parks, play a vital role in psychological restoration by providing opportunities for individuals to connect with nature, alleviate mental fatigue, and recover from stress (Jiang et al., 2016).

City parks play important social and ecological roles and can also be developed as restorative landscapes. In Bogor City, there are 106 parks and green open space with recreational and children's interaction facilities including Bogor City Square, Sempur Park, and Heulang Park that serve the surrounding community in these capacities (Disperumkim Kota Bogor 2025). These three active parks were selected as the research locations because they are freely accessible to the public and are among the most popular destinations for city residents. Studying visitor preferences for their restorative potential is necessary to understand existing conditions, explore opportunities, and provide recommendations for restorative landscape development in city settings. Given that such landscape serve as “exemplars” of self-regulation and restorative experiences (Korpela & Hartig, 1996), evaluating the types of natural landscape individuals consider their favorite places, and identifying the elements that contribute to these preferences, is essential.

There is a clear gap in studies that combine visitor experience, spatial data, and image content analysis to evaluate restorative landscape elements in city parks from the users’ perspective. Most existing research lacks fine-grained, location-specific insights into what features of city green spaces are perceived as restorative by users. Additionally, there is limited integration of geotagged visual data and advanced image recognition technologies to support this analysis (Yang et al., 2009; Heyman, 2012; Wartmann et al., 2019; Pratiwi et al. 2022a; Hadi et al., 2023). This research offers an integrative approach to evaluating restorative city landscapes by combining the Visitor-Employed Photography (VEP) method, automated image analysis using the Google Cloud Vision API, and psychological perception measurement through the Perceived Restorativeness Scale (PRS). Automated image recognition makes the analysis more efficient and scalable (Chen & Chen, 2017; Shi et al., 2021), while integrating PRS adds depth to understanding visitors’ psychological responses. Conducted in three city parks in Bogor, Indonesia, this research provides context-specific insights and a user-centered framework that can inform city planning and enhance the well-being benefits of green spaces. This integrative approach offers new insights into how restorative environments are experienced and can inform the planning and design of more effective therapeutic landscapes in city areas.

The main objective of this research was to identify and evaluate restorative landscape elements in city parks based on subjects’ perceptions and experiences. Specifically, this research aimed to (1) identify landscape views perceived as restorative in three city parks in Bogor City, (2) classify restorative landscape elements, and (3) evaluate the restorative effects felt by university students.

2. METHODS

2.1. Time and Location

The research focused on three Bogor City Parks, namely Bogor City Square and Sempur Park in Central

Bogor District, and Heulang Park in Tanah Sareal District, with an area of 1.7 ha, 1.95 ha, and 2.8 ha, respectively. The criteria for selecting the research location were: (1) pedestrian paths with a minimum distance of 400 m, (2) relatively flat road types, (3) dense vegetation around the park, (4) there is a waiting room in the park, and (5) located in the city center (Pratiwi et al., 2020).

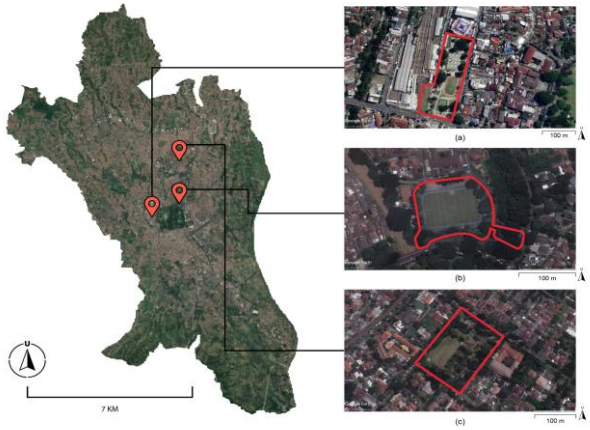

Figure 1. Research Location. (a) Bogor City Square, (b) Sempur Park, (c) Heulang Park (Source: Pamungkas et al. 2025)

2.2. Tools and Materials

The tools used in this research were hardware and software, including GPS Garmin Oregon 650 to create track walking courses, SPSS 26 to process research data, Google Earth Pro to compile research location maps, Google Vision API to analyze image annotation classifications, QGIS 3.28 to analyze the distribution of hot spots from geotagged photos taken in the field spatially, and the Perceived Restorativeness Scale (PRS) questionnaire to determine the restorative effect factors on participants after walking around the park. The PRS questionnaire, developed from Attention Restoration Theory (ART), consists of four categories: being away, fascination, coherence, and compatibility, with 17 statements, which are the translations of Hartig et al. (1997). The scale used is from 1 (very unsuitable), 2 (slightly unsuitable), 3 (neutral), 4 (slightly suitable), and 5 (very suitable).

Tabel 1. Reliability Scores of Perceived Restorativeness Scale Questionnaire

Activity	Being Away	Fascination	Coherence	Compatibility
Sitting	0.811	0.763	0.766	0.753
Walking	0.865	0.871	0.851	0.808

The PRS score indicates the level of restoration felt by the participants when they were in the three parks (Bogor City Square, Sempur Park, and Heulang Park). The PRS questionnaire underwent comprehensive assessments to evaluate its reliability. The test results indicated that all data met reliability criteria, and with the score exceeded the acceptable reliability value (>0.60), as presented in Table 1.

2.3. Experimental Design

The data collection phase was carried out in one day, walking through the park in three locations. The activity started from 09.00 to 12.00 by randomly dividing the participants into two groups containing a maximum of 4 people. Participants should be screened to avoid transmission of COVID–19. Participants signed the informed consent form, followed by an explanation of the experimental procedure. During the experimental activity, participants continue to implement health protocols. On the experimental day, the participants did a guided walk by the researcher team for 20 minutes and captured the landscape views that provides a restorative experience. The participants filled out the questionnaire. Afterward, participants rested and moved to the next experimental locations.

2.4. Sampling Technique

The eligibility criteria for participants in the research included: (1) students of IPB University aged between 19 and 26 years, (2) students residing in Bogor and its surrounding areas, (3) individuals not currently undergoing treatment for cardiovascular disease or hypertension, and (4) individuals capable of walking for a duration of 20 minutes or more without difficulty. Participants for the experiment were selected through a snowball sampling method, which involved ten key informants across various faculties. Because institutional records lacked information on health status, place of residence, or physical capability, identifying eligible participants using conventional probability sampling methods proved challenging. Consequently, the initial participants who met the inclusion criteria were asked to recommend other individuals in their social networks who also met the eligibility criteria. This method is methodologically justified and is recognized as highly effective for accessing hard-to-reach populations (Naderifar et al., 2017; Gierczyk et al., 2023). Participant recruitment consisted of the following steps: (1) dissemination of announcement posters via social networking services, specifically utilizing WhatsApp; (2) provision of a Google Forms link on the poster for interested individuals to express their willingness to participate in the research; (3) clarification of the research objectives and procedures prior to the commencement of the experiment; and (4) ongoing communication regarding the experimental process and related information through WhatsApp. Finally, 30 students were selected as research subjects. The procedural framework for the experiment adheres to the regulations set forth by the Research Ethics Commission Involving Human Subjects, IPB University (Reference Number: 735/IT3.KEPMSM-IPB/SK/2022).

2.5. Data Analysis Procedures

2.5.1. Preparation Stage

During the preparation phase, the researcher disseminated online questionnaires to gather data pertaining to participant selection and demographic attributes, including gender, academic major, and willingness to participate. Additionally, a preliminary survey was conducted to identify suitable walking courses within the park.

2.5.2. Data Collection Stage

The photos were taken using each participant's smartphone by activating the GPS (geotagging) feature. The photos taken must meet the criteria to facilitate the data analysis process. The photo-taking technique is as follows:

a. The photo was taken with a photo position, namely landscape (horizontal) and a 16:9 ratio, which is close to the 'golden ratio' (Ghane and Shahbahrami, 2012).
b. Participants must activate GPS/location tags on their devices (Hadi et al., 2017; Shi et al., 2021).
c. Participants take landscape photos that provide restorative experience according to participants' preferences, as many as ten photos or more (Hadi et al., 2017; Shi et al., 2021; Pamungkas et al., 2025; Mangetan et al., 2026).
d. Photos must meet the criteria, namely eye level (Arnberger & Eder, 2015), as well as focus (not blurry/blurred) and appear whole (without zoom) (Lo and McKercher, 2015).

Participants then filled out a questionnaire to determine the restorative effect factors on the participants after walking around each park. Afterwards, participants sent the photos they had taken to a folder already available on Google Drive.

2.5.3. Data Processing Stage

This research consists of three main stages: spatial analysis of photo distribution, analysis of photo content, and evaluation of restorative preferences.

A. Spatial Analysis

The Visitor Employed Photography (VEP) method was utilized to assess subjects' perceptions of city parks. Additionally, this method offers potential for quantitative analysis of photographic content, such as vegetation structure and the presence of features relevant to biodiversity conservation (Heyman, 2012). Participants were instructed to photograph any restorative views encountered using their own smartphones. The resulting images were submitted to the researchers either online or via direct transfer to the researchers' laptops. Irrelevant photographs, including accidental captures, images lacking focus, blurry or moving photos, and duplicates, were excluded from analysis (Hadi et al., 2023). The results of the photos taken by the subjects were then distributed spatially based on the coordinates of the shooting locations through the QGIS v3.28 software so that a map of the restorative area was obtained from the user's perspective at each research location.

Kernel Density Estimation (KDE) is an established method for hotspot mapping. This technique converts incident point data into a continuous density surface, effectively representing the concentration of these points (Hu et al., 2018). In the QGIS v3.28 software, this technique can be used with the help of the "Density Analysis" plugin by Hamilton (2023). This algorithm uses the QGIS count point in the polygon algorithm, which is quite time-intensive and significantly beats the speed implemented in commercial software.

B. Content Analysis

Photo content analysis focuses on identifying landscape elements that foster a restorative effect. While natural features such as trees, water bodies, and green spaces are commonly recognized for their positive impact, man-made elements, including buildings and landmarks, also play a significant role in enhancing the visual assessment of landscapes. The Google Cloud Vision API is an advanced pre-trained machine learning tool designed to match images to a comprehensive database of photos, each tagged by pixel values (Wartmann et al., 2019). The Visual Studio Code software assists the content analysis process as a text editor in Python, which is connected to the Google Cloud Vision API service. The results of this content analysis will display ten identifications of landscape elements (keywords/labels) on each photo. 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 ranging from 0 to 1
d. 'topicality' = assessment of the relevance of the label in relation to the image, measuring the importance of the label within the overall context.

Quantitative content analysis was performed using KH Coder 3, an open-source software frequently employed for semantic network analysis. Keywords extracted via the Google Cloud Vision API were analyzed by generating a word co-occurrence network. This network diagram illustrates similarities among keywords with high co-occurrence, using connecting lines to represent their collective interconnections (Higuchi, 2016).

C. Restorative Preference Analysis

The subject's restorative preference analysis aims to know the participants' preferences for restorative effects in a landscape. The questionnaire results were then analyzed using the Kruskal-Wallis Test using the Statistical Program for Social Science (SPSS) application to examine differences in ratings in various categories assuming the data were not normally distributed.

3. RESULTS AND DISCUSSION

3.1. The Potential of City Parks on The Level of Restoration

Figure 2 provides a visual representation of the average distribution across the PRS domains, which include aspects of being away, fascination, coherence, and compatibility. Through the Kruskal-Wallis test in each PRS domain of walking activity, each domain influences the restorative level of participants, with the following significance: being away (p-value=0.030), fascination (p-value < 0.000), coherence (p-value < 0.000), and compatibility (p-value < 0.000). Whereas the PRS domain scores of on-site sitting activities, each domain had a significant effect on the participants' restorative level, with the following significance: being away (p-value < 0.000), fascination (p-value < 0.000), coherence (p-value < 0.000), and compatibility (p-value < 0.000). Follow-up post hoc tests indicated that Heulang Park achieved the highest restoration value among participants in comparison to the other two parks (mean rank of walking = 63.18, p-value < 0.000, and mean rank of sitting = 61.97, p-value < 0.000). Heulang Park features a green area where landscape elements such as trees, shrubs, and grass are more prevalent than pavement and building structures. This is supported by research utilizing thermal drone imagery to characterize the park's thermoscape. The study found that the isothermal areas dominated by green and blue accounted for 39.2% and 22.79% at 09:00, 53.79% and 17.49% at 12:00, and 81.28% and 16.4% at 15:00, respectively (Pratiwi et al., 2024).

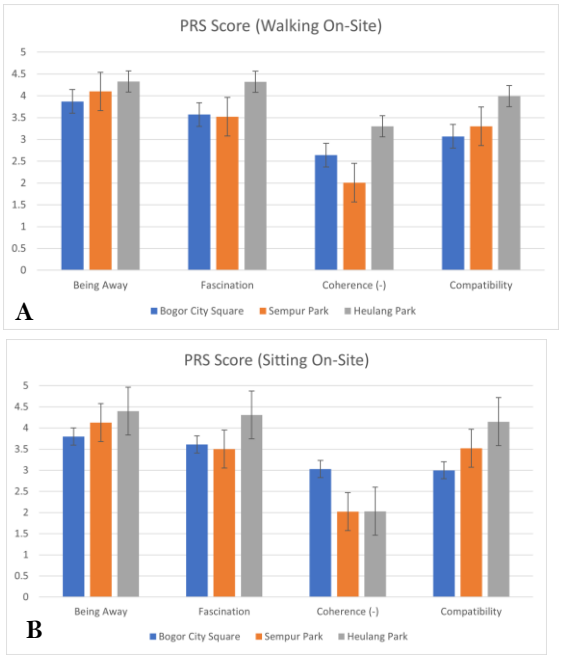

Figure 2. Comparison of the Results of the Walking (A) and Sitting PRS Subscales After Experiments at the Three Locations On-Site (B)

3.2. Classification of Landscape Elements

Spatial characteristic analysis was carried out by mapping various landscape views taken by participants at each research location. A total of 1,133 photos taken (385 photos in Bogor City Square, 368 photos in Sempur Park, and 380 photos in Heulang Park) by participants were distributed through the GIS application based on the coordinates contained in the photo metadata. Figure 3 illustrates the results of the distribution of participants' photos based on the point where they were taken. Landscape-view characteristics can be seen in the density of photos at each research location, illustrated in a heat map. The brighter the color on the heat map, the more people find the attractive and restorative views. There are three dominant spots around the jogging track in the center and south, and the plaza in the north of Bogor City Square, with views of the Bogor City Station and mural paintings. Bogor City Station, located to the west of the park, is a cultural heritage building from the Dutch colonial era that may attract participants. Previous related research on local park visitors found that visitors preferred the *Asmaul Husna* sculpture, one of the iconic structures in Bogor City Square, which may have influenced attention (Pamungkas, 2025). There is one main spot on the jogging track in the north with a view of the Sempur Park signage and three other spots on the southeastern track. The existence of jogging track facilities made Sempur park an attractive place to exercise (Pamungkas et al., 2025). There is one main spot in Southeastern Heulang Park, namely the seating area, and two other spots in the middle of the site, with views of the lawn and tree stands. These kinds of spots may encourage visitors to feel comfortable having a picnic and relaxing (Mangetan et al., 2026).

A total of 1,133 photos were then analyzed using the Google Cloud Vision API to find out the content contained in the photos through keywords or labels. Through the Google Cloud Vision API, 11,330 keywords were obtained, with ten keywords for each photo. A total of 312 unique keywords were detected, with the highest number being 1,445 (plant) followed by 1,099 (tree), and 853 (grass). Figure 4 shows the 25 most frequently found keywords in photo analysis results using the Google Cloud Vision API.

The results from the Google Cloud Vision API were then analyzed using the KH Coder to display the collective interconnection relationships among these keywords. Figure 5 shows the results of the keyword co-occurrence network analysis. The keywords "plant" and "outdoor" became central topics. They showed that plant and the outdoor provide the most important landscape elements for connecting others, such as woody, terrestrial, flowering, and annual directly connected to plant; benches, furniture, recreation, and equipment directly connected to the outdoor. The natural environment (land and natural resources) is the second degree of centrality. The others are 'track', 'field', 'athletics', 'street', 'furniture', 'equipment', 'natural', 'land', 'vehicle', and 'area'. Sports facilities (track, field, and athletics) are used by participants engaged in intensive physical activity. In addition, supporting facilities and accessibility (street,

furniture, and equipment) are needed to provide services that enable participants to access city parks.

3.3. Discussion

3.3.1. Restorative Potential of City Parks

The findings indicate that sitting and walking activities in city parks produce restorative effects for participants. The observed restorative potential across the three parks aligns with meta-analytic evidence demonstrating that natural environments, such as wild nature, city parks, or avenues, are generally perceived as more restorative than city built settings. Other related research showed that physical activities, walking and sitting relaxed, carried out in these three parks, can increase positive emotions, reduce negative emotions, and reduce anxiety levels (Sari et al., 2023). Green open spaces are proven to enhance both psychological and physiological restoration (Zhao et al., 2023; Wu et al., 2021; Liu et al., 2021; Deng et al., 2020; Pratiwi et al., 2020; Pratiwi et al., 2019). Notably, the results support Liu et al. (2021), who found that environments featuring structured layers, such as shaded facilities and dense canopies, may produce stronger restorative effects than untouched natural settings like pristine forests.

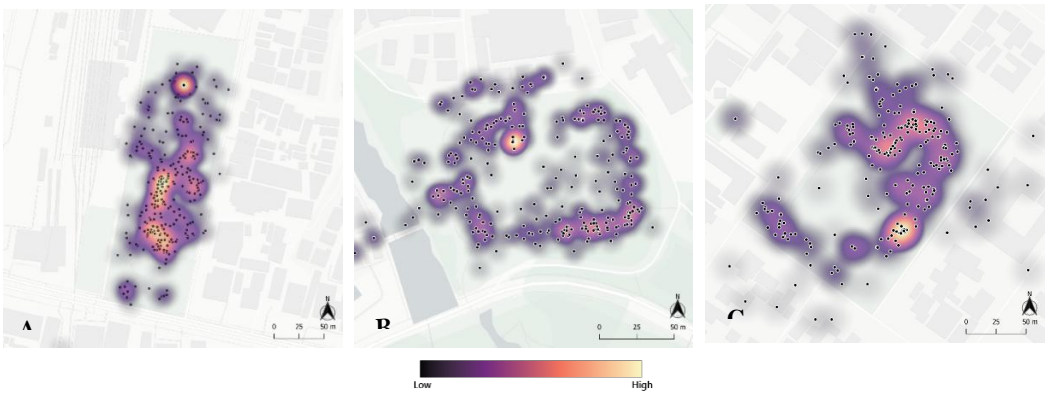

Figure 3. Heatmap of Photo Taking of Each Research Location. (A) Bogor City Square. (B) Sempur Park. (C) Heulang Park

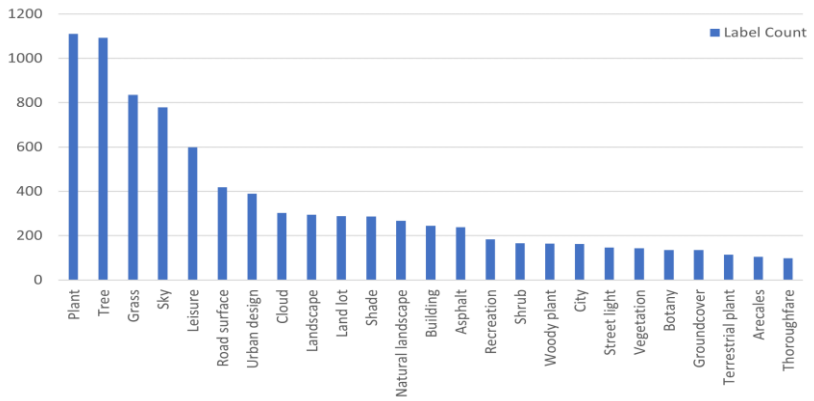

Figure 4. The 25 Most Frequently Found Keywords in Google Cloud Vision API Photo Label Results

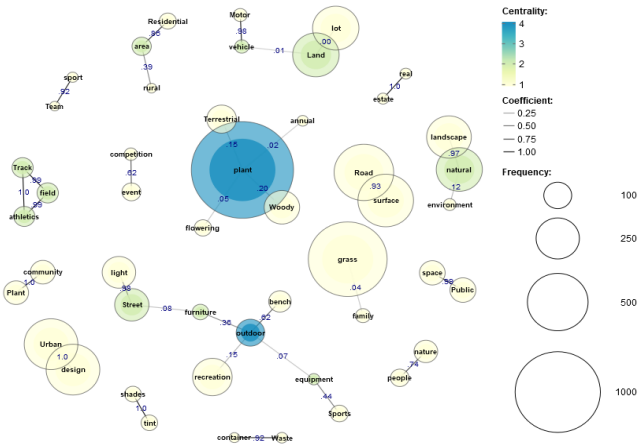

Figure 5. Co-Occurrence Network of Keyword Results Based on Google Cloud Vision API

3.3.2. Environmental Quality as a Determinant of PRS

City parks are green open spaces that bring people together with nature. City parks with vistas or prospects, spaces, and appropriate designs can form awareness of nature, leading to satisfaction, pride, and prosperity for city communities. Furthermore, city parks can also provide psychological effects with the main goal of recreation (Pratiwi et al., 2022b; Tok et al., 2020). In line with this, Heulang Park, which received the highest Perceived Restorativeness Scale (PRS) score among the three sites, offers a variety of plant species with vibrant colors that create a visually engaging, or "soft fascination," environment. Complementary amenities such as gazebos, shaded trees, and seating areas enhance opportunities for rest and social interaction, contributing further to its restorative quality (Deng et al., 2020). The higher PRS score observed for Heulang Park can be attributed to its enhanced perceived environmental quality, characterized by vegetation richness, seating facilities, and opportunities for social interaction. The design and care of spaces, social interaction, and the presence of sensorial elements explain 57% of the variance in perceived restorative capacity (Ríos-Rodríguez et al., 2021).

3.3.3. Importance of Preferred Landscape Elements

The results of participants' photos are predominantly concentrated along the existing circulation paths within the parks, particularly in areas offering visually appealing and stress-relieving views. The perceived level of restoration depends on environmental characteristics (Kang & Kim, 2019). Analysis using the Google Cloud Vision API revealed that the most frequently photographed elements across the three locations were plants, trees, grass, sky, and leisure-related features. This finding is in line with Pratiwi et al. (2022a), which found that such natural elements are strongly associated with reductions in negative emotions and anxiety. Landscape elements, including trees, lawns, and flowering plants, are associated with psychological and physiological restoration, such as reduced blood pressure and heart rate, and increased vigor after park visits (Deng et al., 2020; Pratiwi et al., 2020). Liu et al. (2021) highlighted the role of volatile organic compounds (VOCs), particularly from coniferous trees, in reducing mental fatigue and enhancing cognitive function through phytoncide emissions. Huang & Lin (2019) also emphasized that color diversity and bright floral features in the landscape enhance visual preference and contribute to perceived restoration. The frequent appearance of 'sky' and 'cloud' in visitor photographs suggests a preference for open, high-prospect landscapes, which, according to Pratiwi et al. (2022b), are key spatial attributes of restorative environments. This preference may be attributed to open, high-prospect settings, as greater sky visibility has been shown to enhance restorative perceptions by increasing fascination and promoting a sense of escape (Masoudinejad & Hartig, 2020). Conversely, the presence of artificial structures (e.g., roads, buildings, asphalt), although occasionally appearing in the images, may negatively influence perceived restoration, echoing the findings of Wartmann et al. (2019), who noted that city construction materials can diminish restorative effects.

This research confirms that city parks in Bogor City possess restorative potential for participants, supporting prior findings that landscapes with well-organized spatial structures positively influence both ecological quality and visual preference (Gao et al., 2020). However, when compared to previous studies emphasizing the significance of water features in enhancing restorative experiences (Kang & Kim, 2019; Wu et al., 2021; Wang et al., 2019), the three parks studied show a clear limitation. While water elements are known to boost landscape attractiveness and improve psychological recovery, their presence is either absent or underutilized in the case research sites. Bogor City Square lacks any water features entirely, while Heulang Park has a non-functional fountain, reducing its potential restorative contribution. Sempur Park has the latent potential for a water element through the presence of the Ciliwung River on its western boundary; however, the view and accessibility of this feature are significantly obstructed by buildings, dense vegetation, and physical barriers. The limited integration of water features in these parks contrasts with evidence indicating that blue spaces enhance visitor satisfaction and perceived restorativeness, especially when linked to serenity and prospect (Qi et al., 2021). Consequently, the absence of water features represents a significant consideration for city planners and designers seeking to develop environments that comprehensively support psychological restoration in city green spaces.

3.3.4. Site-specific Landscape Characteristics and Perceived Restorativeness

This research contributes novel insights by integrating geotagged photo analysis with perceptual data to assess the restorative quality of city parks. The inclusion of three contrasting city parks in Bogor enhances the robustness of the findings, as it enables a comparative evaluation across different spatial contexts, usage intensities, and environmental settings. The observed differences among the three parks underscore the significance of site-specific landscape characteristics, which have been shown to positively influence perceived restorativeness and place attachment. Furthermore, local landscape characteristics, place dependence, and place identity were found to be positive predictors of restorative perceptions (Qiu et al., 2020).

These findings provide evidence-based recommendations for the design of city green spaces. Specifically, the composition of plants (including trees and grass), openness to the sky, water features, and other leisure-related elements should be incorporated into

future park enhancements. Landscape architects, city planners, and park managers should consider these factors to optimize the restorative potential of city green spaces.

3.4. Limitations and Future Research

This research has several limitations. First, the research subjects were limited to the academic community of IPB University in the young adult age category. Further research is needed to determine how city green open spaces in Bogor City affect other age categories, such as children and the elderly. Second, the research is limited to active park-type green open spaces. Further research can examine other types of open spaces, such as waterscapes (river-scapes, beaches, and lakescapes), forest-scapes (mixed forests and deciduous forests), and micro-landscapes (neighborhood parks and pocket parks). Third, taking landscape photos in this research using each subject's smartphone camera connected to GPS. Further research can provide camera devices connected to GPS to minimize data errors. These limitations need to be considered for future research.

4. CONCLUSION

City parks in Bogor City offer measurable restorative benefits and underscore the significance of vegetation composition, spatial openness, sky visibility, and environmental quality in shaping visitor experiences. These findings reinforce the role of city green spaces as essential elements for public health and psychological well-being in rapidly urbanizing settings. This research advances the findings on restorative environments by integrating the Perceived Restorativeness Scale (PRS) with geotagged photo analysis and image recognition. The findings offer empirical evidence from a tropical city landscape and demonstrate that landscape elements influence perceived restorativeness. City designers and park managers are encouraged to prioritize vegetation diversity, maintain unobstructed views of the sky, enhance restorative amenities, improve the integration of water features, minimize visual intrusion from city infrastructure, and uphold high standards of park maintenance. Implementing these interventions may enhance the restorative capacity of city parks and promote the mental well-being of city residents.

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