Tree Risk Assessment using VTA at Universitas Indonesia

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Abstract. Universitas Indonesia’s urban forest is a part of Universitas Indonesia’s campus area, which covered 192 hectares from total 320 hectares campus area. Universitas Indonesia as a green campus has many green open spaces that distributed throughout campus and consists of several tree species. The age of the most vegetation in both urban forest and green open space has been 30 years old. This condition required routine management to evaluate tree health and risk. Some routine management has been conducted which consist of pruning and eliminating dead trees followed by replanting of new trees. This management aims to reduce the risk posed by trees related to community safety and for keeping environmental sustainability. The method that we used to assess the tree risk were visual tree risk assessment (VTA) based on biological characteristics of the risked tree. The result showed that there are four major species that need more routine management and had a higher percentage of managed trees during 2018. Those species were Acacia mangium, Hevea brasiliensis, Enterolobium cyclocarpum, and Delonix regia.

1. Introduction
Universitas Indonesia’s urban forest is a part of Universitas Indonesia’s campus area, which covered around 192 hectares from a total of 320 hectares campus area [1]. The campus first established in 1986 and used to be agricultural fields, rubber plantation, and inhabited by people. Since 1988, Universitas Indonesia’s rector and staff were encouraged replanting program that later became zonation program of UI’s urban forest based on Wallace imaginary line that divided UI’s urban forest into 3 zones: Wales Barat (West Wallace), Wales Timur (East Wallace), and Vegetasi Alami (natural vegetation). These were intended to create an urban forest that serves as vegetation collection and conservation area for trees around Indonesia, and as a watershed catchment area for Ciliwung river. Furthermore, the replanting program had been done too in many green open spaces around campus, especially around the building and at the roadside.

Universitas Indonesia as a green campus has many green open spaces distributed throughout the campus area. Many plant species could be found here. There are around 817 plant species that consisted of native species, alien species, and naturalized species [2]. Because this program had been done along with the development of our campus, the age of the most vegetation in both urban forest and green open space has been 30 years old. The old trees could be found decayed and dead. Even a
few trees such as *Albizia* and *Enterolobium* from *Fabaceae* had reached its maximum height with excessive canopy. This condition required routine management to evaluate tree health and risk.

As a campus with 320-hectare area and consisted of urban forest and green open spaces, routine management for tree risk is needed to maintain the community health, safety, and environment. Some routine management has been conducted which consist of pruning and eliminating dead trees followed by replanting of new trees. That management aims to reduce the risk posed by trees related to community safety and for keeping the environmental sustainability. However, how to decide which tree that need to be maintained by pruning and elimination, and which method could be done effectively for management at such large areas.

In this paper, we would discuss how Occupational of Health, Safety, and Environment (OHSE) team conduct routine management for tree and which method that had been used in determining the trees that need to be managed.

2. Theory
The urban forest can be defined as systems or networks consisted of all woodlands, group of trees, and individual trees located in urban and peri-urban areas, including forests, street trees, trees in parks and gardens, and trees in derelict corners. There are five main types of urban forests: peri-urban forests and woodlands, city parks and urban forests, pocket parks and gardens with trees, trees on streets or in public squares, and other green spaces with trees [3]. Based on this definition, we could assume that every corner of the city or roadside that have trees on it could be called an urban forest.

However, the concept of urban forest based on Indonesian regulations is quite different. The urban forest as defined by government regulations is a stretch of land that grows small trees and tightly in urban areas both on state land and land rights, which are designated as urban forest by an authorized official [4].

Urban forests have an essential role both for environment and society, and the management is done with great care. This is indicated by the founding of several organizations that focused on urban forestry such as the International Society of Arboriculture (ISA) and other government-based arboriculture organization. Furthermore, the management needs to be regarded as encompassing planning, planting, and care of trees. Partnership approaches need to be carried out too by involving both the public and private sector for successful urban forestry program [5].

Assessment of tree risk as one of trees management program should be conducted to maintain community safety and environmental sustainability. Tree risk assessment is a systematic process consists of identifying, analyzing, and evaluating the risk posed by trees. There are three levels of tree risk assessment regarding time, training, and equipment used: limited visual assessment (Level 1), basic visual assessment (Level 2), and advanced risk assessment (Level 3). A limited visual assessment can be carried out by foot or in the vehicle and focused on catching the most glaring defects or adverse conditions, while basic visual assessment is carried out by doing 360-degrees visual inspection of a tree and its surrounding. Meanwhile, the advanced risk assessment is carried by using advanced technology to detect tree decay and stability [6].

3. Method
Data collection had been conducted by routine inspection throughout Universitas Indonesia' area, especially at green open spaces and some urban forest area that visited by people daily. The inspection frequently conducted at least once a week. The inspector would do the assessment using a visual tree risk assessment (VTA) by filling a simplified inspection form. There are 12 characteristics that we use to determine whether the assessed tree needs to be pruned or eliminated. These characteristics are a dead tree, dead branch, cracked branch, curved branch, slope tree, shallow roots, damaged/rotten roots, hollow stem, fungal infection, termites/destructive insects attack, excessive canopy, and close to assets.

The method was used because VTA is the most efficient and straightforward method that can be used in Uls urban forest. It is because the tree risk management program at UI needs to be done most
efficiently and straightforwardly throughout UI's area. With its microclimate that quite similar to a tropical rainforest with high rain intensity, the risk potential posed by trees especially the old ones with big size should be mitigated as soon as possible. Furthermore, those 12 biological characteristics used in visual tree risk assessment were selected based on the most common characteristics that can be seen at UI's trees that need to be managed, including the common traits on fallen trees at Universitas Indonesia. So we need to evaluate whether this method could be applied too in another area or should be adjusted based on the characters of each area.

4. Result and Discussion
Based on trees management data during 2018, 292 trees had been managed comprising of pruning and elimination. Those trees have consisted of several species based on trees that had been identified and analyzed. There are four important species that need more routine management and had a higher percentage of managed trees. Those species were *Acacia mangium*, *Hevea brasiliensis*, *Enterolobium cyclocarpum*, and *Delonix regia*.

*Acacia mangium* is a fast-growing plant and categorized as a native species. It is a single-stemmed evergreen tree and has a dense canopy. Most of it was a pioneer species that had been planted for reforestation in 1988. So the age of the trees mostly around 20—30 years old and most of them was a dead tree. Several trees also infected by termites from the root and lower stem, causes the tree to tilt.

The other three species also fast growing plants but categorized as a non-native species [7]. Only *Hevea brasiliensis* that had been cultivated since before Universitas Indonesia established in Depok. Even some of them are still harvested for the sap. Most of the trees were non-productive anymore and showed a sign of dead tree.

![Figure 1. All managed trees during 2018 based on species](image-url)
Enterolobium cyclocarpum has a massive size and excess canopy. The trees produce large roots that run along the surfaces for 2—3 m [7]. Most of it has an excessive canopy and infected by termites and fungus such as Ganoderma.

Delonix regia has shallow roots and weak stem. The trees could be uprooted during intense storms, and broken by strong winds [7]. Most of it has an irregular and excessive canopy. Termite infection could be seen too in this tree.

However, in all of them, we could see the termites attack both in living and dead trees. This because Universitas Indonesia has six species of termites that nesting and feeding in both living and dead trees [8]. In some trees, we also could found fungal infection such as Ganoderma and termites related fungus.

Besides on those four tree species, the characteristics of managed trees such as a dead tree, termite and fungal infection, shallow roots, excessive canopy, and irregular architecture of tree that had been
mentioned above could be found too in most of the managed tree species during 2018. Those characteristics were easily seen and the most common condition of old trees at UI's urban forest. However, the comprehensive inspection about trees health and its surrounding is carried out too by our OHSE inspector.

Sometimes, the surrounding of the trees became our top consideration for managing the trees. That is because our campus is more focused on maintaining community safety, especially around green open spaces, so the management of the trees often focused on green opens spaces around buildings and roadside. Furthermore, a quick assessment needs to be done in such a large area with many trees, without neglecting the tree health and environment sustainability. All of these reasons become our basis for choosing the visual tree risk assessment.

However, advanced technology for assessing tree risk and health such as tree decay and stability is still needed. That is because a few trees collection at UI's urban forest could be categorized as a rare species that need to be managed carefully. Moreover, it cannot be achieved without enhancing both the equipment and knowledge for assessing tree risk and health. If we could fulfill all of it, a better campus that concerns both community safety and environmental sustainability for a better life could be achieved.

5. Conclusion
Universitas Indonesia has been managed around 292 trees during 2018, with four important species such as Acacia mangium, Hevea brasiliensis, Enterolobium cyclocarpum, and Delonix regia. The management has been conducted by assessing the risk using visual tree risk assessment, and consist of pruning and eliminating the trees. Enhancing both equipment and knowledge for assessing the tree risk and health could make a better campus that concern on both community safety and environmental sustainability.

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