Tree Health Analysis at Bungkirit Urban Forest in Kuningan Regency

Ika Karyaningsih[1], Devi Rahmatullah[2], Ilham Adhya[3]

Faculty of Forestry, Universitas Kuningan, Kuningan, Indonesia

{ika.karyaningsih@uniku.ac.id[1], defirahmatullah97@gmail.com[2], ilham.adhya@uniku.ac.id[3]}

Abstract. Bungkirit is an urban forest that is open for public activities, many visitors come for recreation, educational tours and nature tourism interests. Trees in the Bungkirit urban forest area are thought to have decreased in tree quality. This study aims to determine the level of tree health. Data analysis using Forest Health Monitoring methods. Based on observations in the field, the health level in the Bungkirit urban forest has damage as many as 56 trees or about 39.2% of the total number of trees observed and 85 trees or (59.5%) do not have damage that is categorized as very healthy with a NIK of 5.01 including the category of minor damage. There are 7 types of damage experienced by trees in the Bungkirit urban forest, namely fungal cancer of open wounds, broken stems or roots, broken or dead branches, damaged leaves, buds or shoots and discolored leaves (not green). The most types of damage are broken or dead branches with the most damage locations on the trunk.

Keywords: Forest Health Monitoring (FHM); Bungkirit Urban Forest; Tree Health

1 Introduction

Urban forest aims to create sustainability, harmony and balance of urban ecosystems which include environmental, social and cultural elements. As an urban forest ecosystem, it functions to improve and maintain the microclimate and aesthetic value, absorb water, create balance and physical harmony in the city and support the preservation of Indonesia's biodiversity. [2]

The trees in the Bungkirit Urban Forest area are suspected of having decreased tree quality. The decline in tree quality can be seen from the level of damage suffered by the constituent trees. Based on the initial observations that have been made, the trees experienced many broken branches and fallen trees. This condition has the potential to cause death or seriously endanger the safety of visitors or the management in Bungkirit Urban Forest. Damage can be caused by disease, insects, pests, weeds, fire, weather, animals or due to human activities. A tree is said to be healthy or normal when the tree is still able to carry out its physiological functions. On the other hand, it is said to be unhealthy if the tree is structurally damaged in whole or in part. The main causes of plant diseases can be pathogenic living organisms or physical environmental factors [1].

Analysis of tree health can use the modified Manglod concept [4] through the Forest Health monitoring method. This concept assesses forest health based on the health of the trees that make up the forest. In the framework of looking at forest health, an individual tree will be incorporated into a population so that the health of the tree as an individual must be

UNISET 2021, December 02, Kuningan, Indonesia

DOI 10.4108/eai.2-12-2021.2320306

considered. The death of an individual tree is an important issue to consider because it will lead to a decline in the population. The health level of a tree or group of trees is basically the end result of interactions between trees and biotic and abiotic factors [7].

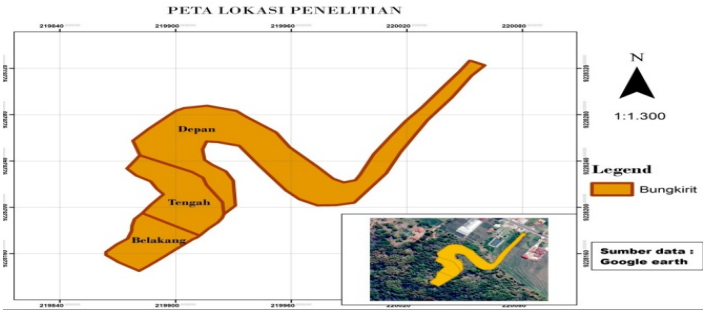
Tree damage should be detected early by knowing the level of damage assessed in terms of the type of damage, the location of the damaged tree and the severity of the damage. Detecting tree damage can allow it to take maintenance action. To take action against tree damage, it is necessary to have data on tree health in the Bungkirit Urban Forest, so that it can be used as a recommendation for taking tree care actions so as to minimize the damage that occurs to trees.

Based on the problems above, this study aims to determine the level of tree health in the Bungkirit Urban Forest. The benefit of this research is to find out information about the health condition of trees in Bungkirit Urban Forest so that it can be the basis for further plant management. Identification of tree health status is an important effort in tree management, according to silvicultural rules to maintain the health of forest trees in stages controlling, facilitating, protecting and salvaging [5].

2 Methodology

2.1. Research Sites

The research was carried out in Bungkirit Urban Forest, Kuningan District, Kuningan Regency, West Java which has an area based on the Kuningan Regency Government Decree in 2008 which is 1.5 ha. Geographically, Bungkirit Urban Forest is located at coordinates 6 0 58'34.47" South Latitude and 108o 27'53.22" East Longitude. This Urban Forest can be accessed from Kuningan town square for 2 km.



Data retrieval using the census method by dividing the observation area into 3 (three) parts, namely: the front is the entrance, the middle and the back. . The census method on individual trees is used to assess the health of trees in recreational areas for visitors. Identification of tree health status was carried out using the method of the modified Manglod {4} concept through the Forest Health Monitori method namely the method of assessing tree health by classifying the type and level of damage per individual plant. The data taken include tree species, types of damage to trees, location of tree damage and severity of tree damage.

2.2. Data Analysis

In the Forest Health Monitori (FHM), signs and symptoms of damage are recorded according to the definition of damage that can kill the tree or affect the long-term viability of

the tree. Signs and symptoms of damage were given priority and recorded by location according to the order: roots, roots and rootstock, rootstock, rootstock and scion, scion, shoots, branches, buds and shoots and leaves with code 0 – 9. Within a given location, damage is recorded in order of priority following the number of possible damage types for that location. The higher the serial number of the damage type, the lower the priority. If there is more than one damage in the same location, then the damage has the highest priority scale (the most damaging) that is recorded [8]. The scoring codes for tree health assessment based on the FHM method are:

Table 1. Location of tree damage

Code	Explanation
0	No damage
1	Root
2	Rootstock (1/2 part of the initial branch/head margin)
3	Trunk before the first branch of the crown boundary
4	Rootstock
5	Top stem (1/2 part stem)
6	Stem inside the header
7	Branch
8	Branches and shoots
9	Leaves

Table 2. Damage Type

Code	Explanation
01	Cancer
02	Mold
03	Open wound
04	Gumosis
11	Broken stems or roots
12	Lots of water shoots
13	Roots broken inside
21	Dead shoots
22	Broken and dead
23	Excessive water shoots
24	Leaf damage
25	Leaf color change

Table 3. Severity

Code	Explanation
2	20 - 29 %
3	30 - 39 %
4	40 - 49 %
5	50 - 59%
6	60 - 69%
7	70 - 79 %
8	80 - 89%
9	90 - 99%

The scores for the three scoring codes can be seen in the table as follows:

Table 4. Code and Weight of Damage Index Value

Damage Type		Location of tree damage		Severity	
Code	Value Index (x)	Code	Value Index (y)	Code	Value Indeks (z)
1	1.9	0	1.5	0	1.5
2	1.7	1	2	1	1.1
3	1.5	2	2	2	1.2
4	1.5	3	1.8	3	1.3
11	1.6	4	1.8	4	1.4
12	1.3	5	1.6	5	1.5
13	1	6	1.2	6	1.6
21	1	7	1	7	1.7
22	1	8	1	8	1.8
23	1	9	1	9	1.9
24	1				
25	1				

The three weighted values are added up by the formula:

$$NIK = \sum_{1=1}^{1104} (x.y.z)$$

Explanation:
NIK : Damage Index Value to trees
x : Tree damage type value
y : Value of tree damage location
z : Assess the severity of tree damage

Furthermore, it can be seen the classification of tree health based on the weight of the index value with the following criteria:

Table 5. Tree damage class classification

Skor NIK	Class
0- <5	Healthy class
6 – 10	Light damage class
11 – 15	Medium damage class
16 – > 21	Heavy damage class

Notes : The higher the damage index value, the more it shows a high class of tree damage

3 Results and Discussion

3.1. Type Of Damage

Figure 1 shows that there are 7 types of damage that occurred in the Bungkirit urban forest. The most common type of damage was broken or dead branches, which accounted for 39.26% of the total damage encountered, while the least common type of damage was leaf damage (not green) at 1.51%.

The damage observed was caused by the disruption of the physiological processes of the tree either due to disease, pests and other abiotic causes. Some of the symptoms that can be observed due to disruption of plant growth are changes in plants in shape, size, color, texture and others [3]. The sensitivity level of susceptible plants varies, so the severity of the damage suffered by each tree is also different.

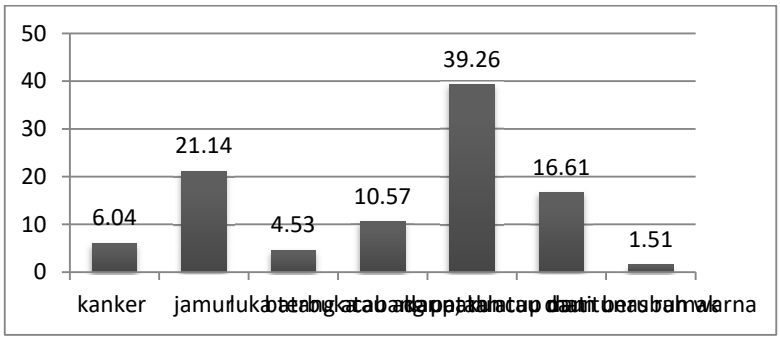
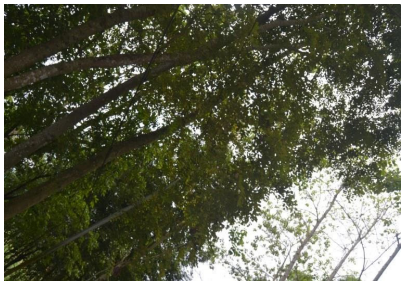


Figure 2. Type of tree damage

Table 6. The Types Of Damage That Occurred In Bungkirit Urban Forest Are:

Damage type	Explanations	Damage form
Cancer	The surface of the skin is usually slightly pressed down or part of the skin is broken so that the wood is visible. Cancer can be infected seasonally or annually, so from season to season it will get bigger. Cancer attacks the cambium so that it kills the function of transporting nutrients and distributing nutrients [5]	
Mold	The number of trees affected by this damage is as many as 14 trees. Fungi which is a disease in the form of green or white spots found on the main stem of plants and the stems of plant branches. The process of weathering of wood by microorganisms with a wide range depends on the microorganisms that cause weathering, plant species and microhabitats in food sources. [9]	
Open wound	Wounds are divided into 2 parts, namely: a) wounds that are limited to the outer skin only and b) wounds that occur on the outer skin, inner skin and also wounds on sapwood and heartwood [5]. All shapes and sizes of wounds can serve as sites of infection, from wounds caused by macroscopic insects to wounds caused by cutting stems and branches. Many pathogens use wounds as alternative sites of infection and take advantage of the vulnerable tissues [9].	

Broken stems or roots	The damage found occurred in the mango tree, Mangifera indica, due to burning garbage near the tree, causing the bark of the tree to be injured, causing pathogens and pests to attack the exposed trunk. Termites are a type of pest that attacks tree trunks	
Broken or dead branches	Damage to the branches or tree branches is broken or dead. Broken and dead branches occur due to several factors, such as wind when it rains and branch damage due to infection by fungal diseases or pests, so branches tend to be weak and break easily. Tree defects that generally cause damage to the branches are excessive load, rot, and weak connection with the main trunk [10].	
Damaged leaves and shoots	The most visible symptom is that the leaves are eaten by insects or attacked by pests. One example is the black spot pest on the Mangifera indica tree, this is caused by a fungus called Meliola mengifer. In leaf damage there is also leaf rust and powdery mildew [10].	
Leaves changing color	Damage occurred to the Angsana tree *Pterocarpus indicus*. This color change can be caused by the destruction of chlorophyll (green leaf substance) or due to lack of sunlight or due to disease. Damage to chloroplasts causes yellowing of the leaves, which are usually green. These symptoms often precede the symptoms of necrosis. If this yellowing symptom is systemic and is present on all leaves, it is usually a secondary symptom caused by parasitic attacks on other parts or can also be caused by unfavorable external conditions.	

3.2. Location Of Tree Damage

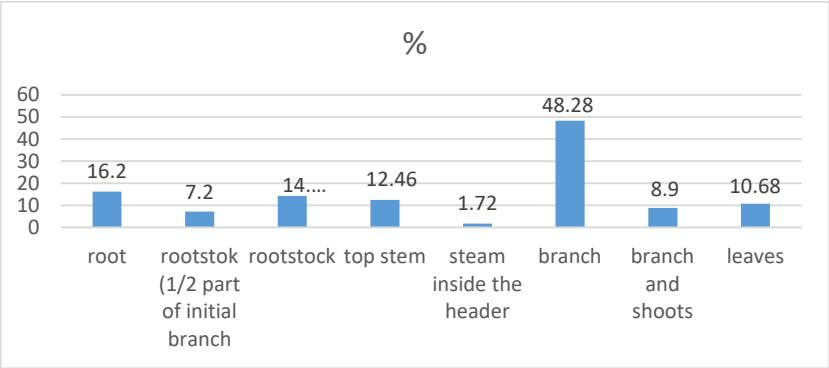


Figure 3. Location of damage

The part of the tree that was most damaged was part 7 (branches) of 46.28% of the total part of the tree that was damaged. The percentage of damaged tree parts can be seen in Figure 3. The dominant type of damage is dead tree branches. This is due to the frequent occurrence of rain and high humidity resulting in weathering of branches so that these parts are easily broken. Broken branches also often occur because of the wind when it rains. Winds at speeds of approximately 45 km/hour can cause mechanical damage such as broken twigs or branches, fallen leaves, broken tree trunks and uprooted trees [8].

The part of the tree that suffered a lot of other damage was part 2 (roots and rootstock) of 16.2%. of the total part of the tree that was damaged. This part of the tree suffered the most damage to the type of fungus. Bar 4 (lower and upper stem) was damaged by 14.24%, section 5 (upper stem) was 12.46% and section 3 (lower stem) showed the smallest damage of 7.12%.

Physically the stem is a canopy support and physiologically acts as an organ supporting the transport system for the distribution of nutrients. The role of stems according to [12] in the process of tree survival ranks third after roots and leaves, because infection by fungi can harm trees and cause death.

Damage to the stems that have been observed has damage, one of which is due to termites. Damage caused by termites. Symptoms of this damage are characterized by the presence of soil crust covering the stem and its attack can cause plant death. Termite attacks do not only occur in one tree but can spread from one tree to another through trunks, branches, twigs on the forest floor and also from lianas on the tree.

Damage to the trunk was also found in the presence of lightning strikes which resulted in the trunk peeling horizontally, the symptoms of being struck by lightning on the Gmelina arborea tree. The condition of the tree that was struck by lightning at the time of the study had peeling skin wounds so that the wood was visible. This can spur pests to attack the injured part of the stem.

3.3. Tree Health Level

The number of trees in Bungkirit Urban Forest is 147 trees, there are 56 (39.2%) damaged trees and 85 (59.5%) healthy trees. Based on observations through the FHM method, it was found that the tree's health condition was classified as light with a damage index value (NIK) of 5.01. The severity of tree damage in the Bungkirit urban forest was 60% of the individual trees were not damaged (healthy), 22% of the trees were only 20-29% damaged and only 18% of the individual trees had 35% damage.

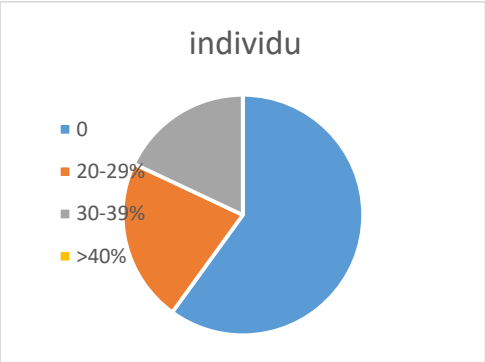


Figure 4. savarity

The front area is the main access entrance area that is passed by visitors and managers, tree health in this area is included in the healthy category. The central region is an area where many visitors' activities for recreation and nature tourism are also categorized as having healthy trees. Meanwhile, the back area is an area for recreation for visitors, marked by several gajebos that have been erected indicating damage to the trees, although they are still in the light index category. So it is necessary to get greater attention from the manager for the comfort and safety of visitors and not to cause transmission of damage to other individual trees.

In the condition of tree damage in Bungkirit Urban Forest, it can still be overcome by carrying out maintenance. According to [7] that maintenance is an activity to maintain and care for trees in urban forests for all the constituent trees so that conditions are maintained properly. Maintenance that can be done to cope with the damage that exists in the Bungkirit Urban Forest, such as pruning, felling, treatment of wounds, treatment of holes due to damage to trees (cavity treatments), pest and disease control, control damage from nuisance plants, and embroidery.

Trees that are not found to be damaged can be said to be resistant to damage, under normal conditions they can adapt to pathogens and other causes of damage that are in their body tissues so that they do not affect their production capacity. Trees with a healthy class are classified as trees that are quite resistant to damage and are able to adapt well to their environment. Trees with light, medium and heavy damage are trees that are not resistant to damage.

4 Conclusion

Damaged trees found in the Bungkirit urban forest experienced 7 types of damage, namely: cancer, fungus, open wounds, broken stems or roots, broken or dead branches, damaged leaves and buds, and discolored leaves. The location of the greatest damage occurs in the main trunk and branches that are broken or fallen. The health condition of the tree is classified as healthy with a light class damage index value so that it can still be handled with regular maintenance and pruning only.

References

[1] Karlinasari, L. dan Surjokusumo, S. 2010. *Kebugaran Pohon Berdiri (StandingTree) Sebagai Aset Lingkungan Perkotaan dan Perumahan. Di dalam:Workshop Pemantauan Kesehatan Hutan Pada Ruang Terbuka Hijau di Lingkungan Perkotaan*. Institut Pertanian Bogor. Bogor.

[2] Khoiri, S. 2004. *Studi Tingkat Kerusakan Pohon di Hutan Kota Srengseng Laporan Penelitian*. [Skripsi]. Universitas Lampung. Bandar Lampung. 20 p.

[3] Miardini A.2006. *Analisis kesehatan pohon di Kebun Raya Bogor.* Bogor: Departemen Konservasi Sumberdaya Hutan dan Ekowisata, Institut Pertanian Bogor.

[4] Mangold, R. 1997. *Forest Health Monitoring: Field Methods Guide.* [Buku] USDA Forest USDA Forest Service General Technical Report. New York. 135 p.

[5] Duryat, Gitosaputro, S. dan Riniarti, M. 2014. *Analisis Status Dan Pemetaan Kondisi Kesehatan Pohon Penghijauan Di Kota Bandar Lampung*. [Laporan Penelitian]. Universitas Lampung. Bandar Lampung.

[6] Rikto. 2010. *Tipe Kerusakan Pohon HutanKota (Studi Kasus: Hutan Kota Bentuk Jalur Hijau, Kota Bogor-Jawa Barat)*. [Skripsi]. Institut Pertanian Bogor. Bogor. p.128.

[7] Supriyanto, Kenneth, S. dan Soekotjo, A. dan Ngaloken, G. 2001. *Forest Health Monitoring Plot Establishment*. Technical Report No 1. dalam Forest Health Monitoring To Monitor The Sustainability Of Indonesian Tropical Rain Forest, Volume I. Buku. Japan: ITTO dan Bogor: SEAMEOBIOTROP. 78 p.

[8] Stalin, M., Farah, D., Harnani, H. 2013. *Analisis Kerusakan Pohon Di Jalan Ahmad Yani Kota Pontianak*. Jurnal Hutan Lestari; 1 (2): pp.8.

[9] Karyaningsih, I dan windi W. 2020. Prosiding Fahutan I (01) : Konservasi untuk Kesejahteraan Masyarakat; Identifikasi jenis Kerusakan tanaman di lingkungan kampus I universitas kuningan dalam upaya peningkatan kenyamanan kampus. P. 221-229.

[10] Ginawan, G, ilham A, dan Ika K. 2020. Prosiding Fahutan I (01) : *: Konservasi untuk Kesejahteraan Masyarakat*; Identifikasi serangan hama pada tanaman akasia (acacia mangium) di iuuphhk-hti pt hutan rindang benua provinsi Kalimantan selatan. p 257-265.

[11] Rahmat, S., Cristine, W., & Hari, K. 2019. Penilaian Kesehatan Hutan Pada Berbagai Tipe Hutan di Provinsi Lampung. Jurnal Sylva Lestari, 1 :95-109.

[12] Widyastuti, Sumardi, Harjono. 2005. Patologi Hutan. Gadjah Mada University Press. Bulaksumur Yogyakarta: Universitas Gadjah Mada.