

# Ecotherapy Healing Forest Concept in Natural Tourism Park (NTP) Mount Kelam Sintang Regency West Kalimantan, Indonesia

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## Abstract

*Ecotherapy healing forest (EHF) is a new approach that utilizes forest resources for health and increasing ecosystem value. EHF is an alternative that functions to provide physical and mental health interventions by utilizing the environment and forest ecosystem. Ecotherapy healing forest can also help ensure that environmental conditions can always be maintained, so that people's health and welfare can improve, in line with the Sustainable Development Goals (SDGs). This research was conducted in the area of Mount Kelam National Tourism Park, Sintang Regency, with data collection time in August 2022 – January 2023. Location selection is determined purposively by considering accessibility, travel time, and location value. The method used uses a site identification approach carried out on the routes available at NTP. The suitability of the Mount Kelam NTP location as a new EHT location was carried out by taking measurements at 6 location points covering an area approximately 8 ha, including measurements of vegetation, microclimate, noise level, wind speed and negative ion content. Based on the results of the analysis of site identification, community perceptions and preferences, site carrying capacity, and thermal comfort, the Mount Kelam Sintang Natural Tourism Park conservation area is very representative of being a site of ecotherapy healing forest which is beneficial for health. The final results of this research are described in the form of design recommendations for the site of ecotherapy healing forest at the six observation points.*

**Keywords:** Ecotherapy Healing Forest, Environment, Mental Health, National Tourism Park Mount Kelam, Sustainable development goals (SDGs)

## 1. Introduction

Forest ecosystems are an important support for human life, from land, water to air. Natural physical factors such as temperature, humidity, heat radiation, wind speed, climate comfort have an influence on human responses, especially health [1], while also playing a role in human psychological health which includes mental processes, stress, anxiety and emotions, cognitive processes, social life (skills, interactions, behavior and lifestyle) and spiritual well-being [2][3][4] and [5]. The biophilia theory coined by [6] explains that humans have a tendency to affiliate with nature which has restorative properties that are able to provide positive energy to human psychology [7]. In addition, the aroma of plant emissions in the forest atmosphere also

provides important benefits through the inhalation of biogenic volatile organic compounds (BVOC), especially certain plants that are endowed with antioxidant and anti-inflammatory activity, as well as being beneficial for psychological and cognitive processes [8].

Therefore, human interaction with nature (forests) becomes an important natural interaction [9] as well as being an inseparable part of human life which led to the creation of the concept of Ecotherapy healing forest (EHF). EHF is a new category of special interest tourism activities that uses a forest approach as a forum for carrying out healing therapy, maintaining and/or improving human health.

The concept of EHF has developed into a world trend as a new way to relieve stress, both physical and mental, improve concentration and memory, increase feelings of happiness, by presenting natural attractions as the main component of supporting therapy [10][11][12][13] and [14].

The UN has officially recognized the benefits and potential of forest therapy for recovery from the COVID-19 pandemic. Park et al., [15] states that forest ecosystems have various beneficial elements for humans, such as landscape views, clean air, sunlight, sound, phytoncide and anions, which can be directly felt and resonate with humans' sense of comfort. Humans will experience pleasant feelings when in nature (biophilia hypothesis), because genetically they have a homing instinct, affiliation and attachment to nature [15]. Robbins [16] adding about ecopsychology or how the effects of exposure to nature on health can reduce stress and increase healing. This is reinforced by the statement [17] that humans and the environment are integral natural systems in forming ecosystems that influence each other [18]. World Health Organization (WHO) identified that stress has become a global problem that continues to increase and is a risk factor for the development of diseases such as heart disease, diabetes and depression [19]. Furthermore, stress can be a cause of the phenomenon of death at a young age [20], thereby encouraging governments, businesses and health service providers to increasingly consider human needs for nature in the way they plan and operate. EHF is also a part of forest environmental services which is included in the cultural category which can be used as an idea to support the Indonesian economy so that it is in line with the Indonesian government's efforts to develop the economy. Afifah [21] states on the sustainable development side, ecotherapy healing forest ensures that the environment can always be maintained, so that people's health and welfare can improve, in line with the objectives of the Sustainable Development Goals (SDGs) [22].

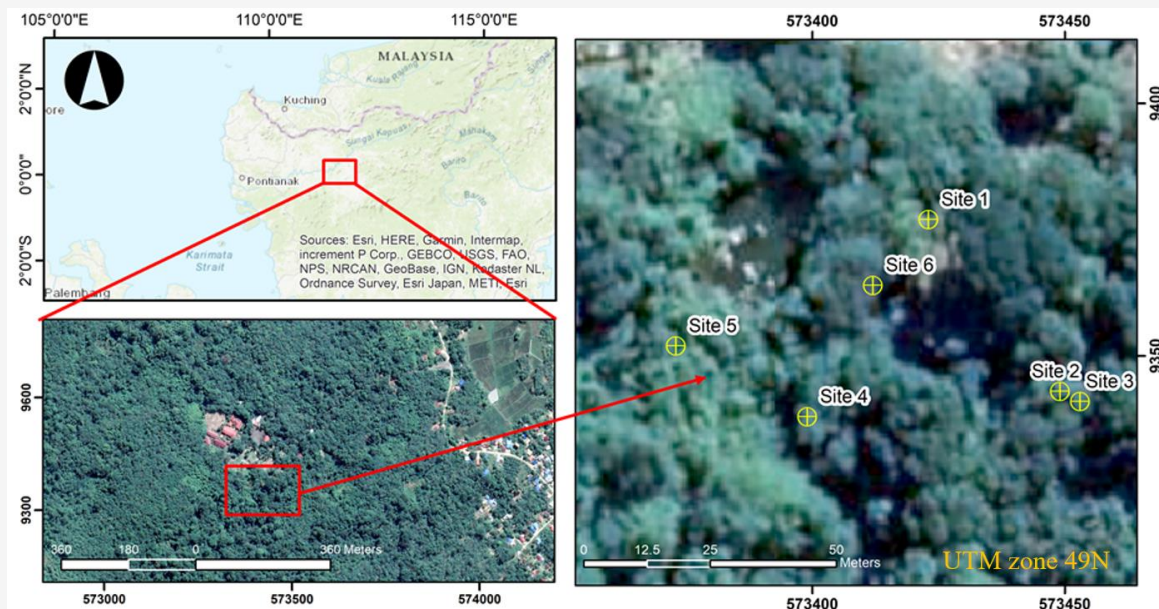
Optimizing forest environmental services through ecological healing forest ecotherapy can reduce the phenomenon of deforestation, making Indonesia a Green Tourism Destination and becoming an alternative tourism choice. The ecotherapy healing forest scheme has its own uniqueness in carrying out trading activities in environmental services without removing any ecosystem elements from the forest itself. This healing forest ecotherapy activity is not like ecotourism in general, but requires several special provisions that support the forest's function as a therapy, including selecting special spots that have a therapeutic function, creating therapeutic routes,

limiting the number of visitors, as well as health measuring instruments such as sphygmomanometers. Considering how important the ecotherapy healing forest is for people's lives, it is necessary to have a special representative site of ecotherapy healing forest. The site of ecotherapy healing forest study process involves spatial data and geoinformation to obtain measurable information. As a first step, it is necessary to identify the site with several measurement parameters in accordance with the rules, principles and functions of forest tourism for health therapy based on SNI 9006:2021, which includes: academic principles, principles of professional responsibility, precautionary principles, principles of connecting people to nature. From the results of the site identification, then supported by community perceptions and preferences, site carrying capacity, and thermal comfort (microclimate), a draft design recommendation for each site will be presented, so that the site of ecotherapy healing forest in the future can provide maximum benefits for public health. Based on this background, this research tries to examine EHF from a geoinformation perspective in the area of Mount Kelam NTP.

## 2. Material and methods

The study was conducted in the area of Mount Kelam NTP, Sintang Regency, West Kalimantan Province. Data was taken between August 2022 to January 2023. Mount Kelam NTP is included in the area of the Natural Resources Conservation Center of West Kalimantan Province, in the management area of conservation section II of Sintang Regency. The site location is determined purposively by considering several things, namely: (1) accessibility to the location around 20 m from Sintang city; (2) can be reached in 30 minutes using a private vehicle; (3) has exotic natural tourist attractions. Location determination and site identification are based on the parameters contained in SNI 9006:2021 concerning forest tourism for health therapy, and are carried out on the routes available at NTP. Mount Kelam is divided into 6 measurement points with a total tracking distance of 3.9 km and a land area of 8 Ha, including measurements of: (a) vegetation measurements (2) microclimate (3) noise level (4) wind speed (5) negative ion content.

The proximity of each location, from site 1 to site 6, taking into account the unique natural characteristics of each location that are not found in other locations and supported by a pedestrian area that is not too far away, so it is hoped that in the future the EHF location This can be intended for all ages including elderly parents



**Figure 1:** Mount Kelay Nature Tourism Park (NTP)

## 2.1 Normalized Difference Vegetation Index (NDVI) Calculation

Vegetation measurements are carried out using 2 techniques:

### 2.1.1 Vegetation analysis

The method used to study vegetation at the ecotherapy healing forest location uses the census method, with a single plot covering an area of 8 km. Tree species are measured based on plant level mature trees, poles, saplings, seedlings, undergrowth (ground cover). This observation was carried out along the route by recording the name of each type of plant encountered. The Importance Value Index (INP) for pole and tree levels is calculated using equation 1.

$$INP = KR + DRr + FR$$

Equation 1

where:

<i>KR</i>	is relative density
<i>DRr</i>	is relative dominance
<i>FR</i>	is relative frequency

Meanwhile, the seedling and sapling levels are calculated using equation 2.

$$INP = KR + FR$$

Equation 2

The species richness index (*D*) is used to determine the species richness of individuals, it can be determined from equation 3.

$$D = \frac{S-1}{\log(N)}$$

Equation 3

where:

<i>D</i>	is species richness index
<i>S</i>	is number of types
<i>N</i>	is number of individuals

The dominance index (*ID*) is a parameter that states the level of centrality of species dominance in a community which can be determined from equation 4.

$$ID = \sum_{i=1}^N \left( \frac{n_i}{N} \right)^2$$

Equation 4

where:

<i>ID</i>	= dominance index
<i>n<sub>i</sub></i>	= importance value of <i>i</i> species
<i>N</i>	= total important values

The species diversity index (*H*) is an index that states the characteristics of community levels based on their biological organization using equation 5:

$$H = - \sum_{i=1}^N \left( \frac{n_i}{N} \log \left( \frac{n_i}{N} \right) \right)$$

Equation 5

where:

$H$  is species diversity index  
 $n_i$  = importance value of  $i$  species  
 $N$  = total important values

The species abundance index ( $e$ ) is influenced by species diversity and number of species as expressed by equation 6.

$$e = \frac{H}{\log(S)}$$

Equation 6

where:

$e$  is abundance of species  
 $H$  is species diversity  
 $S$  is number of types

### 2.1.2. Normalized difference vegetation index

Vegetation measurements are carried out by measuring vegetation density. This vegetation density is obtained from the Normalized difference vegetation index (NDVI). The image used for NDVI calculation is sentinel 2 obtained from <https://sentinels.copernicus.eu/web/sentinel/home>. NDVI is the result of calculations from equation 7 [23].

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

where:

$NIR$  is near infrared spectral band  
 $RED$  is red spectral band

Equation 7

The range of vegetation density levels is classified into five classes as illustrates in Table 1.

### 2.2 Microclimate

Air temperature and humidity also light intensity are the main microclimate data used in developing this concept. Measurements for air temperature and air humidity use a humidity thermometer, hygrometer, while for light intensity you will use a lux meter. This

measurement was carried out during the time period from 08.00-11.00 WIB for air temperature and humidity. Meanwhile, for light intensity, this measurement was carried out during the time period from 08.00-15.00 Western Indonesian Time (WIB) every 15 minutes for one week (Monday-Sunday) using a lux meter. Apart from that, from the results of measurements of air temperature and air humidity, the thermal humidity index (THI) value is determined as an indicator of thermal comfort. From the results of measuring temperature and humidity data, the THI is determined from equation 8 [24].

$$THI = 0.8T + \frac{RH \cdot T}{500}$$

Equation 8

where:

$T$  is air temperature ( $^{\circ}C$ )  
 $RH$  is air humidity (%)

The comfort index value is then determined using the comfort category in the research area with a range of THI values in Table 2.

### 2.3 Slope

The development of the Ecotherapy Healing Forest concept also requires an analysis of the slope level in selecting the site location, where the slope is an illustration of the relative size of the slope of the land which is measured based on a flat plane benchmark, and is generally illustrated in degrees or percentages [25]. The level of slope was measured by conducting geographic information system (GIS) analysis using 10m resolution sentinel 1 imagery and ArcMap 10.4.1 software. Sentinel 2 imagery 10m resolution. The image used for NDVI calculation is sentinel 2 (<https://sentinels.copernicus.eu/web/sentinel/home>). The slope level is classified into 5 height classes which are shown in Table 3. The slope is a priority because it concerns safety aspects for activities in open spaces [26].

**Table 1:** Vegetation density based on NDVI [27]

NDVI	Vegetation Density
$0.8 < NDVI \leq 1.0$	High
$0.6 < NDVI \leq 0.8$	Moderatly high
$0.4 < NDVI \leq 0.6$	Moderately Low
$0.2 < NDVI \leq 0.4$	Low
$0 < NDVI \leq 0.2$	Very low
$\leq 0$	No vegetation

**Table 2:** THI comfortability level [28]

THI	Category
< 8	Uncomfortable (too cold)
$8 \leq \text{THI} \leq 21$	Tolerable (Comfortable if there is light)
$21 \leq \text{THI} \leq 24$	Comfortable
$24 < \text{THI} \leq 26$	Tolerable (Comfortable if there is cold)

**Table 3:** Slope Classification [29]

Class	Slope (Degree)	Description
1	0-10	Flat
2	10-20	Sloping
3	20-30	Somewhat Steep
4	30-40	Steep
5	>40	Very Steep

#### 2.4 Noise level

Sound is a living part of all ecosystems on earth, where in some conditions the sound transforms into an unpleasant or unwanted entity, which is called noise. The intensity of the disturbance is influenced by the quality of the sound and the attitude we show towards it. Sound measurements help identify levels that are detrimental or indicate errors, and are useful in reducing noise [30]. Noise levels are measured using a sound noise level meter. Noise measurements refer to the Decree of the Minister of Environment number 48/MenLH/11/1996 concerning noise level standards, namely taking measurements within a period of 10 minutes. Data recording is carried out every five seconds, with the height of the measuring instrument microphone being 1.2 m from the ground and a proportional distance between the measuring officer and the microphone. Outdoor noise measurements are carried out using microphone instruments which are generally installed on the ground [31]. The movement delay between different measurement locations is spaced up to five minutes to reduce instability in the surrounding environment. Noise level is a factor to consider because humans will be able to perform maximum meditation in a calm and quiet location. Noise problems can be a serious health problem after air pollution [32].

#### 2.5 Wind speed

Wind speed is measured using an anemometer, and the meteorological unit is Knots (Beaufort Scale). The tool must be placed in an open area when the wind blows, the propeller on the anemometer will move in the direction of the wind. The units used in the Anemometer are based on wind direction and meteorological units are  $0^{\circ}$ - $360^{\circ}$  from the cardinal

direction. Wind is a factor that can be dangerous if it occurs at extreme intensity [33]. The wind that blows over the Indonesian archipelago, especially across the island of Kalimantan, is the Australian-Indonesian monsoon system [34].

#### 2.6 Negative ion

In this research, to measure the negative ion content, a negative ion tester will be used, in order to determine the level or quality of negative ion concentration in the air. Atmospheric ions (air) and terrestrial organisms always coexist.

Under natural conditions, ions are formed in the region below the atmosphere through various initial energy sources, such as cosmic rays, natural radioactivity from the atmosphere and soil, and electrical discharges [35]. Proposed the hypothesis that serotonin has a role in triggering significant neurovascular, endocrine, and metabolic effects in humans or animals, and has a crucial role in regulating basic life patterns such as sleep and mood [36]. Further explains that exposure to Negative Ions has a broad impact on human and animal health, and has the potential to act as an antimicrobial agent and plant fertilizer [37]. The impact of Negative Ions on human and animal health is mainly related to the cardiovascular and respiratory systems, as well as mental health aspects. In terms of the cardiovascular system, Negative Ions can improve erythrocyte deformability, increase aerobic metabolism, and lower blood pressure. Meanwhile, in the context of mental health, exposure to Negative Ions has shown very significant improvements in psychomotor tasks, feelings of cheerfulness, and levels of alertness [37] and [38].

### 3. Result

#### 3.1 Vegetation measurement

In healing forest ecotherapy, vegetation is one of the main considerations, considering that vegetation has a big influence on thermal comfort conditions (air temperature), where lush and wide vegetation canopies will be able to provide larger areas of shadow and shade [39]. Vegetation also plays a role in producing substances known as plant killers or phytoncides which are the plant's immune system which regulates the growth of infections in plants. Based on studies that have been conducted, it shows that the human body responds positively to phytoncides [40]. The green color that comes from vegetation also makes humans feel very comfortable, combining natural fractals has been scientifically proven to reduce stress by as much as 60% [12]. So, if we as a species find calm in certain natural environments in the form of comfort, repair and even healing, then connecting with nature becomes an important component of well-being for humans. Based on vegetation analysis carried out at the research location as shown in Figure 1.

The species richness index for seedlings, saplings, poles and trees usually ranges from 0-4, if

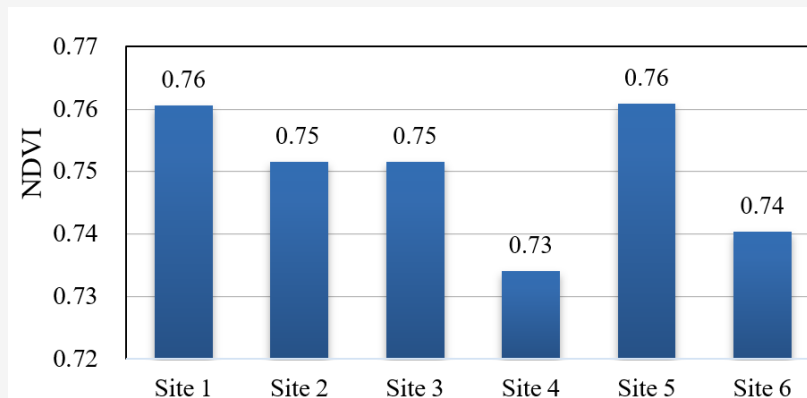
it is more than 4, this indicates that the richness of vegetation species at the research location is high so it really supports the formation of comfortable thermal conditions in the forest which can support success. healing forest ecotherapy treatment. The Dominance Index (*ID*) of seedlings, saplings, poles and trees is quite small, indicating that at the research location the species dominance pattern is spread across several dominant species, one of which is the dominance of *Dipterocarpa* (*Dipterocarpus spp.*, *Shorea spp.*, *Hopea spp.*, and *Dryobalanops spp.*) with a dense canopy, which influences temperature, humidity and light intensity in the forest. The species diversity index value is greater than 3, indicating that the species found in the research location have a high level of stability, because the higher the species diversity index (*H*) value, the more stable the species in the community. The level of stability of species in a community uses the value of the species evenness index (*e*), the higher the value of *e*, the more stable the stability of species diversity in the community. This will support the sustainability of healing forest ecotherapy in the future so that it is beneficial for public health (Table 4). The NDVI of each site illustrates in Table 5 and Figure 2.

**Table 4:** Vegetation index measurement

No	Description	Levels			
		Seed	Tree	Pole	Stake
1	Species Richness Index ( <i>D</i> )	31.563	29.367	30.100	29.584
2	Dominance Index ( <i>ID</i> )	0.021	0.028	0.017	0.027
3	Species Diversity Index ( <i>H</i> )	4.215	4.094	4.242	4.002
4	Species Abundance Index ( <i>e</i> )	2.146	2.122	2.211	2.097

**Table 5:** The NDVI at all sites

Index	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
NDVI	0.76	0.75	0.75	0.73	0.76	0.74



**Figure 2:** NDVI at each site



The average value of NDVI index all site is still included in the very good category, where each site DFhas different vegetation characteristics. Site 1 is dominated by a variety of flowers, with *Terminalia catappa* being large in diameter and having a wide canopy, shading the surroundings. Site 2 is dominated by vegetation of *Durio Zibenthinus*, *Terminalia catappa* and *Shorea pinanga* with a large diameter of  $\pm 150$  cm and above, which has a wide and lush canopy. Site 3 is dominated by pole-level vegetation and trees with a diameter of more than 10 cm with a wide and dense canopy. Site 4 is dominated by *Bambusa vulgaris schrad* vegetation, where bamboo is one of the largest oxygens producing plants compared to other plants. Site 5 is dominated by vegetation at the seedling level, saplings and poles as well as *Bambusa vulgaris schrad* which is not too dense, with various forms of rock, and the light intensity is still very sufficient at this site. Site 6 is dominated by *Bambusa vulgaris schrad* vegetation, around water sources.

### 3.2 Microclimate

Ecotherapy healing forest requires comfortable conditions. Comfortable conditions include circulation, climate, noise, aroma, security, cleanliness and beauty [39]. Microclimate is one that greatly influences thermal comfort conditions. Temperature, air humidity and the Temperature Humidity Index (THI), greatly influence thermal comfort conditions, which can provide comfort for the surrounding community [40].

#### 3.2.1 Temperature

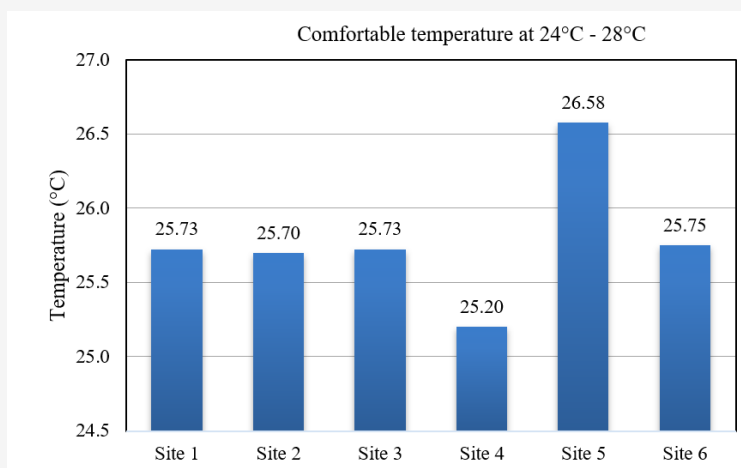
Physical characteristics of forests such as temperature, humidity, atmospheric pressure, wind speed can influence physiological and psychological health responses through the five human senses [41].

Humans tend to feel more comfortable at the right air temperature, air temperatures that are too hot or cold are not good for human psychological and physiological health, temperatures that are too low or high can increase lactic acid levels and affect oxygen intake (oxygen intake), which is less than optimal [42]. Humans tend to be uncomfortable and can cause physiological and psychological stress if they experience this condition [41]. The temperature of each site depicts in Figure 3.

The temperature measurement values at site 1 – site 6 have temperature values still in the range of 25°C - 26°C and according to SNI 9006:2021 and the air temperature measurement results are still in the range of 24-28°C, still included in the thermally comfortable category [42]. When conforming to SNI 9006: 2021, then this kind of location is only limited to health improvement -oriented activities (promotive) and disease prevention (preventive), not for healing (curative), recovery (rehabilitative), health maintenance (preservative), and healing risky diseases (palliative).

#### 3.2.2 Humidity

High humidity will increase body temperature, so sweat or body fluids can come out excessively, excess fluid expenditure without consuming fluids can cause dehydration, this condition can cause humans to tend to feel uncomfortable [43]. Baehaqi [42] added, physical microclimatic factors such as air temperature, air humidity, heat radiation, wind speed, climate comfort influence human health responses, so that microclimate factors are one of the main considerations for determining a representative site for healing forest ecotherapy therapy. Figure 4 illustrates the air humidity measurements for each site.

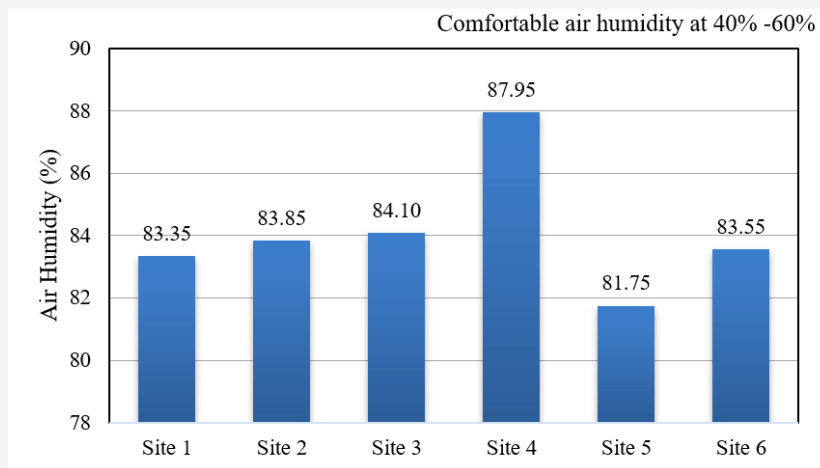


**Figure 3:** Temperature at each site

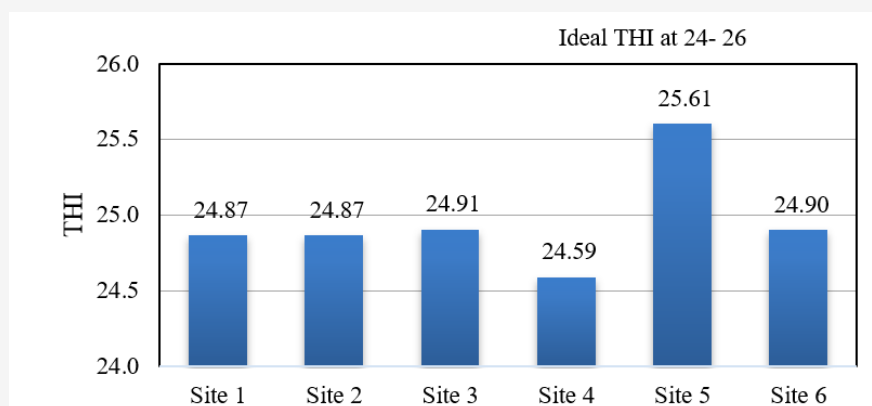
The air humidity measurement value at site 1 – site 6 ranges between 83%-87% and is included in the high category. This is because the research location is in Sintang Regency, which is part of the West Kalimantan Province. Based on its specific geographic location, it is directly crossed by the Equator ( $0^{\circ}$  latitude) precisely above Pontianak City, making it a tropical area with quite high air temperatures accompanied by high humidity and rainfall. Apart from that, Kalimantan forests are also included in tropical rain forests, with the dominance of *Dipterocarpa* (*Dipterocarpus* spp., *Shorea* spp., *Hopea* spp., and *Dryobalanops* spp.) and are characterized by a dense canopy and lots of lianas (climbing plants) such as rattan and bamboo [44]. This condition of a fairly high vegetation density is what causes the humidity in the air to be higher, because the litter covers the ground surface tightly, causing water vapor to be locked in it [45].

### 3.2.3 Thermal Humidity Index (THI)

Thermal Humidity Index is a method that can be used to assess the level of comfort in an area, where variations in THI values are influenced by temperature and air humidity which are categorized into forms of comfort such as comfortable, moderate and uncomfortable categories [44]. Where a THI value that is excessive or very low can cause an unfavourable body response, because the heat moving in and out of the body is inadequate or excessive [45]. Forest healing ecotherapy can provide maximum benefits when carried out in a location with comfortable conditions. The Thermal Humidity Index measurement result for each site illustrates in Figure 5. The Thermal Humidity Index (THI) measurement value at site 1 – site 6 has a value ranging between 24-25°C and is included in the comfortable category. A Thermal Humidity Index (THI) value in a comfortable range is needed to provide good health response changes [46].



**Figure 4:** Air humidity at each site



**Figure 5:** THI at each site



### 3.2.4 Light intensity

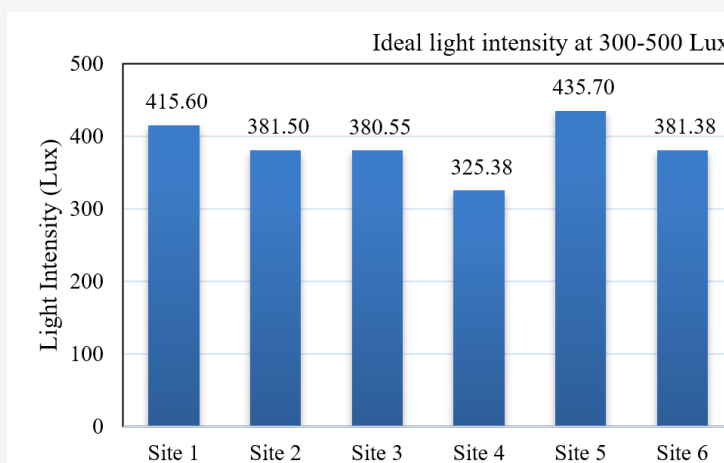
Light intensity is closely related to canopy density, when canopy density is high light intensity tends to be low and vice versa [47]. If the vegetation density is denser, the oxygen released into the air will be higher. Most types of trees can also release phytoncides which can have a positive effect on the health response in forest bathing activities [3]. Light intensity measured from each site in the study area depicts in Figure 6.

The light intensity measurement values at site 1 – site 6 have values ranging between 318 – 415 Lux and are included in the ideal category. Light intensity with an ideal value range tends to be comfortable for humans during activities and does not cause eye fatigue [48]. Eye fatigue can cause symptoms such as eye irritation, double vision, headaches, decreased accommodation power and visual acuity, which can interfere with the health response of ecotherapy healing forest [49].

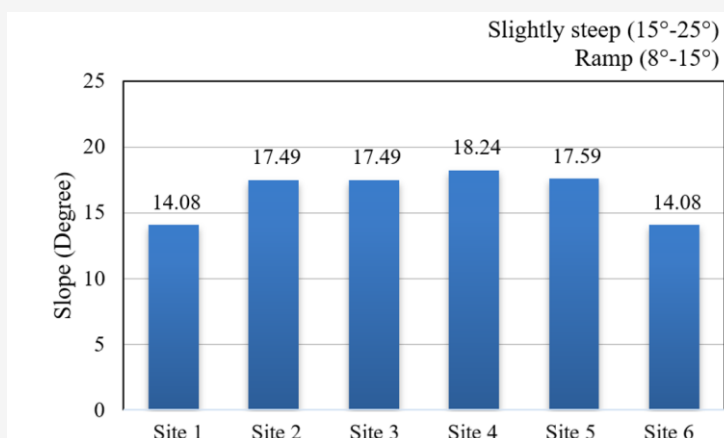
### 3.3 Slope

In healing forest ecotherapy, the slope value of the site is one of the considerations in determining whether the location is representative, because it influences the health response of visitors when tracking. High slopes can cause higher physical activity which can be tiring [42]. Slope measured at each site depicts in Figure 7.

The average value of the slope index from site 1 until site 6 is still included in the gentle and slightly steep category, so it can still be recommended as a site of ecotherapy healing forest, considering that it is not yet included in the steep or very steep category. Slopes that are too steep can cause physical activity and excessive muscle contractions, lack of oxygen and fatigue in the body so that the body will have difficulty reducing lactic acid levels which then causes a buildup of lactic acid, which causes aches and pain and the body becomes uncomfortable [50].



**Figure 6:** Light intensity at each site



**Figure 7:** Slope at each site

### 3.4 Noise

Beutel et al., [51] found that there is a relationship between noise and the human psychological level, where the higher the noise disturbance will cause the greater the human psychological disturbance. Several studies have shown that humans prefer natural sounds compared to urban sounds. As was done by researchers from Brighton and Sussex Medical School (UK) who looked for the relationship between the brain and the body with various kinds of sounds from nature and man-made sounds. The results show that natural sounds can reduce the human body's sympathetic nervous system and increase the parasympathetic system, which indicates that healing forest therapy will make people feel calmer when listening to natural sounds [12]. Noise level measured at each site depicts in Figure 8.

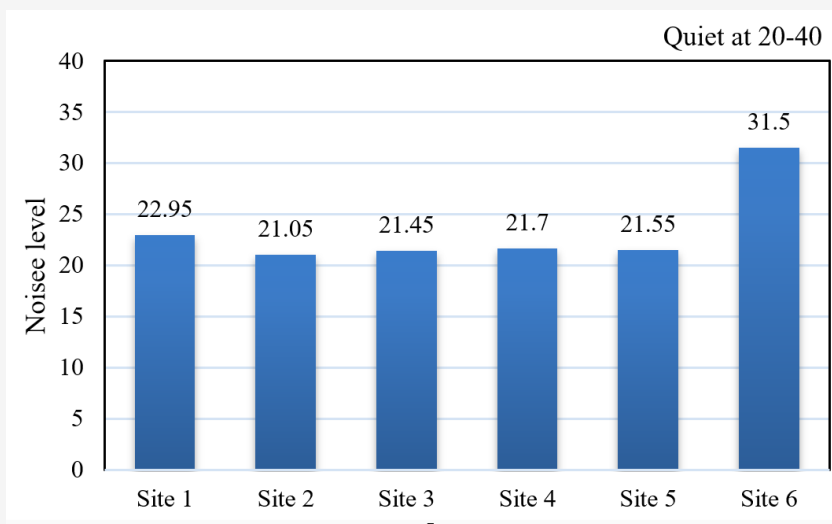
The average noise value from site 1 - site 6 is included in the ideal (quiet) category, so it is very representative of being a healing forest ecotherapy location. The noise value at site 6 is the highest among other sites, because at site 6 there is a water element, so there is a gurgling sound water combines with the friction of leaves and tree trunks. Noise that exceeds the ideal value range can have a negative impact on changes in human physiological and psychological health responses [52]. Noise also influences people's comfort levels for activities, levels of depression and also influences changes in blood pressure [53] and [54]. Nature is very important for humans, the sound of canopy, flowing water, birds singing can make humans tend to be more relaxed [55].

### 3.5 Wind Speed

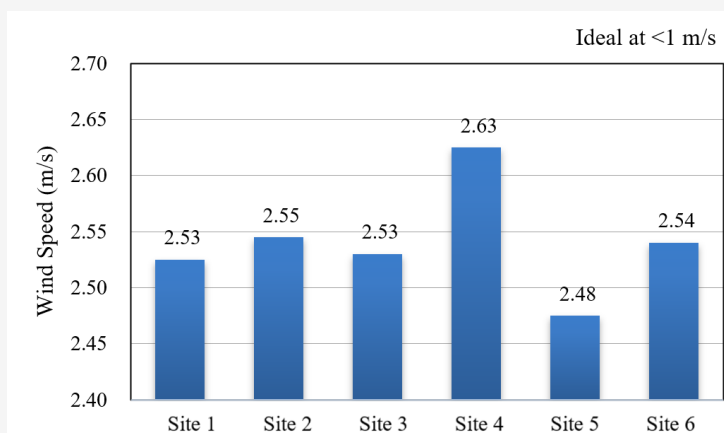
Microclimate elements such as temperature, humidity, solar radiation, wind speed greatly influence the state of the environmental microclimate and thermal comfort in the surroundings [56]. Physical characteristics of forests such as wind speed can also influence physiological and psychological health responses through the five human senses [57]. The results of noise measurements for each site is presented in Figure 9. The average wind speed value from site 1 - site 6 is included in the above ideal category ( $>1\text{m/s}$ ). However, this is normal considering that Indonesia experiences the rainy season during the west monsoon and the dry season during the east monsoon, as well as the location of Indonesia's territory in the equatorial region and the geographical situation which consists of 70% of the water area, which causes Indonesia to have large wind energy potential [58].

### 3.6 Negative Ions

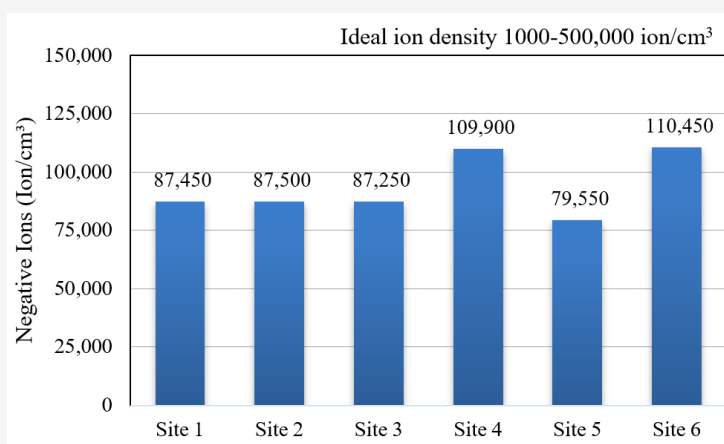
Abundant negative ion content can be found most often in forest, mountain and waterfall ecosystems, affecting human health by increasing the activity of NK cells, the parasympathetic and relaxed nervous systems [59]. Negative ions in the air in the healthy air category have a very good effect on human health [60]. This is one of the reasons why the negative ion content can be considered as a representative location for healing forest ecotherapy. According to Figure 10, the following data was obtained: The average value of negative ion content from site 1 - site 6 is included in the health category. And the highest negative ion value is at site 6 (near the water source).



**Figure 8:** Noise level at each site



**Figure 9:** Wind speed at each site



**Figure 10:** Negative ion content at each site

The flow of water from the source is the most healing factor in the health therapy process [12]. Water is a fundamental requirement in all life, a source of beauty and healing power because water can bring the essence of peace [40]. One of the relationships between humans and water is that humans have the power to bring blessings and water has the power to bring all these blessings. This is written in religious traditions such as baptism rituals where it is believed that baptismal water can provide blessings. The negative ion content is greatly influenced by air temperature, the presence of plants, light intensity or radiation and water elements [37] and [60].

#### 4. Design Recommendations

The site of ecotherapy healing forest design recommendations provided in this research refer to the results of site identification analysis (Identification of the Mount Kelam NTP landscape with several measurement parameters, to see its

suitability as a site of ecotherapy healing forest), community perceptions and preferences (to interpret data, identify problems and projecting a representative site of ecotherapy healing forest design into the future), site carrying capacity, and thermal comfort.

##### 4.1 Site 1

Site 1 was designed as an induction site, taking into account its gentle slope and being dominated by a variety of flowers and several trees with large diameters and wide canopies as illustrates in Figure 11, making it ideal as a gathering place and initial conditioning for tourists. At site 1, the interpreter provides information and instructions regarding the detailed implementation of therapy activities, including health checks, as well as initial conditioning for tourists to relax, one of which is tea party activities (drinking tea or regional health drinks).

Green tea is an exogenous antioxidant (antioxidants from outside), which can reduce oxidative stress (a condition where there is an imbalance between oxidants and antioxidants in the body which can trigger psychological stress) [61]. Between site 1 and site 2, space can also be designed for walking and resting for a while enjoying the natural air. Lee et al., [57] indicates that walking in the forest can improve health status and tends to reduce individual psychological stress, especially since walking is a common form of physical activity that is often carried out and is an important activity in preventing cardiovascular disease.

#### 4.2 Site 2

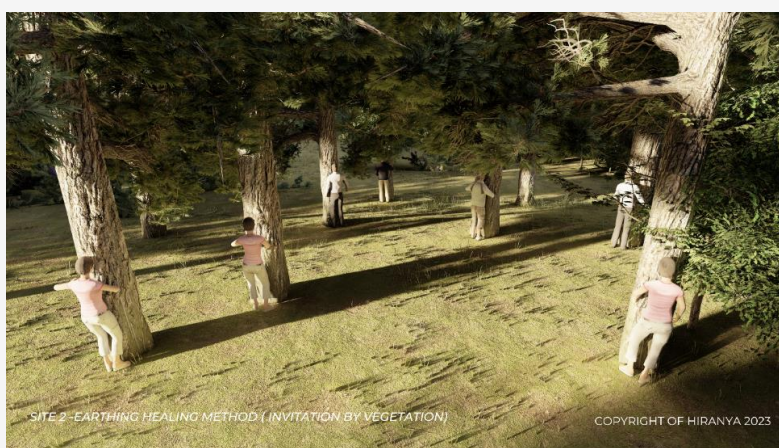
Site 2 is dominated by trees with a large diameter and has a wide and dense canopy as shown in Figure 12, so it is appropriate to design it as a relaxing health therapy site. Where at this site the earthing healing method will be carried out, tourists will be guided by

interpreters and Yoga instructors, to connect people to nature (in direct contact with nature) in a relaxed manner (not in a rush) to provide an opportunity for all senses to connect with nature in a more focused manner through activities invitations by vegetation tree hugging and breathing. Touching tree wood induces significant physiological and psychological relaxation [62]. With the tree hugging activity, we are invited to touch the natural elements of the forest, so that we can better connect the interaction between the human psyche and nature so that we can get the following benefits:

1. inhale the tree's natural aromatherapy in the form of phytoncides which have an impact on the body's immunity;
2. Digital detox of everyday technology that affects health.
3. Being connected to nature can be calming
4. Natural sounds as nature sound therapy, which can increase a positive mood



**Figure 11:** Site 1 (a) Induction tread (b) Rest spot



**Figure 12:** Site 2 (Earthing Healing Method)

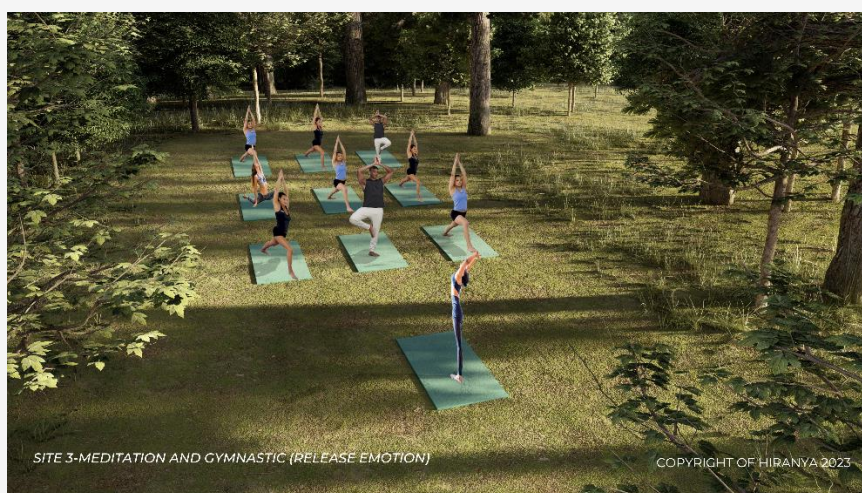


#### 4.3 Site 3

Site 3 is dominated by pole-level vegetation and trees that have a diameter of more than 10 cm with a wide and dense canopy as shown in Figure 13, making it ideal to be recommended as a location for meditation and gymnastics method therapy. Where this site is specially designed so that tourists can release existing emotions (Release emotions), by calming the mind and restoring calm to the soul through meditation and gymnastic methods, guided by Yoga interpreters /instructors, to meditate by listening to nature, feeling the forest air, Cultivating the breath (pranayama) is the most important part although it does not exclude movement (asana), meditation and relaxation. By making Pranayama a lifestyle today, a person will be healthier and have a much better mind [63].

#### 4.4 Site 4

This site is dominated by bamboo vegetation as shown in Figure 14, which is one of the largest oxygen-producing vegetation compared to other plants. Bamboo produces the largest amount of oxygen compared to other plants. When compared to trees of the same size, a bamboo grove can release 35% more oxygen [64]. Based on this consideration, this site is designed for forest wisdom method activities, where tourists will be guided by interpreters to unite with nature through the air (Invitations by air), and interpret nature in an effort to heal mentally, relieve stress, fatigue and anxiety.



**Figure 13:** Site 3 (Meditation and Gymnastic)



**Figure 14:** Site 4 (Forest Wisdom Method)





**Figure 15:** Site 5 (Sensory Element)



**Figure 16:** Site 6 (Invitations by water)

#### 4.5 Site 5

At this site there are various shapes of rocks, and the light intensity is still very sufficient at this site as shown in Figure 15, so it is recommended to design sensory element therapy at site 5. At this site, tourists will be invited to take off their footwear and their 5 senses will be invited to work through various elements to revive motor sensations. By reactivating the 5 senses in synergy with the forest, you can get various benefits from the forest applying the principle of reciprocity [40].

#### 4.6 Site 6

At site 6 there is a water element as shown in Figure 16, so it is designed for Invitations by water therapy (merging with nature through water). This site applies water elements and mineral water sources to

soothe the soul, one of which is by inviting tourists to soak their feet and feel the cool forest air. The flow of water from the source is the most healing factor in the health therapy process [12]. Water is a fundamental requirement in all life, a source of beauty and healing power because water can bring the essence of peace [40]. Negative ion content is also usually found most in areas close to moving water (rivers, seas, waterfall). Free negative ions generated from air molecules around a waterfall occur when water droplets collide with each other or with wetted solids to form a fine spray of droplets. The formation factors and concentration of free negative ions are the temperature of the water droplets, dissolved impurities, the speed of the impinging air blast, and the outer surface of the impinging droplets [65].



## 5. Conclusion

Forest healing ecotherapy is new research in the use of forest resources for health and increasing the value of forest ecosystems. Healing forest ecotherapy is a new alternative in Indonesia for physical and mental health interventions that can help reduce stress in communities. Visiting the Forest for Healing Forest Ecotherapy is one effort that can be made to reduce/soften depression, anxiety or stress that arises from the complexity of urban life. In this study, using 6 sites, where site 1 was an induction site for checking the health and readiness of respondents to participate in EHF activities, site 2 was dominated by vegetation of *Durio Zibenthinus*, *Terminalia catappa* and *Shorea pinanga* with a large diameter of  $\pm 150$  cm and above, had a wide canopy and lush, so site 2 is recommended for vegetation therapy by doing tree hugging and breathing. Location 3 is dominated by pole-level vegetation and trees that have a diameter of more than 10 cm with a wide and dense canopy, so location 3 is recommended for meditation and exercise therapy methods.

Location 4 is dominated by *Bambusa vulgaris* schrad vegetation, so location 4 is recommended for Invitation with air therapy (merging with nature through the air), considering that Bamboo is one of the largest oxygen producing plants compared to other plants. Location 5 is dominated by vegetation at the seedling, sapling and pole level as well as *Bambusa vulgaris* schrad which is not too dense, with various rock shapes, and the light intensity at this location is still very sufficient so it is recommended for sensory use. element therapy at location 5. Location 6 is dominated by *Bambusa vulgaris* schrad vegetation, around water sources, so location 6 is recommended for Invitation with water therapy (merging with nature through water).

By returning and interacting with nature, it is hoped that you will get natural life energy directly which can reduce levels of boredom, levels of depression/anxiety/stress, so that you can increase productivity and health again through the five senses (touch, sight, hearing, smell). Apart from that, the existence of healing forest ecotherapy can also help ensure that environmental conditions can always be maintained, so that people's health and welfare can improve, in line with the Sustainable Development Goals (SDGs). Based on the results of the analysis of site identification, community perceptions and preferences, site carrying capacity, thermal comfort and site design recommendations, the Gunung Kelam Sintang Natural Tourism Park conservation area is very representative of being a site of ecotherapy healing forest which is beneficial for health.

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