International Jurnal Islamic Education, Research and Multiclturalism
(IJIERM)
Available online https://journal.yaspim.org/index.php/IJIERM/index

Comparison of Plant Health Aspect In Green Open Spaces of Alun-Alun Kebumen and Alun-Alun Karanganyar, Kebumen, Central Java

Herfiana Anggun Mustika Dewi
herfianaanggun@apps.ipb.ac.id
Bogor Agricultural University, Indonesia

Nizar Nasrullah
Bogor Agricultural University, Indonesia

Bambang Sulistyantara
Bogor Agricultural University, Indonesia

Abstract: Alun-alun Kebumen and Alun-alun Karanganyar are green open spaces located in Kebumen, Central Java. Trees are one component of green open space that has various benefits. The physical condition of the trees is something that needs to be considered in a public green open space so that the trees remain in healthy condition and can grow normally. Study of physical damage of plant at the Alun-alun was raised as a topic of research activity to determine the physical condition of the plants in the Alun-alun in Kebumen Regency. The purpose of this study is to identify the damage of plants and the factors that cause the damage, analyzing the level of gap in plant maintenance had been implemented, and compiling recommendations for plant maintenance in Alun-alun Kebumen and Alun-alun Karanganyar. This plant damage research have been conducted using the FHM (Forest Health Monitoring) method and the USDA Forest Service damage index. Alun-alun Kebumen has an area of 3,9 ha and located in the center of the district, has 16 species of trees, 18 species of shrubs, and 2 species of grass. The tree population in Alun-alun Kebumen is 252 trees. Alun-alun Karanganyar has an area of 3,2 ha and located in a sub-district which is 14 km from the district center. It has 18 species of trees, 15 species of shrubs, and 1 species of grass. The tree population in Alun-alun Karanganyar is 262 trees. The results of this research is that Alun-alun Kebumen had more physical damage of plants with 380 cases from total 252 trees, while Alun-alun Karanganyar had 319 cases from total 262 trees. Damage of trees can be caused by a lack or excess of nutrients, pests or disease. The gap value of plant maintenance in Alun-alun Karanganyar is greater than Alun-alun Kebumen. Handling physical damage of trees is carried out by carrying out routine maintenance combined with chemical treatment in the form of

applying pesticides according to the level of tree damage. This research is the initial stage of mitigating fallen trees. Developments that can be implemented after this research are designing green open space for public squares by selecting tree species that have been evaluated for their vulnerability and whose health is monitored regularly.

Keywords: Alun-Alun, Green Open Space, Physical Damage of Plant, Forest Health Monitoring, USDA Forest Service

INTRODUCTION

Kebumen is one of the regencies in Central Java that borders the Indian Ocean. Kebumen has a coastal area that is one of the areas with earthquake and tsunami potential. There have been 15 disasters in the Kebumen Regency that have caused damage and economic losses (BPBD Kebumen, 2021). The most recent earthquakes that shook the Kebumen region were of magnitude 6.6 in June 2023 and 5.3 in December 2022 (BMKG, 2022; BMKG, 2023). In addition, heavy rain and strong winds in September 2022 caused a banyan tree with a diameter of 1 m to fall on one unit of street vendor tents in Kebumen Square (BNPB, 2022). This is related to the sense of security felt by the community in outdoor activities. Green open spaces (RTH) play an important role in providing freedom of movement for user activities [1]

The square is a form of green space that is commonly found in Java (Utomo, 2015). The square is a public green space in the form of a large, grassy field surrounded by roads and can be used for various community activities [2]. The square in the city in Central Java Province has a relatively large area and is characterized by Ficus benjamina as the main tree [3]. The square can be used as a place to relieve stress, a place for sports, a concert venue, a place for cultural exhibitions, a place for culinary exhibitions, a place for ceremonies to commemorate important days, a place to carry out religious activities with large masses, and can be used as an evacuation site if an unpredictable natural disaster occurs. The existence of plants, especially trees in the square has an important role. Trees that grow normally can provide aesthetic, architectural, and ecological benefits that can increase the comfort of RTH users, as well as improve the

[1] Setyani, Wuri, Santun Risma, Pandapotan Sitorus, and Retno Panuju. "Analisis Ruang Terbuka Hijau Dan Kecukupannya Di Kota Depok An Ana." *Buletin Tanah Dan Lahan* 1, no. 1 (2017).

[2] Wiwik Dwi Susanti, "Identifikasi Pemanfaatan Alun-Alun Malang," *Jurnal Ilmiah Teknik Lingkungan* 7, no. 2 (2015).

[3] Takako Kohori, Akhmad Arifin Hadi, and Katsunori Furuya, "THE SPATIAL COMPOSITION OF ALUN-ALUN ON JAVA ISLAND TODAY," *TATALOKA* 21, no. 2 (2019), https://doi.org/10.14710/tataloka.21.2.204-215.

physical quality of the environment and improve the microclimate [4]. If the physiological function of the plant is inhibited due to other causes, the plant can be said to be in a state of illness [5]. Trees as one of the elements of green spaces can be useful as oxygen providers, shade providers, air purifiers, microclimate controllers, as well as providing user comfort and aesthetics of an area [6].

The poor physical strength of trees can provide a crucial problem in extreme weather conditions that can cause tree branches to break and even fall trees that can endanger the safety of green space users. Comparison of plant health aspects in two different locations needs to be done to determine the comparison of the level of damage and the level of maintenance. Therefore, it is necessary to conduct research on plant health studies in Kebumen Square and Karanganyar Square, Kebumen, Central Java which is expected to provide insight into the physical condition of plants and proper handling of damaged plants to improve the safety and comfort of green space users. This study aims to identify the health status of plants by looking at plant damage and factors that cause damage in Kebumen Square and Karanganyar Square.

THEORETICAL BASIS

Green Open Space (RTH) Square

RTH is a form of land use for greening plants in an area (Afaar 2015). RTH can take the form of squares, urban forests, city parks, public cemetery parks, sports fields, green lanes, flat roads, railroad banks, and riverbanks. RTH has an important role in providing freedom of movement for its users due to the growing activities and development of the city Click or tap here to enter text.. The square is a public RTH in the form of a large and grassy field surrounded by roads and can be used for diverse community activities [7]. The square is an open space as part of the city center which has a function as a community center and government

[4] Regan Leonardus Kaswanto, Tataq Aisyah Filqisthi, and M. Bagus Suryono Choliq, "REVITALISASI PEKARANGAN LANSKAP PERDESAAN SEBAGAI PENYEDIA JASA LANSKAP UNTUK MENINGKATKAN KESEJAHTERAAN MASYARAKAT," *Jurnal Lanskap Indonesia* 8, no. 1 (2017), https://doi.org/10.29244/jli.v8i1.17638; Amarizni Mosyaftiani et al., "Monitoring and Analyzing Tree Diversity Using I-Tree Eco to Strengthen Urban Forest Management," *Biodiversitas* 23, no. 8 (2022), https://doi.org/10.13057/biodiv/d230822; Hendra Kurniawan and Rizki Alfian, "KONSEP PEMILIHAN VEGETASI LANSEKAP PADA TAMAN LINGKUNGAN DI BUNDERAN WARU SURABAYA Hendra," *Buana Sains* 10, no. 2 (2010); Ismi Saroh and Krisdianto, "Manfaat Ekologis Kanopi Pohon Terhadap Iklim Mikro Di Ruang Terbuka Hijau Kawasan Perkotaan," *Jurnal Hutan Dan Masyarakat* 12, no. 2 (2020).

[5] Sutarman, "Dasar-Dasar Ilmu Penyakit Tanaman," *Umsida Press*, 2017.

[6] Meghan L. Avolio et al., "Tree Diversity in Southern California's Urban Forest: The Interacting Roles of Social and Environmental Variables," *Frontiers in Ecology and Evolution* 3, no. JUL (2015), https://doi.org/10.3389/fevo.2015.00073.

[7] Susanti, "Identifikasi Pemanfaatan Alun-Alun Malang."

center and is located in front of the palace and pavilion. The square is very distinctive with the presence of banyan vegetation (Ficus benjamina) in the middle based on the concept of four cardinal directions that form an axis with the palace or temple and has sacred value, generally a rectangular square or parallelogram [8]. According to Kohori et. al. (2019), the square in the city in Central Java Province has a relatively large land area and characterizes Ficus benjamina as the main tree. The square in the city in Central Java Province still has the characteristics of the square in the colonial period, namely a rectangular square, located adjacent to the city mosque, and located adjacent to the regent's office or palace [9].

Plants as RTH Components

Plants are softscapes that compose a landscape to improve environmental quality. Based on their optimal height, shape, and habitat, plants are grouped into several categories, namely ground cover plants, shrubs, shrubs, trees, aquatic plants, and vines [10]. Trees are the main element in an RTH that plays a role in creating comfort for its users. Trees are all plants with a main trunk that grows upright and supports the tree canopy and has woody branches. Trees are all single-trunked hardwoody tree-bearing plants (Minister of Public Works 2012). The parts of the body of the tree morphologically consist of roots, trunks, branches, leaves, flowers, and fruits. Trees are the main elements that individually or in groups their appearance can affect visual appearance and give different impressions from different observation distances in the landscape [11]. Trees can provide aesthetic, architectural, and ecological benefits that can increase the comfort of RTH users, as well as improve the physical quality of the environment and improve the microclimate [12]. The characteristics of each tree differ according to the type of tree and its environment. Tree sizes based on tree height are grouped

[8] Rina Setyati and Warsito Utomo, "Implementasi Kebijakan Penataan Ruang Terbuka Hijau Kawasan Perumahan Kota Banjarbaru," *JKAP (Jurnal Kebijakan Dan Administrasi Publik)* 19, no. 1 (2015), https://doi.org/10.22146/jkap.7534.

[9] Kohori, Hadi, and Furuya, "THE SPATIAL COMPOSITION OF ALUN-ALUN ON JAVA ISLAND TODAY."

[10] Garsinia Lestari and Ira Puspa Kencana, *Galeri Tanaman Hias Lanskap*, *Penebar Swadaya.*, 2015.

[11] Intan Muning Harjanti and Pratamaningtyas Anggraini, "Green Open Space Functions in Kauman Area, Semarang City, Indonesia," *Journal of Architectural Design and Urbanism* 3, no. 1 (2020), https://doi.org/10.14710/jadu.v3i1.7164.

[12] Kaswanto, Filqisthi, and Choliq, "REVITALISASI PEKARANGAN LANSKAP PERDESAAN SEBAGAI PENYEDIA JASA LANSKAP UNTUK MENINGKATKAN KESEJAHTERAAN MASYARAKAT"; Mosyaftiani et al., "Monitoring and Analyzing Tree Diversity Using I-Tree Eco to Strengthen Urban Forest Management"; Kurniawan and Alfian, "KONSEP PEMILIHAN VEGETASI LANSEKAP PADA TAMAN LINGKUNGAN DI BUNDERAN WARU SURABAYA Hendra"; Saroh and Krisdianto, "Manfaat Ekologis Kanopi Pohon Terhadap Iklim Mikro Di Ruang Terbuka Hijau Kawasan Perkotaan."

into short trees with a maximum height of 6 m, medium trees with a maximum height of 6 – 12 m, and large trees with a height of more than 12 m (Booth 1990). The qualification of tree trunk diameter is grouped into seedling trees with a trunk diameter of less than 0.1 m, small trees with a diameter of 0.1 – 0.3 m, medium trees with a trunk diameter of 0.3 – 0.6 m, and large trees with a trunk diameter of more than 0.6 m [13]. Tree canopy consists of seven groups, namely rounded/globular, columnar, spread, picturesque, weeping, pyramidal, and fastigiate (Booth 1990). The forms of cabanagan are classified into five groups, namely weeping, pendulous, tortuous, vertical, and horizontal [14].

Plant Damage

Plants that grow healthy require ideal environmental conditions, namely by paying attention to the height of the place, temperature, humidity, light, rainfall, water content, and nutrient content in accordance with plant needs [15]. Damaged plants can be affected by insect pests, pathogens, air pollution, as well as artificial and natural factors that affect plant resilience and growth [16]. Plants attacked by diseases can be caused by viruses, fungi, nematodes, and bacteria which can be divided into infectious and non-communicable diseases Click or tap here to enter text.. Advanced tree damage can result in death of tree parts such as trunks, branches, branches, and twigs. According to Arifin and Arifin (2005) the death of tree parts can be caused by nutritional deficiencies, damage to the root system, the presence of toxic elements in the air or soil, inappropriate humidity both at air temperature and soil temperature, poor aeration of the root system, excessive tree canopy, fungal attacks, bacteria, and pests, as well as mechanical injuries or talent wounds on trunks / branches and roots. Damaged trees are very dangerous for RTH users. The potential danger due to tree damage will increase along with the high damage to trees, size, and activity around trees (ISA 2013). Some types of damage that affect tree hazards are the type of tree damage, the dimensions of the tree, and objects around it. The condition of physical damage to trees can get worse when facing extreme weather where there is a possibility of falling trees that can cause loss of life and property[17].

[13] Dennis H. Knight, "Vegetation Ecology Aims and Methods of Vegetation Ecology Dieter Mueller-Dombois Heinz Ellenberg," *BioScience* 25, no. 9 (1975), https://doi.org/10.2307/1297072.

[14] Billie Giles-Corti et al., "City Planning and Population Health: A Global Challenge," *The Lancet*, 2016, https://doi.org/10.1016/S0140-6736(16)30066-6.

[15] Garsinia Lestari and Kencana, *Galeri Tanaman Hias Lanskap*.

[16] Simon Taka Nuhamara and Kasno, "Present Status of Forest Vitality," in *Forest Health Monitoring to Monitor The Sustainability of Indonesian Tropical Rain Forest*, vol. 1, 2001.

[17] Hartini Muharama Hanan and Putu Gde Ariastita, "Penilaian Efektivitas Fungsi Taman Kota Sebagai Ruang Terbuka Hijau Publik Di Kota Malang," *Jurnal Teknik ITS* 9, no. 2 (2021), https://doi.org/10.12962/j23373539.v9i2.52902.

Plant Maintenance

Plants need to be cared for to maintain optimal growing conditions. The plant maintenance process consists of stages of watering, fertilizing, pruning, pest and disease control, weed control, and embroidery or plant replacement [18]. According to Arifin and Arifin (2005), maintenance is part of management intended to maintain and care for the landscape area with all the facilities in it to remain good and in accordance with the purpose of the original function design. Maintenance is divided into ideal maintenance and physical maintenance. Ideal maintenance is maintenance that refers to the original purpose and design so that at a certain period it needs to be evaluated. Physical maintenance includes work to maintain the neatness, beauty, beauty, comfort, and safety of the garden to balance ideal maintenance. Based on the design form and use of hardscape and softscape, maintenance levels are classified into high level maintenance (intensive), medium maintenance (semi-intensive), and low maintenance (extensive). The higher a level of maintenance requires more attention, effort, and cost. The more detailed the design of a park, the more intensive its maintenance will be [19]. Park maintainers are referred to as park maintenance supervisors. Maintainers must be able to control the growth and development of plants that have been planted, have a maintenance work plan prepared with the right method, and budget sufficient costs and skilled labor.

RESEARCH METHODS

This research was conducted in Kebumen, Central Java, precisely at Kebumen Square and Karanganyar Square. The selection of research locations is based on the location of the square, the square which is located in the city center, namely Kebumen Square and the square which is located quite far from the city center, namely Karanganyar Square. The tools used in this research consist of stationery, cellphones, roller meters, laser meters, and laptops with Microsoft Office 2019, Google Earth, AutoCAD, Adobe Photoshop, Canva, and JASP 0.16.2.0 software. This research was conducted from December 2022 to September 2023. Data collection was conducted from March to May 2023.

[18] Garsinia Lestari and Kencana, *Galeri Tanaman Hias Lanskap*.

[19] Safira Salsabila and Ardy Maulidy Navastara, "Penilaian Kesesuaian Fungsi Ekologi Ruang Terbuka Hijau Di Kawasan Inti Kraton Yogyakarta," *Jurnal Teknik ITS* 12, no. 1 (2023), https://doi.org/10.12962/j23373539.v12i1.93794.

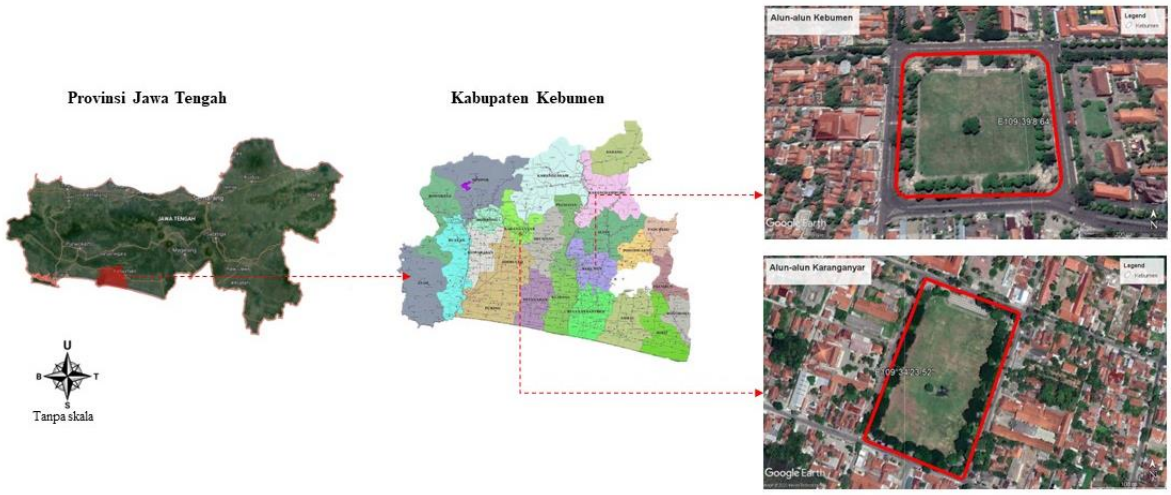

Figure 1. Research Location

Data Collection

Data collection was conducted through field observations and literature studies. Data collection on the physical condition of plants in the form of symptoms of tree damage using the Forest Health Monitoring (FHM) method (Mangold, 1997). The objects observed were plants in the form of trees located in both squares with the criteria of having a clear trunk, crown, and not limited to the size of the trunk diameter and height of trees and shrubs. The approach used is physiognomy assessment or external appearance of the plant. Assessment of tree physiognomy is done through observation of tree damage symptoms that can be seen directly without the help of tools [20].

Damage observed is in the form of root, stem, and crown damage. Tree damage variables observed include damage type, damage location, and severity class [21]. Damage types observed included cankers or puru, advanced weathering indicators, open wounds, exudation, broken trunks, termite nests, lianas on the trunk, broken trunks, brum on the roots or trunk, broken or dead roots, lianas on the crown, loss of dominant tip, broken or dead branches, brum on branches or areas in the crown, leaf damage, discolored leaves, and other damage, namely the presence of epiphytic plants. Damage locations observed included exposed roots and root bases, roots and lower stems, lower stems, upper and lower stems, upper stems, crown stems, branches, buds and shoots, and leaves. The observed severity classes were classified into 1-9%, 10-19%, 20-29%, 30-39%, 40-49%, 50-59%, 60-69%, 70-79%, 80-89%, and 90-99%.

[20] Izzy Yi Jian, Jiemei Luo, and Edwin H.W. Chan, "Spatial Justice in Public Open Space Planning: Accessibility and Inclusivity," *Habitat International* 97 (2020), https://doi.org/10.1016/j.habitatint.2020.102122.

[21] Nuhamara and Kasno, "Present Status of Forest Vitality."

Data analysis

Data analysis in this study refers to the FHM method (Mangold, 1997), using the weight of the physical tree damage index set by the USDA Forest Service in [22]. Each type, location, and severity of damage will have a weight that is then calculated to obtain the damage index value (NIK). The calculation of the tree's NIK uses the formula specified in Nuhamara et al. (2001), as follows:

$$NIK = \sum (xi.yi.zi)$$

Description:
NIK: damage index value at tree level
xi : weight value on damage type
yi : weight value on the location or part of the tree that is damaged
zi : weight value on the severity of damage

Damage selection was done based on the first three damages found at the bottom of the tree. The resulting tree NIK is classified in Table 1.

NIK = [(Damage type 1)(Damage location 1)(Damage severity 1) +
(Damage type 2)(Damage location 2)(Damage severity 2) +
(Damage type 3)(Damage location 3)(Damage severity 3)

Table 1. Crop damage status

Not	Klasifikasi	NIK
1	Trees in good health	0 ≤ NIK < 5
2	Lightly damaged	5 ≤ NIK < 10
3	Medium broken	10 ≤ NIK < 15
4	Heavily damaged	15 ≤ NIK < 21

Source: USDA *Forest Service* in Nuhamara *et. al.* (2001)

The results of plant damage identification were analyzed using descriptive statistical analysis and correlation. Descriptive analysis is an analysis that re-describes the results of observations with the theory obtained from the literature into more concise information [23]. Descriptive analysis is used to analyze

[22] Nuhamara and Kasno.

[23] Irsadunas Noveri, Khairun Najib, and M. Yusuf, "The Analysis of Public Green Open Space Management in Jambi City," *Policy & Governance Review* 4, no. 3 (2020), https://doi.org/10.30589/pgr.v4i3.305.

climate data, physical conditions of plants, and physical dimensions of plants. Correlation analysis is a measurement carried out to determine the closeness of the relationship between variables [24]. Correlation analysis is used to analyze the factors that cause plant damage by looking for correlations between the physical dimensions of trees and tree NIK and looking for correlations between climatic factors and the incidence of fallen trees caused by tornado disasters.

RESULTS AND DISCUSSION

General Condition of the Site

This research is located in Kebumen Regency, Central Java. The first square is Kebumen Square and the second square is Karanganyar Square. Kebumen square has an area of 3.9 ha and is geographically located between 7o40'07.50'' S and 109o39'06.45'' E. Kebumen square is square with a focal point in the form of 1 banyan plant (Ficus benjamina) in the center of the square. The altitude of Kebumen Square is 27 meters above sea level with the distance to the district capital is 0 km and the distance from the coastline is 13.4 km. Karanganyar Square has an area of 3.2 ha and is geographically located between 7o37'51.1'' S and 109o34'25.13'' E. Karanganyar Square is rectangular with a focal point in the form of 2 banyan plants (Ficus benjamina) in the center of the square. The altitude of the Karanganyar Square area is 18 meters above sea level with a distance of 14 km to the district capital and 15.8 km from the coast.

Both locations are included in the tropical climate with an air temperature of 17.92 - 34.5 oC, air humidity between 77 - 94.58 %, air pressure ranging from 998.75 - 1,002.25 mbar, average wind speed of 37.33 m/sec, rainfall per year of 4,548 mm3, the number of rainy days per year 223 days, and average sunshine 41.75 %. The condition of Kabupaten Kebumen is in the form of coastal areas and hills, and most of it is lowland (BPS Kebumen 2023).

Plant Diversity

Kebumen Square has 16 tree species, 18 shrub and groundcover species, and 2 grass species. The tree population in Kebumen Square is 252 trees consisting of 166 trees on the inner side and 86 trees on the outer side. Kebumen Square is dominated by sawo kecik (Manilkara kauki), banyan (Ficus benjamina), squirrel tail palm (Wodyetia bifurcata), and red shoots (Syzygium campanulatum). Karanganyar Square has 18 tree species, 15 shrub and ground cover species, and 1 grass species. The tree population in Karanganyar Square is 262 trees consisting of 180 trees on the inner side and 82 trees on the outer side. Karanganyar Square is dominated by banyan (Ficus benjamina), followed by mahogany (Swietenia

[24] Abdi Iswahyudi Yasril and Fitria Fatma, "PENERAPAN UJI KORELASI SPEARMAN UNTUK MENGKAJI FAKTOR YANG BERHUBUNGAN DENGAN KEJADIAN DIABETES MELITUS DI PUSKESMAS SICINCIN KABUPATEN PADANG PARIAMAN," *Human Care Journal* 6, no. 3 (2021), https://doi.org/10.32883/hcj.v6i3.1444.

mahagoni), trembesi (Samanea saman), and round glodogan (Polyalthia fragrans). Trees in Kebumen Square and Karanganyar Square are dominated by mature trees with medium height and medium crown density. The branching form in Kebumen Square and Karanganyar Square is predominantly vertical. The crown shape in Kebumen Square is dominated by a rounded shape, while in Karanganyar Square it is dominated by a spreading shape.

Table 2 Tree species diversity in Kebumen Square and Karanganyar Square

No	Scientific Name	Amount in	
		Kebumen Square	Karanganyar Square
1	*Acacia auriculiformis*	0	9
2	*Areca catechu*	1	0
3	*Artocarpus heterophyllus*	0	9
4	*Casuarina equisetifolia*	1	0
5	*Erythrina fusca*	1	3
6	*Ficus benjamina*	51	61
7	*Lagerstromia speciosa*	4	0
8	*Mangifera indica*	0	6
9	*Manilkara kauki*	54	9
10	*Michelia champaca*	0	6
11	*Muntingia calabura*	0	2
12	*Mussaenda pubescens*	0	1
13	*Polyalthia fragrans*	0	29
14	*Polyalthia longifolia*	10	14
15	*Pterocarpus indicus*	0	3
16	*Samanea saman*	3	29
17	*Spathodea campanulata*	2	0
18	*Swietenia mahagoni*	1	35
19	*Syzygium campanulatum*	44	0
20	*Syzygium malaccense*	0	16
21	*Tabebuia argentea*	11	2
22	*Tabebuia pallida*	7	0
23	*Terminalia catappa*	0	2
24	*Terminalia mantaly*	11	26
25	*Vitex pinnata*	1	0
26	*Wodyetia bifurcata*	50	0

Damage Type

Damage types observed are those whose values are at least equal to their severity threshold values. Damage type is the type of damage based on the symptoms observed on all parts of the tree from the roots (exposed) to the top of

the tree. Based on the results of the study (Table 3), the growth condition of trees in Kebumen Square shows that the most common type of damage is the indicator of advanced rot as much as 25.53%, followed by discolored leaves 17.11%, and dead ends 16.05%. The most common type of damage in Karanganyar Square was the advanced rot indicator at 25.71%, followed by broken stems at 13.17%, and brum stems at 12.85%. No liana damage type was found on the stem and no liana damage type on the crown in Kebumen Square and Karanganyar Square. In addition to damage types based on the FHM method, several other damages were also found such as leaning or tilting tree trunks and fungi on tree trunks or roots.

Table 3 Types of damage in Kebumen Square and Karanganyar Square

No	Damage Type	Percentage in	
		Alun-alun Kebumen	Alun-alun Karanganyar
1	Kanker, gol (puru)	13,16%	10,66%
2	Liver rot/weathering, fruit bodies (fruit bodies), and indicators of advanced rot	25,53%	25,71%
3	Open wounds	2,89%	3,13%
4	Exudation (resinosis or gummososis)	0,26%	1,25%
5	Batang pecah	2,89%	0,00%
6	Termite nests	1,05%	0,00%
7	Liana on the stem	0,00%	0,00%
8	Broken stem less than 0.91 m	1,84%	13,17%
9	Brum on the root or stem	1,84%	12,85%
10	Roots broken or dead more than 0.91 m	0,00%	0,31%
11	Liana on the headline	0,00%	0,00%
12	Dead end (loss of dominant end)	16,05%	4,39%
13	Broken or dead branches	12,89%	6,58%
14	Brum (abnormal growth) on branches or areas in the header	0,00%	0,31%
15	Leaf damage	1,58%	7,21%
16	Leaves change color (not green)	17,11%	9,09%
17	Others (for example: epiphytes)	2,89%	5,33%

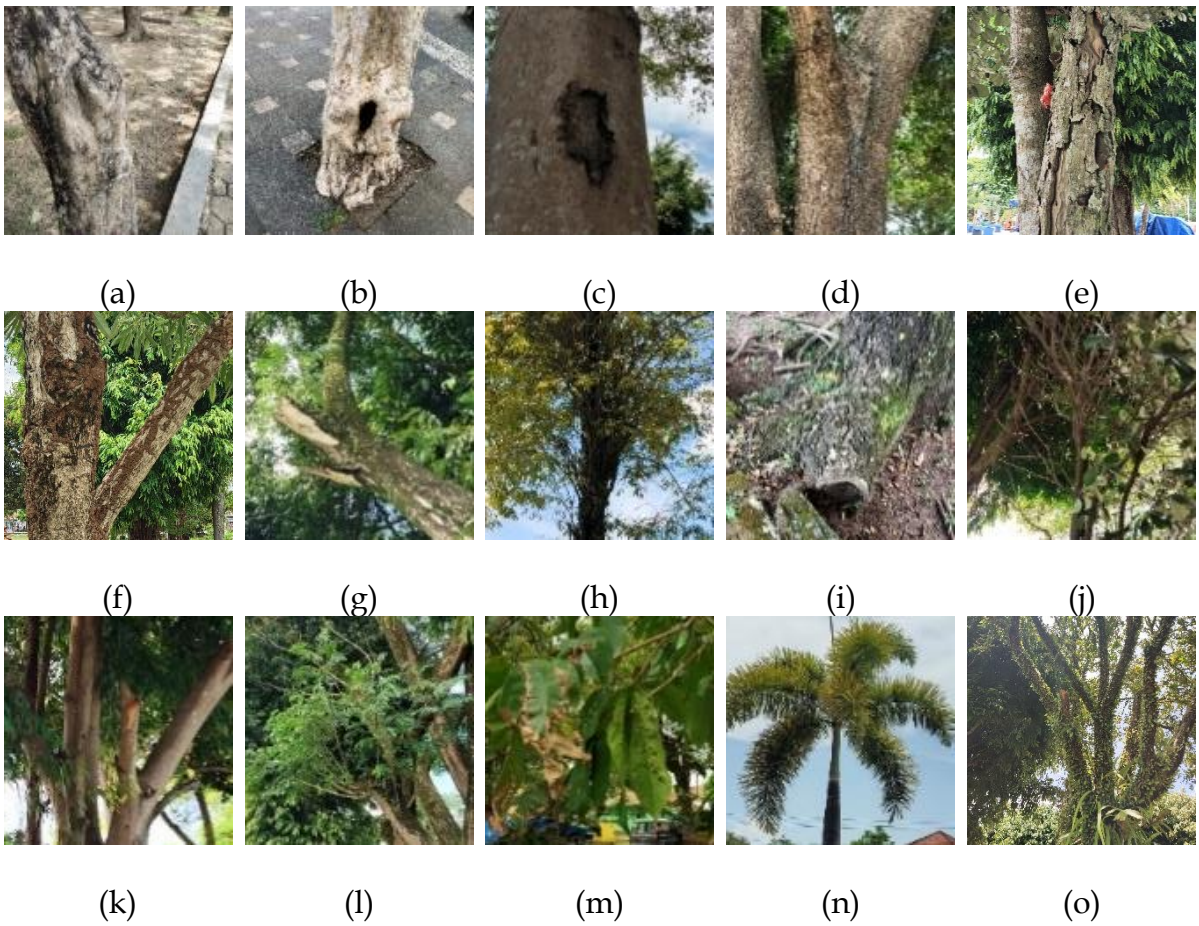

Figure 2. Types of tree damage in Kebumen Square and Karanganyar Square (a) cancer; (b) indicators of advanced weathering; (c) open wounds; (d) exudation; (e) broken rods; (f) termite nests); (g) broken rods; (h) root or stem brum; (i) broken or dead roots; (j) dead ends; (k) broken or dead branches); (l) brum branches or headers; (m) leaf damage; (n) leaves change color; (o) miscellaneous damage i.e. the presence of epiphytes and benalu

Damage Location

Based on the results of the study (Table 4), the location of tree damage in Kebumen Square was mostly found in the lower trunk by 19.21%, branching by 18.16%, and leaves by 17.89%. The most damage locations in Karanganyar Square were found in the upper and lower trunks at 22.57%, lower trunks at 22.26%, and leaves at 15.67%

Table 4 Location of damage in Kebumen Square and Karanganyar Square

No	Damage Location	Alun-alun Kebumen	Alun-alun Karanganyar
1	Roots (open) and root base (30 cm above ground level)	0,26%	0,26%
2	Roots and lower stem	4,47%	4,47%
3	Lower stem (the lower half of	19,21%	19,21%

	the stem between the base of the root and the base of the living crown)		
4	Upper and lower stems	14,21%	14,21%
5	The top of the stem (the upper half of the stem between the base of the root and the base of the living crown)	9,21%	9,21%
6	Title stick (main trunk in the live title district and on the basis of a live title)	8,42%	8,42%
7	Branches (larger by 2.54 cm at the point of branching towards the main trunk or crown trunk within the living canopy area)	18,16%	18,16%
8	Buds and buds	8,16%	8,16%
9	Leaf	17,89%	17,89%

Severity of Damage

Based on the research results (Table 5), the severity of tree damage in Kebumen Square was mostly found at the 20 - 29% damage level with a percentage of 28.42%, followed by the 30 - 39% damage level with a percentage of 21.32%, and the 10 - 19% damage level with a percentage of 15.79%. The severity of tree damage in Karanganyar Square was mostly found at the damage level of 20 - 29% with a percentage of 31.35%, followed by the damage level of 30 - 39% with a percentage of 22.57%, and the damage level of 40 - 49% with a percentage of 14.73%.

Table 5 Damage severity class in Kebumen Square and Karanganyar Square

No	Severity Class	Alun-alun Kebumen	Alun-alun Karanganyar
1	01-09%	0%	0%
2	10-19%	15,79%	1,57%
3	20-29%	28,42%	3,76%
4	30-39%	21,32%	22,26%
5	40-49%	14,21%	22,57%
6	50-59%	11,05%	15,05%
7	60-69%	4,21%	7,84%
8	70-79%	2,37%	8,78%
9	80-89%	1,84%	2,51%
10	90-99%	0,79%	15,67%

Plant Damage Level

Plant physical condition status is the level of physical condition of plants that have been damaged. The physical condition of trees is classified into healthy, lightly damaged, moderately damaged, and severely damaged. Based on the observation results (Table 6), Kebumen Square and Karanganyar Square are dominated by trees in a healthy and lightly damaged state. Of the total 252 trees in Kebumen Square, 65.08% (164 trees) are in the healthy category, 30.95% (78 trees) are in the lightly damaged category, 3.97 (10 trees) are in the moderately damaged category. As for the total 262 trees in Karanganyar Square, 70.99% (186 trees) are in the healthy category, 25.19% (66 trees) are in the lightly damaged category, 3.82 (10 trees) are in the moderately damaged category, There are no trees that are severely damaged in both Kebumen Square and Karanganyar Square.

Table 6 Status of Physical Condition of plants in Kebumen Square and Karanganyar Square

No	Physical Condition	Alun-alun Kebumen	Alun-alun Karanganyar
1	Trees in good health	65,08%	70,99%
2	Lightly damaged	30,95%	25,19%
3	Medium broken	3,97%	3,82%
4	Heavily damaged	0,00%	0,00%

Based on the results of the study, trees in the healthy category that were mostly found in Kebumen Square were squirrel tail palm (Wodyetia bifurcata), small sapodilla (Manilkara kauki), and banyan (Ficus benjamina). The lightly damaged category was dominated by red shoots (Syzygium campanulatum), sapodilla (Manilkara kauki), and banyan (Ficus benjamina). Trees with moderate damage category were found in beringin (Ficus benjamina), ketapang kencana (Terminalia mantaly), bungur (Lagerstromia speciosa), sawo kecik (Manilkara kauki), and mahogany (Swietenia mahagoni).

The trees in the healthy category that are more commonly found in Karanganyar Square are banyan (Ficus benjamina), round glodogan (Polyalthia fragrans), and ketapang kencana (Terminalia mantaly). The lightly damaged category was dominated by trembesi (Samanea saman), mahogany (Swietenia mahagoni), and beringin (Ficus benjamina). Trees with moderate damage category were found in trembesi (Samanea saman), acacia (Acacia auriculiformis) and mahogany (Swietenia mahagoni).

The Forest Health Monitoring (FHM) method has been widely applied to evaluate tree health in forest green spaces in both tropical and subtropical countries, but this method is still not widely applied in public green spaces such as squares. The results of this study are in line with the results of Nabawiah's research

(2023) which suggests that trees found in the botanical garden green space area are dominated by trees in the healthy category. The results of this study are also in line with the results of research by Ramadhan (2023) which suggests that trees found in arboretum and agro-tourism green spaces are dominated by trees in the healthy category. The results of this study are also in line with the results of research by Arisanti et al., (2022) which suggests that the trees found in the green belt road RTH area are dominated by trees in the healthy category and the results of research by Pambudi (2014) which suggests that the trees found in the green belt road RTH area are dominated by trees in the lightly damaged and healthy categories.

Nutrient Content

Based on the research results (Table 7) and the standard of nutrient content in soil, the soil in Kebumen Square has a pH of 5.42 - 6.99 with N content meeting the standard of 0.1%, P content meeting the standard of 0.08%, and K content not meeting the standard of 1%. Karanganyar square has a pH of 4.5 - 6.26 with N content that meets the standard of 0.1%, P content that meets the standard of 0.08%, and K content that does not meet the standard of 1% (Bohn et. al 1995 in Munawar 2011). Based on Table 7 and the standard of nutrient content in leaves, plant leaf samples in Kebumen Square and Karanganyar Square have N content that does not meet the standard of 1.5%, P content that does not meet the standard of 0.1 - 0.5%, and K content that exceeds the standard of 0.5 - 0.8% [25].

Table 7 Nutrient content in plant leaves and soil in Kebumen Square and Karanganyar Square

No	Unsur Hara	Content in	
		Alun-alun Kebumen	Alun-alun Karanganyar
On plant leaf samples			
1	Nitrogen (N)	0,2%	0,17%
2	Phosphor (P)	0,086%	0,129%
3	Potassium (K)	0,054%	0,079%
On soil samples			
1	Nitrogen (N)	1,05	1,21
2	Phosphor (P)	0,06	0,08
3	Potassium (K)	1,18	1,35

The available N and P content in the soil was insufficient because the available N and P content in the leaves did not meet the standard. It was also found

[25] Ali Munawar, "Kesuburan Tanah Dan Nutrisi Tanaman," *Bogor : IPB Press, 2013*, 2013.

that the available K content in the soil tends to be lacking but the K content in the plants has exceeded the standard. N deficiency in plants can result in yellowing of the lower leaves which will dry and fall off, the bones below the surface of young leaves will appear pale, plant growth is slow, and flower and fruit production is disrupted. P deficiency in plants can result in grayish leaves, brown leaf edges, dark green young leaves, and a slow growth phase. Excess K in plants can cause plant growth to be inhibited so that plants experience deficiencies and can cause the absorption of calcium (Ca) and magnesium (Mg) elements to be disrupted (Purba et. al. 2021). This is in accordance with the discovery of the type of damage with code 25, namely discolored leaves in Kebumen Square as much as 17.11% and Karanganyar Square as much as 9.09%.

Correlation of Damage Level with Physical Dimensions of Plants

The analysis showed that physical damage to trees was significantly correlated with tree height (R = 0.402), trunk diameter (R = 0.379), crown diameter (R = 0.442), and root zone (R = 0.317) with a P-value < 0.001. This is in accordance with the statement of Supriatna et al. (2017) which states that tree damage increases directly proportional to the increase in tree height and diameter [26]. Arisanti (2022) suggested that tree height and tree diameter are correlated with physical damage to trees. Increasing tree size will increase the risk of falling trees [27].

Correlation of Climatic Factors with Fallen Tree Occurrence

Based on the results of the correlation analysis of fallen tree events with climatic factors in Kebumen Regency in the last 3 years, namely 2020, 2021, and 2022, it is known that the incidence of fallen trees is significantly correlated with the incidence of tornadoes (R = 0.836), rainy days (R = 0.636), rainfall (R = 0.644), and air humidity (R = 0.356). Tornado events accounted for 32.8% of the tree falls, rainy days accounted for 19.7% of the tree falls, rainfall accounted for 15.3% of the tree falls, and air humidity accounted for 7.8% of the tree falls. Other factors that are not significantly correlated include sunshine, wind speed, air pressure, and air temperature. Solar irradiation has a 4.9% effect as a cause of falling trees, wind

[26] Asep Hendra Supriatna, Noor Farikhah Haneda, and Imam Wahyudi, "Sebaran Populasi, Persentase Serangan, Dan Tingkat Kerusakan Akibat Hama Boktor Pada Tanaman Sengon: Pengaruh Umur, Diameter, Dan Tinggi Pohon," *Jurnal Silvikultur Tropika* 8, no. 2 (2017).

[27] Sherly Arisanti, Bambang Sulistyantara, and Nizar Nasrullah, "Evaluasi Kerusakan Fisik Pohon Dalam Upaya Menghadirkan Pohon Jalur Hijau Yang Aman Di Kota Padang," *Jurnal Lanskap Indonesia* 14, no. 2 (2022), https://doi.org/10.29244/jli.v14i2.40196; Brandon T. Rutledge et al., "Tree, Stand, and Landscape Factors Contributing to Hurricane Damage in a Coastal Plain Forest: Post-Hurricane Assessment in a Longleaf Pine Landscape," *Forest Ecology and Management* 481 (2021), https://doi.org/10.1016/j.foreco.2020.118724.

speed has a 1.8% effect as a cause of falling trees, air pressure has a 1.2% effect as a cause of falling trees, and air temperature has a 0.1% effect as a cause of falling trees.

Recommendation

Every tree has different damages. Different damages also have different handling actions. Handling trees that are in the healthy category is by performing routine maintenance without any special handling. Routine maintenance on trees includes watering, fertilizing, pruning, and pest and disease control. The handling of severely damaged trees is to carry out physical control in the form of felling. Trees with severe damage were not found in Kebumen Square or Karanganyar Square. Table 8 presents maintenance recommendations according to the symptoms of damage to trees that experience damage in the mild to moderate category.

Table 8 Recommendations for handling damage to lightly to moderately damaged trees

No	Damage Type	Handling
1	Kanker, gol (puru)	Cleaning cancer scars, applying pesticides, pruning, to cutting down trees
2	Liver rot/weathering, fruit bodies (fruit bodies), and indicators of advanced rot	Pruning rotten parts, cleaning damaged tree parts, applying pesticides, patching cavity *treatments*, to logging.
3	Open wounds	Cleaning of injured parts of the tree and applying pesticides to prevent infection
4	Exudation (resinosis or gummososis)	Cleaning of tree parts that secrete liquid and applying pesticides to prevent infection
5	Batang pecah	Application of pesticides and minerals in the soil
6	Termite nests	Termite eradication by applying pesticides or insecticides or using termite traps
7	Liana on the stem	Disposal of lianas by plucking lianas to the roots
8	Broken stem less than 0.91 m	Applying fault sections to stems, pruning, and applying pesticides
9	Brum on the root or stem	Pruning to maintain a balance of header weight and pesticide application
10	Roots broken or dead more than 0.91 m	Cleaning of damaged parts of the roots and application of pesticides
11	Liana on the headline	Disposal of lianas by plucking lianas to the roots
12	Dead end (loss of dominant end)	Pruning dead parts of the tree and applying pesticides

13	Broken or dead branches	Pruning broken or dead branches and applying pesticides
14	Brum (abnormal growth) on branches or areas in the header	Pruning broken or dead branches to maintain a balance of header weight and pesticide application
15	Leaf damage	Pruning on the part of the crown that has leaf damage to maintain the balance of header weight and pesticide application
16	Leaves change color (not green)	Application of pesticides and minerals in the soil
17	Miscellaneous (epiphytes)	Removal of epiphytes such as benalu that grow on trees to avoid damage to trees

Handling physical damage to trees is done by conducting maintenance combined with chemical handling in the form of pesticide application according to the level of tree damage. The dose of pesticide application is adjusted to the severity class of damage to the damaged part of the tree. The severity class of tree damage that is not too severe (≤ 20%) is given a light dose. The severity class of moderately severe tree damage (20 - 50%) is given a medium dose and the severity class of severe tree damage (≥ 50%) is given a heavy dose [28]. Heavy pruning is carried out on trees that are damaged and intersecting and attempts to reduce crown load. Medium pruning is carried out on trees that are damaged to the main branching parts in the crown area. Light pruning is carried out on branches that intersect with utilities or other branches. Cavity treatment is performed on growing trees by patching holes in the trunk using a mixture of sand and cement up to the crown ring limit and needs to be combined with pruning to reduce crown load (Pirone, 1971; Bernatzky, 1978). The map of tree damage level in Kebumen Square is presented in Figure 3. The map of tree damage level in Karanganyar Square is presented in Figure 4.

[28] Arisanti, Sulistyantara, and Nasrullah, "Evaluasi Kerusakan Fisik Pohon Dalam Upaya Menghadirkan Pohon Jalur Hijau Yang Aman Di Kota Padang."

Figure 4. Map of the level of tree damage in Karanganyar Square

CONCLUSION

Kebumen Square has more plant species than Karanganyar Square. Kebumen Square has more physical damage, 380 cases of physical damage from a total of 252 trees, while Karanganyar Square has 319 cases of physical damage from a total of 262 trees. The most common type of damage is the advanced rot indicator, the most common location of damage is on the lower trunk and leaves. The most common severity level is 20-29%. Based on the calculation of the tree damage index value, the level of physical damage to trees in Kebumen Square and Karanganyar Square is dominated by trees with healthy and lightly damaged classifications. No trees were found in a state of severe damage. Damage to trees can be caused by lack or excess of nutrients, pests, or diseases. Handling of physical damage to trees is done by conducting routine maintenance combined with chemical handling in the form of pesticide application according to the level of tree damage. Tree height, trunk diameter, crown diameter, and root zone were significantly correlated with tree physical damage. The incidence of fallen trees was correlated with the incidence of tornadoes, rainy days, rainfall, and air humidity. The gap value in Karanganyar Square is greater than Kebumen Square. It is necessary to improve the performance of several aspects of maintenance. This research is the initial stage of fallen tree mitigation. Therefore, the development that can be carried out after this research is to design green spaces in the square with the selection of tree species that have been evaluated regarding their vulnerability and monitored for health regularly.

BIBLIOGRAPHY

Arisanti, Sherly, Bambang Sulistyantara, and Nizar Nasrullah. "Evaluasi Kerusakan Fisik Pohon Dalam Upaya Menghadirkan Pohon Jalur Hijau Yang Aman Di Kota Padang." *Jurnal Lanskap Indonesia* 14, no. 2 (2022). https://doi.org/10.29244/jli.v14i2.40196.

Avolio, Meghan L., Diane E. Pataki, Thomas W. Gillespie, G. Darrel Jenerette, Heather R. McCarthy, Stephanie Pincetl, and Lorraine Weller Clarke. "Tree Diversity in Southern California's Urban Forest: The Interacting Roles of Social and Environmental Variables." *Frontiers in Ecology and Evolution* 3, no. JUL (2015). https://doi.org/10.3389/fevo.2015.00073.

Garsinia Lestari, and Ira Puspa Kencana. *Galeri Tanaman Hias Lanskap*. *Penebar Swadaya.*, 2015.

Giles-Corti, Billie, Anne Vernez-Moudon, Rodrigo Reis, Gavin Turrell, Andrew L. Dannenberg, Hannah Badland, Sarah Foster, et al. "City Planning and Population Health: A Global Challenge." *The Lancet*, 2016. https://doi.org/10.1016/S0140-6736(16)30066-6.

Hanan, Hartini Muharama, and Putu Gde Ariastita. "Penilaian Efektivitas Fungsi Taman Kota Sebagai Ruang Terbuka Hijau Publik Di Kota Malang." *Jurnal Teknik ITS* 9, no. 2 (2021). https://doi.org/10.12962/j23373539.v9i2.52902.

Harjanti, Intan Muning, and Pratamaningtyas Anggraini. "Green Open Space Functions in Kauman Area, Semarang City, Indonesia." *Journal of Architectural Design and Urbanism* 3, no. 1 (2020). https://doi.org/10.14710/jadu.v3i1.7164.

Jian, Izzy Yi, Jiemei Luo, and Edwin H.W. Chan. "Spatial Justice in Public Open Space Planning: Accessibility and Inclusivity." *Habitat International* 97 (2020). https://doi.org/10.1016/j.habitatint.2020.102122.

Kaswanto, Regan Leonardus, Tataq Aisyah Filqisthi, and M. Bagus Suryono Choliq. "REVITALISASI PEKARANGAN LANSKAP PERDESAAN SEBAGAI PENYEDIA JASA LANSKAP UNTUK MENINGKATKAN KESEJAHTERAAN MASYARAKAT." *Jurnal Lanskap Indonesia* 8, no. 1 (2017). https://doi.org/10.29244/jli.v8i1.17638.

Knight, Dennis H. "Vegetation Ecology Aims and Methods of Vegetation Ecology Dieter Mueller-Dombois Heinz Ellenberg." *BioScience* 25, no. 9 (1975). https://doi.org/10.2307/1297072.

Kohori, Takako, Akhmad Arifin Hadi, and Katsunori Furuya. "THE SPATIAL COMPOSITION OF ALUN-ALUN ON JAVA ISLAND TODAY." *TATALOKA* 21, no. 2 (2019). https://doi.org/10.14710/tataloka.21.2.204-215.

Kurniawan, Hendra, and Rizki Alfian. "KONSEP PEMILIHAN VEGETASI LANSEKAP PADA TAMAN LINGKUNGAN DI BUNDERAN WARU SURABAYA Hendra." *Buana Sains* 10, no. 2 (2010).

Mosyaftiani, Amarizni, Ade Wahyu, Kaswanto, Harityas Wiyoga, Nada Syasita, Arie Fajar Septa, and Djayus Djauhari. "Monitoring and Analyzing Tree Diversity Using I-Tree Eco to Strengthen Urban Forest Management." *Biodiversitas* 23, no. 8 (2022). https://doi.org/10.13057/biodiv/d230822.

Munawar, Ali. "Kesuburan Tanah Dan Nutrisi Tanaman." *Bogor : IPB Press, 2013*, 2013.

Noveri, Irsadunas, Khairun Najib, and M. Yusuf. "The Analysis of Public Green Open Space Management in Jambi City." *Policy & Governance Review* 4, no. 3 (2020). https://doi.org/10.30589/pgr.v4i3.305.

Nuhamara, Simon Taka, and Kasno. "Present Status of Forest Vitality." In *Forest Health Monitoring to Monitor The Sustainability of Indonesian Tropical Rain Forest*, Vol. 1, 2001.

Rutledge, Brandon T., Jeffery B. Cannon, R. Kevin McIntyre, Angela M. Holland, and Steven B. Jack. "Tree, Stand, and Landscape Factors Contributing to Hurricane Damage in a Coastal Plain Forest: Post-Hurricane Assessment in a Longleaf Pine Landscape." *Forest Ecology and Management* 481 (2021). https://doi.org/10.1016/j.foreco.2020.118724.

Salsabila, Safira, and Ardy Maulidy Navastara. "Penilaian Kesesuaian Fungsi Ekologi Ruang Terbuka Hijau Di Kawasan Inti Kraton Yogyakarta." *Jurnal Teknik ITS* 12, no. 1 (2023). https://doi.org/10.12962/j23373539.v12i1.93794.

Saroh, Ismi, and Krisdianto. "Manfaat Ekologis Kanopi Pohon Terhadap Iklim Mikro Di Ruang Terbuka Hijau Kawasan Perkotaan." *Jurnal Hutan Dan Masyarakat* 12, no. 2 (2020).

Setyani, Wuri, Santun Risma, Pandapotan Sitorus, and Retno Panuju. "Analisis Ruang Terbuka Hijau Dan Kecukupannya Di Kota Depok An Ana." *Buletin Tanah Dan Lahan* 1, no. 1 (2017).

Setyati, Rina, and Warsito Utomo. "Implementasi Kebijakan Penataan Ruang Terbuka Hijau Kawasan Perumahan Kota Banjarbaru." *JKAP (Jurnal Kebijakan Dan Administrasi Publik)* 19, no. 1 (2015). https://doi.org/10.22146/jkap.7534.

Supriatna, Asep Hendra, Noor Farikhah Haneda, and Imam Wahyudi. "Sebaran Populasi, Persentase Serangan, Dan Tingkat Kerusakan Akibat Hama Boktor Pada Tanaman Sengon: Pengaruh Umur, Diameter, Dan Tinggi Pohon." *Jurnal Silvikultur Tropika* 8, no. 2 (2017).

Susanti, Wiwik Dwi. "Identifikasi Pemanfaatan Alun-Alun Malang." *Jurnal Ilmiah Teknik Lingkungan* 7, no. 2 (2015).

Sutarman. "Dasar-Dasar Ilmu Penyakit Tanaman." *Umsida Press*, 2017.

Yasril, Abdi Iswahyudi, and Fitria Fatma. "PENERAPAN UJI KORELASI SPEARMAN UNTUK MENGKAJI FAKTOR YANG BERHUBUNGAN DENGAN KEJADIAN DIABETES MELITUS DI PUSKESMAS SICINCIN KABUPATEN PADANG PARIAMAN." *Human Care Journal* 6, no. 3 (2021). https://doi.org/10.32883/hcj.v6i3.1444.