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Analysis of Biophysical Potential and Urban Community Needs for Healing Forest in City Park 2 BSD, South Tangerang City

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Abstract

Interacting with nature is widely recognized for its ability to reduce stress and boost immunity. Healing forests have emerged as a safe, cost-effective form of preventive medicine, with city parks offering significant potential to support urban well-being. This study aims to identify and analyze the biophysical potential of City Park 2 BSD, evaluate stakeholder perceptions and preferences, and formulate a development concept for its transition into a healing forest. Originally established as a Corporate Social Responsibility initiative to address urban challenges, City Park 2 BSD serves as a vital green space for the community. Biophysical data were collected through field observations of ten parameters, while social data were gathered via questionnaires and interviews regarding residents' perceptions of healing forests. The results of this study indicate that City Park 2 BSD possesses characteristics that support its development as a healing forest. Out of the ten parameters assessed, three require improvement: natural aromatherapy, temperature, and humidity. Furthermore, there is a high level of awareness among urban residents regarding the importance of green open spaces for supporting mental and physical health. Based on a SWOT analysis, the concept for developing City Park 2 BSD as a healing forest follows an S–O (strength–opportunity) strategy. This involves five key approaches: creating spaces for relaxation and meditation, developing hardscape and softscape, enhancing promotion and branding, ensuring easy, affordable accessibility for all levels of society, and establishing institutional partnerships.

Keywords: healing forest, stress, SWOT, urban forest, urban health

1. Introduction

The modern health paradigm prioritizes the protection and maintenance of health over merely curing illness, which significantly reduces the public burden of medical costs. This preventive approach can be implemented through environmental services, rooted in the Biophilia Hypothesis, which suggests humans possess an innate biological connection to nature [1]. By engaging in healing activities in natural settings, the body stimulates the release of endorphins, promoting relaxation and enhancing positive moods. Consequently, these activities serve as a powerful tool for reducing stress and improving overall physical and mental well-being. Therefore, the development of healing forests represents a strategic and effective preventive health effort for urban populations.

The concept of a healing forest represents a form of nature-based recreation designed to enhance health and well-being. A healing forest is an activity in nature that activates the senses of sight, hearing, taste, smell, and touch to connect with nature [2]. In Japan, these activities are known as *shinrin-yoku*. The term *shinrin* means 'forest' and *yoku* means 'bathing,' together signifying the practice of 'bathing' in the forest atmosphere or experiencing nature through the senses [3].

One of the famous Green Open Spaces (*Ruang Terbuka* Hijau/RTH) in the Serpong District, South Tangerang City, is City Park 2 Bumi Serpong Damai (BSD). The park features a variety

of facilities currently utilized for recreation [4]. To support a healthy urban paradigm, preventive health measures can be implemented by transforming City Park 2 BSD into a formal healing forest. The therapeutic benefits of such a space are maximized when its biophysical potential meets the national standards stipulated in SNI 9006:2021. Consequently, this study aims to: (1) identify and analyze the site's biophysical potential; (2) evaluate the perceptions and preferences of stakeholders, including the local community and visitors; and (3) formulate a development concept to establish City Park 2 BSD as a model healing forest.

2. Materials and Methods

2.1. Research Area

South Tangerang City is located in eastern Banten Province, geographically positioned between 06°39'-06°47' South Latitude and 106°14'-106°22' East Longitude [5]. Serving as a vital buffer zone for DK Jakarta Province, the city is bordered by Tangerang City and DK Jakarta Province to the north, Depok City and DK Jakarta Province to the east, Bogor Regency and Depok City to the south, and Tangerang Regency to the west [6]. This study was conducted from September to December 2024 at City Park 2 BSD, a 9-ha site located on Letnan Sutopo Street, Ciater Village, Serpong District, South Tangerang City, Banten Province. The park's total area comprises 2 ha of riparian (river) section and 7 ha of green open space. The site's specific location and its surrounding administrative boundaries are illustrated in Figure 1.

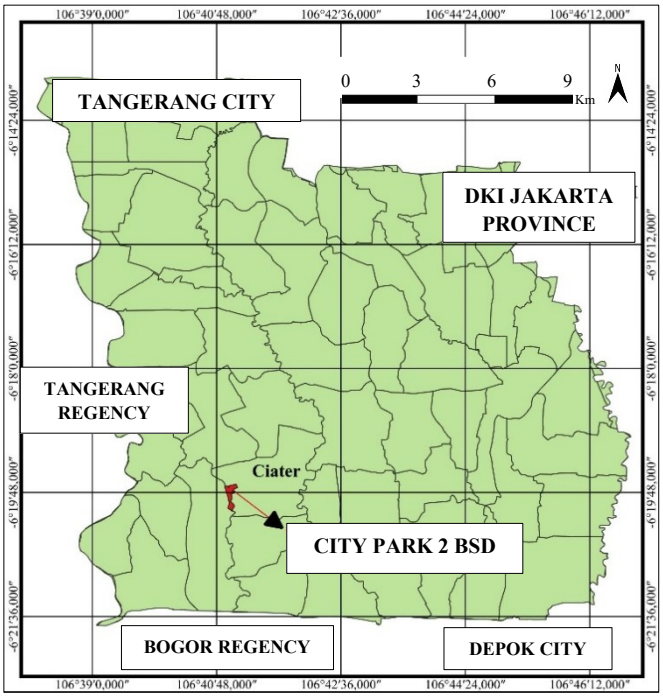

Figure 1. Map of the study area in City Park 2 BSD, South Tangerang City.

2.2. Tools and Instruments

Tools are generally designed for specific functions and can often be used without specialized skills. In contrast, instruments are more precise, complex devices intended for specific purposes, such as data measurement, and require in-depth expertise. This study utilized standards from SNI 9006:2021 [7] regarding forest tourism for healing therapy, covering noise, wind speed, temperature, humidity, slope, and canopy density. Following Ramdan and Kendali [8], parameters for light intensity and location security were added, while [9] contributed the assessment of natural aromatherapy and forest sounds.

Physical measurements were conducted using a dry-wet thermometer for temperature (standard 20–26˚C) and humidity (standard 40–80%), an anemometer for wind speed (standard ≤ 1 m/s), a sound level meter for noise (standard ≤ 50 dB), a lux meter for light intensity, and a clinometer for slope (standard 0–15%) [10]. Data for natural aromatherapy, location security, and natural sounds were collected through field observations. Canopy density was assessed via hemispherical photography using a camera, a fisheye lens, and a tripod, and then analyzed with HemiView 2.1. Social data were collected using specific instruments, including a questionnaire and an interview guide, and all data were processed in Microsoft Excel.

2.3. Data Collections

2.3.1. Abiotic and biotic

Abiotic data were collected for six physical parameters: noise level (sound level meter), light intensity (lux meter), temperature and humidity (dry-wet thermometer), wind speed (anemometer), slope (clinometer), and canopy density (hemispherical photography). Measurements were performed during three daily periods, such as morning (06:00–09:00), afternoon (11:00–14:00), and evening (15:00–18:00) with nine repetitions at 20-minute intervals for each session. This rigorous sampling method provides accurate data on environmental fluctuations and helps identify the most supportive times for relaxation or nature therapy. By capturing actual field conditions, the study can evaluate the optimal timing for forest activities and obtain a representative average of environmental quality. These findings are essential for determining necessary improvements to enhance visitor comfort and overall environmental control.

Biotic parameters assessed in this study included natural aromatherapy, natural sounds, and site security. Data were gathered through direct field observations to identify aromatic plant species and supplemented by visitor perceptions recorded via questionnaires. Wildlife and natural sounds were monitored using binoculars and audio recordings to identify species present at the four designated measurement areas (Figure 2). These measurement points were strategically selected based on high visitor accessibility and the presence of existing pedestrian paths. Leaf Area Index (LAI) was measured using digital hemispherical photography at five points within 20 x 20 m observation plots.

The canopy density at the research site was classified according to Ratnasih [11] into three categories, such as very shady (LAI > 2.4), medium shady (1.5 ≤ LAI < 2.4), and not shady (0.1 ≤ LAI < 1.5). The four sampling locations were characterized as follows:

- Location 1: Situated adjacent to the Plaza, this site features a ground surface with medium shade (LAI = 2.303).
- Location 2: Located near the amphitheater, characterized by a ground surface with sparse shade (LAI = 2.088).
- Location 3: Positioned near the Jalatreng River flow, featuring a grassy surface with medium shade (LAI = 2.275).
- Location 4: Situated on a grassy area with isolated single trees, exhibiting "not shady" conditions (LAI = 1.490) and positioned opposite Locations 1 through 3.

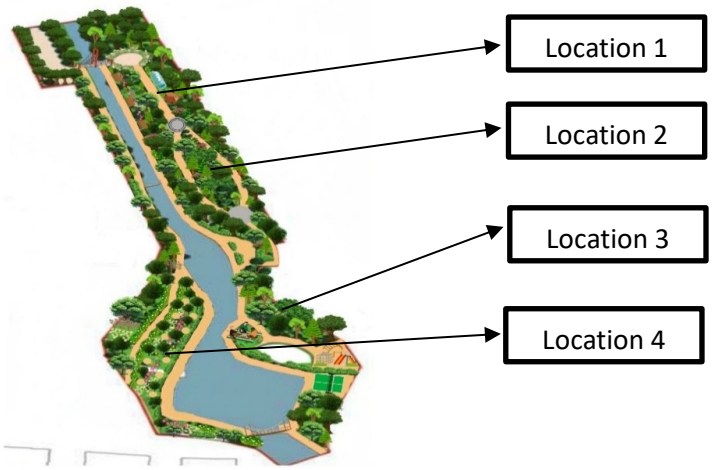

Figure 2. Map of research measurement points (Location 1–4). Selection criteria focused on existing infrastructure and on areas that provide a quiet forest atmosphere.

2.3.2. Perceptions and preferences

Data regarding perceptions and preferences were collected through questionnaires and interviews, with researchers providing direct assistance to participants during the survey process. The study involved 68 respondents, comprising 32 local residents and 36 visitors. Residents were defined as individuals living within 5 km of the site for at least 1 year who had visited the park at least twice, whereas visitors were individuals from any region. Participants were selected using the Accidental Sampling Technique, which identifies respondents who happen to be present at the location during the study [12] This approach ensured that those encountered on-site served as primary data sources for the research.

The study targeted respondents aged ≥ 17 years who were utilizing City Park 2 BSD for exercise, relaxation, or social interaction. To ensure data accuracy and prevent bias, researchers personally assisted respondents in completing the questionnaires, providing necessary explanations for complex questions. Additionally, formal interviews were conducted with key institutional stakeholders using a structured guide. These participants included representatives from the South Tangerang City Water Resources, Highways, and Construction Agency (SDABMBK) and the South Tangerang City Health Agency. This collaborative approach ensured that both public perceptions and official administrative perspectives were integrated into the study.

2.4. Data Analysis

The study synchronized the collection of biotic and abiotic data with actual field conditions to ensure accuracy. These findings were benchmarked against the urban park criteria for healing forests as established by SNI 9006:2021. A binary scoring system was applied for the assessment, where a score of 1 signifies compliance with healing forest standards and 0 indicates a failure to meet them. To identify the specific needs of City Park 2 BSD users, a comprehensive social analysis was conducted using both Likert scales and Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. This dual approach enabled a robust evaluation of both the site's physical potential and its stakeholders' strategic preferences.

2.4.1. Abiotic and biotic

Researchers conducted sensory-based assessments to identify natural aromatherapy through fragrant plants and other environmental scents [13]. Natural sounds were evaluated using auditory cues, while wildlife identification was conducted through direct observation of species present at the site. Canopy density was measured using hemispherical photography, with the resulting values categorized according to a field-modified version of the Ratnasih [11] scale. Land slope was measured with a clinometer to determine the gradient across the research locations. Abiotic data including noise, temperature, humidity, light intensity, and wind speed were calculated by averaging the measurements recorded during the morning, afternoon, and evening sessions.

2.4.2. Community perceptions and preferences

Community perception and preference analyses were conducted using a five-point Likert scale to evaluate views on urban forest benefits and identify necessary site developments. This scale is an established tool for measuring individual or group attitudes toward social phenomena, using a 1-5 scale (strongly disagree, disagree, undecided, agree, and strongly agree). To interpret the data, an interval range was calculated by dividing the difference between the maximum and minimum scores by the number of perception categories. Based on this calculation, a consistent range of 0.8 was established to categorize stakeholder perceptions and preferences. The resulting scale thresholds are defined as: strongly disagree (1.00–1.80), disagree (1.81–2.60), neutral (2.61–3.40), agree (3.41–4.20), and strongly agree (4.21–5.00).

2.4.3. Healing forest development strategy

A SWOT analysis was employed to formulate the development strategy for a healing forest in City Park 2 BSD. This involved preparing an Internal Factor Analysis Summary (IFAS) of strengths and weaknesses and an External Factor Analysis Summary (EFAS) of opportunities and threats, based on field observations, interviews, and literature reviews. These factors were incorporated into a questionnaire using a 1–5 Likert scale, as detailed in **Table 1**, allowing respondents to provide a weighted assessment for each component.

The final strategy was determined by multiplying assigned weights by ratings to calculate scores. These values were then mapped onto a SWOT quadrant diagram, where the x-coordinate represents the difference between strengths and weaknesses (S–W) and the y-coordinate represents the difference between opportunities and threats (O–T). The resulting position within the quadrant coordinates indicates the most appropriate strategic direction; whether aggressive, competitive, conservative, or defensive, based on the site's unique internal and external landscape [14].

Table 1. Description of weight and rating scores. The study used a weighted Likert-scale assessment, in which internal and external factors were evaluated via a questionnaire, and respondents provided their assessments.

Score	Assessment of current condition (weight)	Assessment of the urgency of handling (rating)
1	Very poor	Not very important
2	Poor	Not important
3	Fair	Moderately important
4	Good	Important
5	Very good	Very important

3. Results and Discussion

3.1. Result

3.1.1. General Condition

City Park 2 BSD is administratively located on Letnan Sutopo Street, Ciater Village, Serpong District, South Tangerang City. The park area is 9 ha, consisting of a 2 ha river area and 7 ha of open space, which means the urban forest provides 77.77% open space to support visitor activities. The Jaletreng River, a tributary of the Cisadane River, flows through City Park 2 BSD, which was first opened in 2006 and developed by PT Bumi Serpong Damai Tbk. The development of City Park 2 BSD was intended to overcome urban problems in South Tangerang's central trade area and serves as a form of Corporate Social Responsibility for the Serpong residential area to realize a clean and comfortable city through public green open spaces [4]. Currently, City Park 2 BSD is managed by the South Tangerang Public Works Office [6].

3.1.2. Respondent Characteristics

Visitors and the community at City Park 2 BSD are predominantly women, accounting for 21 residents (65.62%) and 24 visitors (66.67%). Women typically utilize the park for social activities, such as gathering with friends or family. The community is mainly composed of adults aged 26–35 years (31.25%), who require physical exercise and local social interaction to balance their daily routines. Meanwhile, visitor demographics are dominated by the 17–25 age group, totaling 16 individuals. These active teenagers and young adults seek social spaces to enhance their productivity and creativity.

Ethnic backgrounds vary, with the Sundanese tribe forming the majority of the local community at 14 people (43.76%). In contrast, the largest group of visitors is the Javanese tribe, totaling 14 people (38.89%). Regarding education, the community is dominated by university students (43.75%), while visitor education is concentrated at the high school level (44.45%). Education is a key indicator in the Human Development Index (HDI), with higher levels expected to improve local skills and contribute to better park development.

Occupational data shows that 25% of the local community work as private employees, whereas 36.11% of visitors are students. This high percentage of students aligns with the park's role as a frequent site for environmental study by schools and universities. By providing accessible green open space, City Park 2 BSD supports both students' academic needs and the working population's recreational needs. These demographic characteristics highlight the park's diverse social functions within the South Tangerang area.

3.1.3. Biophysical Potential

The assessment of biophysical potential follows SNI 9006:2021, the standard for healing forests, encompassing noise, wind speed, temperature, humidity, and crown density. To complement these standards, Ramdan [8] included parameters for light intensity and the availability of easy, safe access free from disturbances. Wahyudi [9] further noted that site potential is enhanced by therapeutic natural aromas, such as those emitted by specific plant species. Additionally, natural sound parameters were integrated into the assessment for their capacity to promote tranquility and enhance the site's overall value. The results of this comprehensive potential assessment are detailed in Table 2.

Table 2. Biophysical condition assessment results. These ten parameters were analyzed to assess conditions influencing concentration and comfort. Collectively, they play a critical role in creating an environment that supports mental, emotional, and physical recovery.

No.	Parameter	Standard	Results	Value
1	Noise	≤ 50 dB	50.4 dB	1
2	Light intensity	300–500 lux	341 lux	1
3	Wind speed	≤ 1 m/s	0.73 m/s	1
4	Temperature	20–26℃	29℃	0
5	Humidity	40 – 80%	85%	0
6	Canopy density	Medium – dense	Medium	1
7	natural therapeutic aromas	Yes	No	0
8	Nature sounds	Yes	Yes	1
9	Site security	Secure	Secure	1
10	Slope	Flat – sloping	Flat	1
Total				7

a. Noise

The primary source of noise at the site is vehicular traffic, including horns and sirens, due to its proximity to the highway [15]. Data analysis reveals that noise levels are significantly higher on weekends compared to weekdays, driven by increased human activity and social presence. In contrast, natural sounds are most prominent during the early morning and late afternoon. Specifically, bird and insect vocalizations are most audible between 6:00 and 7:00 AM and 5:00 and 6:00 PM. The comprehensive noise measurement results are presented in

Table **3**.

Table 3. Noise measurement results. Morning periods are characterized by audible natural sounds, whereas midday sessions see a decrease in animal vocalizations as human activity becomes dominant. By the evening, sounds of human activity continue to predominate; however, as night approaches, insect and bird sounds gradually re-emerge.

Description		Location measurements				Average (dB)
		1 (dB)	2 (dB)	3 (dB)	4 (dB)	
Weekday	Morning	48.26	49.11	50.67	48.63	49.17
	Afternoon	48.00	46.56	46.93	49.56	47.76
	Evening	48.31	48.17	47.12	49.98	48.40
	Average	48.19	47.95	48.24	49.39	48.44
Weekend	Morning	50.74	50.85	54.63	51.93	52.04
	Afternoon	54.26	54.78	56.15	53.11	54.57
	Evening	49.33	51.70	50.59	50.04	50.42
	Average	51.44	52.44	53.79	51.69	52.34
Average noise (dB)						50.39

b. Light intensity

Light intensity is the amount of light energy falling on a surface per unit area over a given time. While plants require sunlight as a primary energy source for photosynthesis, the average light intensity at the site is 341 lux, which is comfortable for visitors. Peak intensity levels were observed during midday, though measurements near the ground are significantly lower than in open areas due to the shielding effect of canopies and tree trunks. Trees with high canopy density effectively block sunlight transmission, creating a shaded environment [16,17]. The average results of these light intensity measurements are presented in Table 4.

Table 4. Light Intensity Measurement Results. Data indicate that light intensity levels beneath the canopy at measurement Locations 1, 2, and 3 were consistently lower than those recorded on open land (Location 4). This trend was observed throughout all morning, afternoon, and evening assessment periods.

Description		Light intensity (lux)				Average (lux)
		1	2	3	4	
Weekday	Morning	157.3	218.0	207.2	300.5	220.8
	Afternoon	297.3	438.7	411.0	1075.3	555.6
	Evening	190.7	250	212.6	372.9	256.5
	Average	215.1	302.2	276.9	582.9	344.3
Weekend	Morning	203.5	223.0	197.0	272.3	223.9
	Afternoon	321.8	385.9	356.9	1010	518.7
	Evening	217.2	223.2	205.5	441.3	271.8
	Average	247.5	277.4	253.2	574.5	338.1
Average (lux)						341.2

c. Wind speed

Vegetation structure significantly influences wind speed by directing, diverting, blocking, and filtering airflow. Data analysis reveals that the average wind speed at Location 4 was substantially higher than at Locations 1, 2, and 3. This difference is attributed to the dense tree cover surrounding the first three locations, which effectively reduced wind gusts [18]. Conversely, Location 4 consisted of an open field with only a few moderate-height trees, allowing wind gusts to be felt more strongly. The comprehensive results of these wind speed measurements are presented in

Table **5**.

Table 5. Wind Speed Measurement Results. The average wind speed recorded across the research locations was 0.73 m/s. According to comfort standards, this velocity is categorized as a comfortable range for visitor activities.

Description		Wind speed at each location (m/s)				Average (m/s)
		1	2	3	4	
Weekday	Morning	0.27	0.36	0.48	0.77	0.47
	Afternoon	0.56	0.61	0.78	0.89	0.71
	Evening	1.14	1.06	0.89	1.23	1.08
	Average	0.66	0.68	0.72	0.97	0.75
Weekend	Morning	0.33	0.40	0.59	0.61	0.48
	Afternoon	0.77	0.75	0.80	0.84	0.79
	Evening	0.66	0.86	0.85	1.09	0.86
	Average	0.58	0.67	0.75	0.85	0.71
Average (m/s)						0.73

d. Temperature, humidity and Temperature Humidity Index (THI)

The average air temperature at the study site was recorded at 29°C. The lowest temperatures occurred in the morning, averaging 25°C, while the highest were observed in the afternoon at an average of 31°C. Based on these measurements, the site temperature falls into the uncomfortable category, particularly during the afternoon and evening hours. Consequently, healing forest activities are best suited for the morning period when conditions remain more favorable. The comprehensive air temperature measurement results are presented in **Table 6**.

Table 6. Air temperature measurement results. The highest air temperatures were observed at Location 4, which is characterized by open space and limited vegetation. This finding indicates that solitary trees are less effective than dense canopy cover in providing thermal comfort and cooling the surrounding environment.

Description		Location measurements				Average (°C)
		1 (°C)	2 (°C)	3 (°C)	4 (°C)	
Weekday	Morning	26	26	26	27	26
	Afternoon	31	31	31	32	31
	Evening	30	30	30	31	30
	Average	29	29	29	30	29
Weekend	Morning	24	25	25	26	25
	Afternoon	30	31	32	32	31
	Evening	29	30	30	31	30
	Average	28	28	29	30	29
Average (Ĉ)						29

Relative humidity levels are strongly influenced by temperature, the quantity and quality of solar irradiation, vegetation density, wind movement, and air pressure [19]. In accordance with the inverse relationship noted by Edar and Wahyuni [10], higher air temperatures typically result in lower air humidity. While the ideal range for comfort is considered to be 40–75% [17], the average humidity recorded at the research site was 85.07%. The specific humidity measurement results are presented in Table 7.

Table 7. Humidity measurement results. The data demonstrate an inverse relationship: higher air temperatures correspond to lower air humidity levels. This trend was consistently observed across all measurement locations throughout the study period.

Description		Location measurements				Average (%)
		1 (%)	2 (%)	3 (%)	4 (%)	
Weekday	Morning	90	91	89	88	89
	Afternoon	82	78	78	76	78
	Evening	88	88	83	83	86
	Average	86	86	83	82	84
Weekend	Morning	92	88	89	86	88
	Afternoon	82	83	82	79	82
	Evening	86	85	87	85	86
	Average	87	85	86	83	85
Average (%)						85

THI is a metric used to evaluate human comfort levels based on the interaction between heat and moisture. According to the modified scale by Nieuwolt for tropical climates detailed in Table 8, the THI at the site ranges from "less comfortable" in the morning to "not comfortable" during the afternoon and evening. While the morning period remains relatively conducive for activity, the index shifts toward uncomfortable levels as the day progresses. These fluctuations are primarily driven by energy exchange processes within the atmosphere that affect air temperature. The comprehensive THI measurement results are presented in Table **9**.

Table 8. THI comfort intervals. The comfort range applied is a specific modification designed for tropical climates.

THI	Categories
21 < THI ≤ 24	Comfortable
24 < THI ≤ 27	Less comfortable
THI >27	Not comfortable

Table 9. THI measurement results. The data shows that the THI values ranged from 24 to 30. On average, the morning results fell within the "partly comfortable" category, whereas the afternoon and evening index values indicated an "uncomfortable" status.

Description		Location measurements				Average (dB)	Description
		1	2	3	4		
Weekday	Morning	25	25	25	26	26.08	Less comfortable
	Afternoon	29	30	30	31	31.43	Not comfortable
	Evening	29	29	29	30	30.29	Not comfortable
	Average	28	28	28	29	29.27	Not comfortable
Weekend	Morning	24	24	25	25	25.06	Less comfortable
	Afternoon	29	30	30	31	31.22	Not comfortable
	Evening	29	29	29	30	30.13	Not comfortable
	Average	27	27	28	29	28.81	Not comfortable
Average						28	Not comfortable

e. Canopy density

Leaf density and shade were evaluated using the LAI technique to estimate heat exchange and determine the relationship between environmental physics and canopy architecture. Measurements were conducted using digital hemispherical photography at five specific points within a 20 x 20 m square observation plot. To ensure accuracy, the camera was mounted on a tripod at a height of approximately 1 m, with the lens facing upward and oriented toward the north.

The resulting canopy cover photographs were processed and analyzed using Hemiview 2.1 software. The analysis yielded LAI values ranging from 0.96 to 2.69, with a calculated average of 2.04. Based on these findings, the specific classification of canopy density at the research site is detailed in Table 1.

f. Natural therapeutic aromas

The natural scents of a forest, including the fragrance of trees, wet soil, and leaves provide a significant relaxing effect. The study area contains 722 individual trees across 40 different species. According to Li [20] and Isnaniyah [6], the primary phytoncide-producing plants at City Park 2 BSD are cypress (*Casuarina equisetifolia*) and pine (*Pinus merkusii*). Despite the dominance of pine trees (306 individuals), the therapeutic plant aromas were not perceptibly present during the assessment. Consequently, introducing additional scented plant species is recommended to enhance the forest's healing benefits [21].

g. Natural sounds

Nature sounds, such as birds chirping, insect vocalizations, wind whistling, and gurgling water, contribute significantly to the therapeutic environment. Research findings reveal a distinct shift in dominant soundscapes between weekdays and weekends. During weekends, anthropogenic sounds, including talking, shouting, and footsteps become more prevalent due to increased visitor activity. Conversely, natural sounds are most perceptible in the morning and evening. It is during these specific times that bird and insect sounds are most clearly audible to visitors [11].

h. Site security

Site safety at City Park 2 BSD is primarily determined by the presence of wildlife and the health of the trees. Regular monitoring is necessary to detect structural issues early and prevent hazardous trunk or branch failures. Field observations and interviews with local vendors confirmed an absence of dangerous wildlife, such as venomous snakes, aggressive monkeys, or swarming insects. However, both managers and visitors must remain vigilant to maintain a secure environment during therapy sessions. Ultimately, providing safe, environmentally friendly infrastructure is essential to fostering the psychological calm and happiness required for effective forest healing [22].

i. Slope

The topography of the study site is notably varied, featuring a dominant flat slope alongside several steep sections. While the terrain outside City Park 2 BSD appears flatter, the topography within the urban forest is more diverse, ranging approximately from 2% to 25%. Although steep areas are already equipped with stairs to assist visitors, further accessibility improvements are necessary for healing forest activities. Given that the target participants range from youth to the elderly with diverse physical conditions, it is recommended to install sloped ramps in addition to existing stairs. These modifications will ensure the site remains inclusive and easy to navigate for all therapy participants [23].

3.1.4. Social Data Collection

a. Respondents' perceptions and preferences

Perception measurements were conducted to assess community recognition and knowledge regarding the urban forest's role as a healing space [24]. Analysis revealed that the highest values were associated with perceived benefits, such as comfortable temperatures, pollution reduction, and the park's role as a calm urban refuge [25]. These green open spaces support ecological balance by preserving air, water, and soil quality. Respondents noted that comfort is heavily influenced by shady, dominant vegetation that enhances aesthetics and refreshes the atmosphere. Consequently, the integration of complete facilities with this vegetation allows the public to utilize the space optimally.

Respondents reported that City Park 2 BSD significantly improves physical health through easier breathing and mental health by reducing stress [26,27]. The natural scenery provides essential psychological benefits, offering a necessary reprieve from tense daily urban routines [28]. As a friendly and open space, the park is accessible to all levels of society, including individuals with physical disabilities [29]. Preference data shows a strong desire to

visit in the morning, which aligns with biophysical measurements showing higher temperatures later in the day. Weekend visits are most common among workers, with average durations of two hours reflecting a preference for immersive forest experiences.

The primary motivation for visiting is to relieve fatigue, with strong support for healing forest activities like meditation and reflection [30]. Despite its high preference value, respondents indicated that City Park 2 BSD requires better management to address issues such as littering, broken trash bins, and scattered debris. Effective park arrangement is critical, as certain areas are currently marred by waste and poor maintenance. To meet visitor expectations for a healing environment, the park must transition toward a more structured and pristine ecological setting [31].

Based on design criteria, visitor preferences emphasize the need for adequate infrastructure, including clean toilets, prayer rooms, and disability support [32]. Future developments should prioritize dedicated healing facilities for yoga and therapy, along with pedestrian paths and access to drinking water. Vegetation elements should be diversified by adding fragrant, colorful plants and more shady trees to enhance the sensory experience. Finally, maintaining strict cleanliness and organizing street vendors are essential steps to ensure the park remains a high-quality destination for health and relaxation [33].

b. Healing forest development strategy

The SWOT analysis used a Likert scale to evaluate two distinct dimensions: the weight of current conditions and the urgency of handling. While the weight reflects the existing reality of the site, the rating establishes a priority scale based on respondents' needs [34]. By multiplying these factors, the study produced an IFAS score of 1.24 and an EFAS score of 2.06. These results place the site in the "Strengths-Opportunities" (SO) quadrant, as illustrated in Figure 3. Although the SO strategy is the primary recommendation, integrating elements from other quadrants is necessary to achieve optimal management results.

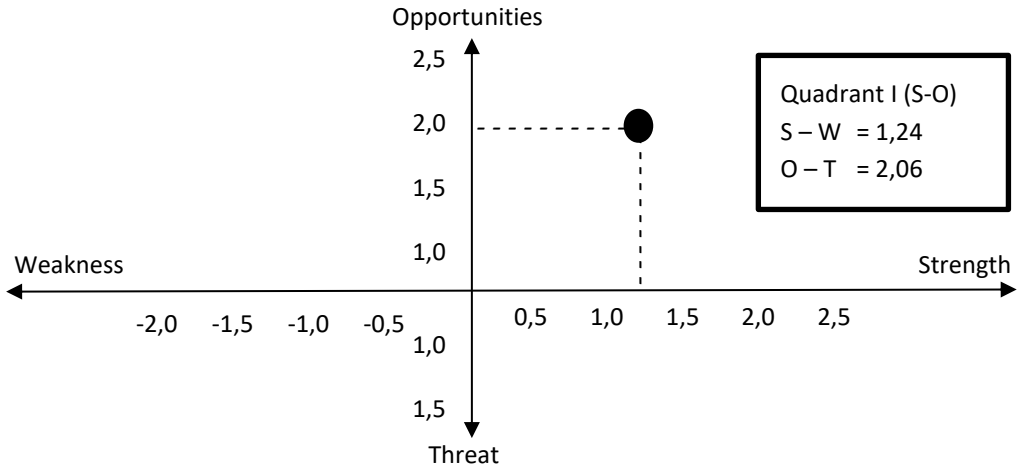

Figure 3. SWOT Chart.

3.2. Discussion

3.2.1. Biotic and Abiotic Potential in City Park 2 BSD

City Park 2 BSD serves as a vital public space in South Tangerang City, attracting visitors from across the region for sports, recreation, and social interaction. Field analysis of biotic and abiotic potential was conducted to determine how environmental factors influence concentration and support physical and emotional recovery. On weekends, the park experiences high visitor density from morning to evening, primarily driven by jogging and group exercise activities. This influx results in higher noise levels from exercise music, street vendor activity, and visitor interactions compared to quieter weekdays.

The average noise level at the site was 50.4 dB, slightly exceeding established comfort thresholds. According to SNI 9006:2021, the noise standard for healing forests should not exceed 50 dB to maintain a tranquil atmosphere conducive to relaxation. This marginal

deviation suggests that while the park has therapeutic potential, management must address weekend noise to meet official healing forest criteria. Ensuring sound levels remain within these limits is essential for creating the calm environment necessary for effective forest therapy.

Noise reduction can be achieved by limiting local noise sources, managing vehicle traffic, or utilizing soundproofing materials. Additionally, increasing vegetation in the area is an effective way to dampen external noise. Urban vegetation can reduce noise by up to 8.6 dB, as dense foliage blocks sound sources and absorbs approximately 0.6% of the acoustic energy. The effectiveness of this mitigation largely depends on the thickness of the vegetation belt along the road.

The ability of trees to reduce sound is significantly influenced by plant species, planting distance, canopy area, tree height, and trunk diameter. For optimal results, shady, dense tree types are preferred, particularly those with foliage growing close to the trunk. These specific structural characteristics maximize the plant's capacity to absorb and deflect noise.

The measured light intensity was comfortable, averaging 341 lux, thanks to the protection provided by tree canopies and trunks. Because trees with high canopy density effectively block sunlight, only a small amount of light passes through the limited gaps. Consequently, the light intensity under the canopy at Locations 1, 2, and 3 was significantly lower than in the open areas. These same trees influence wind speed by directing, diverting, blocking, and filtering airflow, thereby reducing the strength of wind gusts. In contrast, Location 4 featured only a few solitary trees in an open field, allowing wind gusts to be felt much more strongly.

The average temperature at the research location was found to be in the uncomfortable range, with "partially comfortable" conditions occurring only during the morning. Consequently, healing forest activities are best conducted in the morning hours to ensure participant comfort. Temperature reduction can be achieved by increasing the density of vegetation, particularly large trees that provide shade and create cooler microclimates. Furthermore, canopy closure in the "full" category at high density can reduce local temperatures by 3–4°C. Recommended species for this purpose include *Mimusops elengi*, *Ficus benjamina*, *Agathis dammara*, *Ficus lyrata*, *Cerbera manghas*, and *Diospyros blancoi* [16].

In addition to temperature, the site's air humidity remained above the ideal range. Humidity levels can be managed by increasing air circulation through the design of wind paths or natural ventilation. The overall comfort level (THI) is heavily influenced by the lack of vegetation cover, specific tree types, and tree health, all of which affect carbon absorption. Furthermore, the intensity of anthropogenic activities, such as domestic use, industry, and motor vehicles, continues to increase heat and air pollution in the area. These factors combined necessitate a strategic approach to vegetation management to restore environmental quality.

Canopy closure is the proportion of the sky area covered by plant crowns, including leaves, twigs, and branches, as viewed from a specific observation point. The research yielded LAI values ranging from 0.96 to 2.69, with a calculated average of 2.04. **Figure 4** presents the canopy shade photographs captured in the field to document these variations. The higher LAI values indicate denser vegetation, which allows for greater interception of solar radiation by the plants [12].

Figure 4. Canopy shade photographs and hemispherical analysis results: (a) Maximum LAI value of 2.69 representing high canopy density; (b) Minimum LAI value of 0.96 representing lower canopy density.

Natural forest aromas, including the scent of trees, wet soil, and leaves, provide a significant relaxing effect through phytoncides that positively impact human physical and psychological health [17]. City Park 2 BSD contains 722 individual trees across 40 species, including 306 pines, which are recognized as primary phytoncide producers along with cedars and spruces [19]. Despite the dominance of pines, the natural aromatherapy from these plants was not perceptible during the study, and other forest scents were only present sporadically. Consequently, adding more aromatic plants is necessary to strengthen the forest's therapeutic impact on health.

Research reveals a pronounced difference in soundscapes between weekdays and weekends, with human sounds such as talking, shouting, and footsteps becoming more prevalent on weekends due to higher visitor activity. Conversely, natural sounds from birds and insects are most audible in the morning and evening, when human presence is minimal, allowing wind gusts to be heard clearly at Locations 2, 3, and 4. During the day, the atmosphere tends to be quiet regarding wildlife, dominated instead by anthropogenic activity, with only occasional wind and the sound of water, specifically at Location 3. As the afternoon progresses toward evening, stronger winds contribute to a cooler atmosphere and a more audible natural soundscape. While urban noise is often fatiguing and disruptive to concentration, these natural sounds provide a restorative and opposite psychological effect.

Site security at City Park 2 BSD is primarily defined by wildlife presence and tree health, requiring regular monitoring to prevent hazardous trunk or branch failures. This is particularly critical, as previous incidents of trees falling due to rain and strong winds have already damaged local riverbanks. While field observations and vendor interviews confirmed the absence of dangerous wildlife, such as venomous snakes, venomous insects, wasps and bees, and aggressive long-tailed monkeys, both managers and visitors must remain vigilant. Providing safe, environmentally friendly infrastructure is essential to fostering the psychological calm and happiness necessary for effective forest therapy.

To proactively manage wildlife risks, the park should implement active surveillance with motion-sensor cameras and train specialized staff in emergency evacuation procedures. Management should also provide public education through warning signs in vulnerable areas and restrict animal access to high-traffic zones using fences or natural barriers. These combined measures ensure that the physical environment remains secure while supporting the site's therapeutic goals. Such a structured approach to safety allows visitors to focus entirely on their recovery without external distractions or safety concerns.

The topography within the urban forest area ranges from approximately 2% to 25% [6]. Certain steep sections, specifically the paths leading to the old amphitheater (Location 2) and to Location 4, are already equipped with supporting facilities such as stairs and sloped roads. These existing infrastructure elements facilitate easier access for various visitor groups, including youth, the elderly, and people with disabilities. Consequently, these improvements allow participants to engage in park activities with greater safety and physical comfort.

3.2.2. Healing Forest Development Strategy Matrix

The Healing Forest Development Strategy Matrix with SWOT is a planning method that identifies strengths, weaknesses, opportunities, and threats to determine the direction of development for healing forest areas. Through a combination of SO, ST, WO, and WT strategies, this method helps generate relevant, measurable, and sustainable development strategies.

Table 10. Healing forest development strategy matrix.

External / Internal	Opportunity	Threat
	1. High public preference 2. Global trend of increasing public awareness of the importance of green spaces for physical and mental well-being 3. Collaboration with various health institutions, yoga, meditation and schools	1. Limited costs 2. Competition with more modern and well-maintained parks or public facilities
Strength 1. Strategic location 2. Adequate parking available 3. A place for relaxing activities in the middle of the city 4. A large green open space with many large trees and plants 5. Jaletreng River Park and pedestrians around it 6. BSD 2 City Park can be used by all groups with various conditions 7. An area that provides coolness in the middle of the city	SO strategy 1. Provision of areas for relaxation meditation activities 2. Development of hardscape and softscape landscapes for HF activities 3. Promotion and branding of City Park 2 BSD as a HF destination 4. Easy, comfortable and affordable accessibility for all level of society 5. Establishing partnerships with health institutions, yoga, and meditation communities, school, and environmental organization	ST strategy 1. Seek alternative funding sources 2. Involve the community in advocacy and monitoring of policies and development plans around the park 3. Create flagship programs to increase the park's appeal and strengthen its position as a valuable public space
Weakness 1. Lack of human resources and experts in city park management 2. Lack of collaborative management between management and the community 3. No special space for healing forest activities 4. Lack of public understanding of the healing forest concept 5. Damaged pavement is dangerous for road activities during HF 6. There is no natural therapy scent 7. Uncomfortable air temperature during the day and evening 8. Low air quality (pollution) 9. Damaged, unmaintained plants reduce aesthetics	WO strategy 1. Conduct training and workshops for human resources 2. Develop a clear and transparent collaborative management mechanism 3. Carry out repairs and maintenance of existing hardscape and softscape landscapes	WT strategy 1. Optimizing the existing budget for human resources training 2. Determining improvement priorities based on urgency and available budget

3.2.3. Evaluation and Sustainability Planning

a. Providing relaxation and meditation activity areas

Dedicated relaxation and meditation areas can attract visitors interested in mental and spiritual health, increasing the area's popularity as a wellness destination [35,36]. These areas should be situated in quiet, secluded locations away from noise and surrounded by lush trees. To further enhance the relaxing atmosphere, the sites should be positioned near the sound of trickling water. Maintaining cleanliness and comfort is paramount to supporting the concept of nature therapy [37]. A natural and tranquil environment helps visitors feel more relaxed, connect with nature, and reap the therapeutic benefits of the setting [38].

b. Landscape development

Landscape development consists of two elements: hardscape and softscape. Softscape is a landscape element consisting of living and horticultural elements, including flowers, plants, shrubs, and trees [39]. The purpose of softscape is to provide character to the garden landscape, creating an impression and an atmosphere. Hardscape is hard landscape material

used to create an atmosphere in the environment, integrated into the landscape and supporting the beauty of the garden. The development of facilities in City Park 2 BSD for a healing forest begins by maximizing the use of existing facilities through cleaning and maintenance, so that development can focus on facilities that specifically support the healing forest concept.

4. Conclusions

Biophysical potential measurements indicate that most areas meet the requirements for developing a healing forest, though natural aromatherapy, temperature, and humidity require improvement. While City Park 2 BSD already has comprehensive facilities, it requires ongoing management, repairs, and additional infrastructure to support specific forest-healing activities. Stakeholders, including various government agencies and the community, welcome the healing forest concept, but further education through workshops, focus group discussions, and site visits is necessary. Based on a SWOT analysis, the development concept follows a strengths-opportunities (S-O) strategy. This approach includes five strategies: providing relaxation areas, developing landscapes, promoting the park as a wellness destination, ensuring accessible infrastructure, and establishing partnerships with health and environmental organizations.

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LKNS: Writing & Editing**; RH:** Conceptualization, Supervision, Review & Editing; and **EAMZ:** Conceptualization, Analysis, Review.

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The authors did not use any artificial intelligence-assisted technologies in the writing process.

Conflicts of Interest

There are no conflicts to declare.

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