Safeguarding serenity: assessing tree risks and hazards in UMK Jeli Campus for sustainable management.

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Abstract. The UMK Campus Jeli, a renowned public university in Malaysia, has been operating for a decade. This study aimed to investigate potential risks and hazards associated with trees located near campus buildings. Such proximity can impact drainage, leading to water pooling that increases the risk of mold and rot formation. This study covered an extensive sampled area of 0.05 km²within the campus area. The Basic Tree Risk Assessment Survey was employed using a quantitative approach to systematically record and categorize information while conducting visual evaluations to assess tree risks. A total of 44 individual trees were recorded, representing 15 different species and 12 families. The Clusiaceae family dominated, accounting for 17% of the recorded trees, while the Malvaceae family constituted the smallest proportion at 2%. Notably, the Prunus avium tree posed the highest risk due to its proximity to buildings, which could potentially lead to mold and mildew growth over time. Implementing the Basic Tree Risk Assessment methodology holds significant value for the management unit at UMK Campus Jeli, providing essential insights for planning and maintaining tree health while preserving the campus's aesthetic appeal.

1. Introduction

Tree risk and hazard assessment is an important part of maintaining both urban and rural forests, as it plays an important role in protecting public safety. The proximity of trees to populated areas, infrastructure, and public spaces has become more of a concern as a result of increased development and population density in many locations.

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The assessment enables arborists, urban planners, and decision-makers to proactively manage and mitigate risks by revealing important insights about the structural stability, health, and possible hazards posed by trees. Tree risk assessment aids in preventing accidents, damage to property, and even fatalities by detecting and correcting potential dangers such unstable trees, weak branches, and root issues.

This study was carried out to determine the number of potentially dangerous trees and tree species, as well as to identify the tree parts that have led to tree hazards on the campus area. The Basic Tree Risk Assessment was used to gather and organise data. The hazard assessment assesses the dangers that trees present, the possibility that they may fail, and the degree of the harm that could result to their surrounds if they do. It is also used to identify and evaluate problematic trees in each area and to provide corrective measures before the trees fall. As a result, it considerably helps to the creation of safer and more resilient communities while maintaining the environment.

2. Method

Universiti Malaysia Kelantan (UMK), Jeli Campus (Figure 1) are one of Malaysia renowned public universities. Approximately ten years have passed since the campus first opened. The facilities and adjacent surroundings are now being managed, upgraded, and given new constructions. The campus area has expanded since previously. The total area sampled was approximately 0.05 km2, which included many different building and structures.

Fig 1: Location map of the study area in UMK campus Jeli

Every individual tree with a diameter greater than 10cm dbh was measured and analysed. The Tree Risk Assessment method entails a thorough examination of trees in order to detect potential hazards. It starts with a site assessment, then moves on to a visual inspection of the tree's health and structure. A popular technique for determining tree risk is called visual tree assessment (VTA) [1]. To find potential problems and hazards, it entails a visual inspection of trees by arborists. They will look at a variety of tree characteristics throughout the examination, including general health, structural stability, and decay or decline indicators.

They examine the tree from various angles and distances, considering both internal and external factors like cavities or hollow trunks as well as external variables like canopy condition. VTA is a flexible, affordable technology that can be used in a variety of tree species and environments including its simplicity and capability to swiftly evaluate trees and prioritise additional research or management actions.

Within this methodology the trees likelihood of failure is assessed in relation to its likelihood of impacting a target within its fall zone (Figure 2). The likelihood matrix and risk rating matrix are tools commonly used in tree risk assessment to evaluate the likelihood of tree failures and the associated consequences. They help in categorizing and prioritizing tree risks based on their potential impacts (Figure 2). This target-based approach is a powerful tool when prioritising tree inspections in the urban environment, especially for one that responsible for large tree populations.

Subsequently, targeted zones were established, and a risk rating is issued based on identified defects and the health of the tree. Mitigation methods, such as pruning or removal, are then proposed to address identified concerns. The findings of the assessment are documented to ensure proper communication and future reference.

Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impact			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Fig. 2: Tree Risk Assessment matrix [2]

3. Result and Discussion

3.1 Tree Species

A total of 44 trees, including 15 species and 12 families, were documented for the species with the tree risk and hazard evaluation. Table 1 shows that Sapindaceae, Clusiaceae, and Sapotaceae are the dominant families in the area with a percentage of 20%, 17% and 15% respectively.

Table 1: Tree identified in the study area

Family	Genus	Species name	Total
Sapindaceae	Filicium	*Filicium decepeins*	9
Clusiaceae	Garcinia	*Garcinia celebica* L.	7
Sapotaceae	Mimusops	*Mimusops Elengi* L.	7
Lamiaceae	Tectona	*Tectona grandis*	6

Annonaceae	Cananga	*Cananga odorata*	2
Combretacease	Bucida	*Bucida molineti*	2
Myrtaceae	Syzygium	*Syzygium myrtifolium*	2
Fabaceae	Neolamarckia	*Neolamarckia cadamba*	1
Fabaceae	Calliandra	*Calliandra haematocephala*	1
Moracease	Morus	*Morus alba*	1
Phyllanthaeae	Baccaurea	*Baccaurea motleyana*	1
Aracaceae	Cocos	*Cocos nucifera*	1
Malvaceae	Durio	*Durio zibethinus* L.	1
Myrtaceae	Callistemon	*Callistemon citrinus*	1
Fabaceae	Pterocarpus	*Pterocarpus angolensis*	1
			44

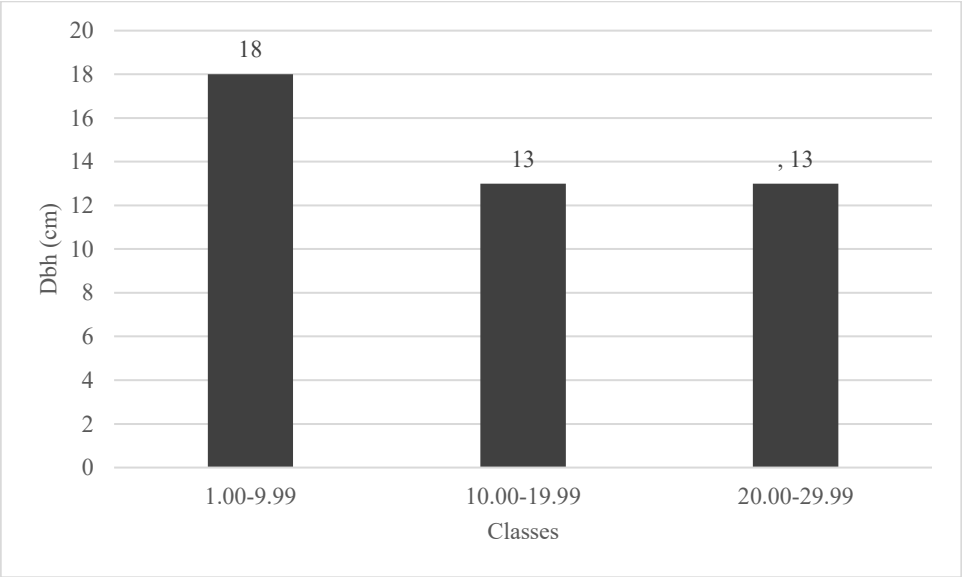

Figure 3: Tree DBH Classes

The majority of the sampled trees have a small diameter, with 18 individuals ranging from 1.00 cm to 9.99 cm (Figure 3). The Lamiaceae family (*Tectona grandis*) has the biggest diameter at 24.00 cm dbh. Meanwhile, the average height for all tree is 5.68m. The relationship between tree species, diameter at breast height (DBH), and tree height is considered during the assessment. Different tree species exhibit variations in growth habits, wood properties, and structural characteristics that influence the visual cues assessed during VTA. Tree height, in conjunction with DBH, provides valuable insights into the overall size, growth patterns, and potential risks associated with different species. By understanding the relationship between species, DBH, and height, one can better interpret visual cues, identify species-specific indicators of hazards, and make informed decisions for effective tree management and risk assessment.

3.2 Likelihood and Risk Rating Matrix

In terms of the risk associated with different tree parts (Figure 4), many of the assessed risks are related to leaves, accounting for 21% of the cases. Branches pose a risk in 11% of the cases, while root risks are identified in 9% of the cases. The risk associated with the stem is relatively low, representing only 2% of the assessed tree risks. Regarding the target for risk categorization based on the distance between tree sections with buildings or other structures, the highest risk is associated with FIAT building, accounting for 21% of the cases. The risks categorized (Figure 5) under Block A, Block B and BAP building represent 7%, 7%, and 8% of the assessed tree risks, respectively.

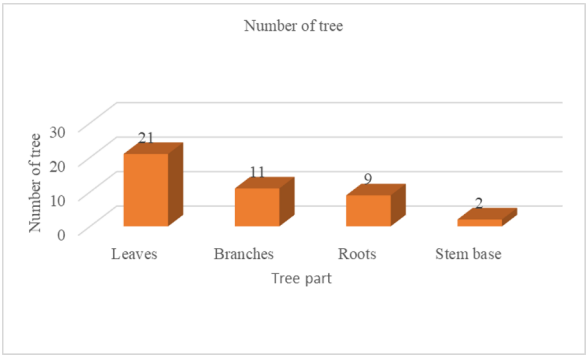

Fig. 4: Tree Part

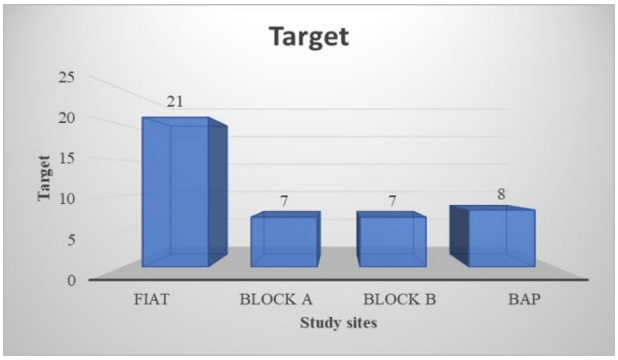

Fig. 5: Target for risk categorization

These findings highlight the importance of considering different tree parts and their proximity to buildings when assessing tree risks. Leaves, branches, and roots are identified as significant risk factors, while the stem poses a relatively lower risk. Additionally, given the possible risks connected with tree sections being close to buildings or structures, certain targets like the area around the FIAT building deserve extra care.

The following conclusions can be derived based on the likelihood matrix and risk rating matrix supplied for tree risk assessment. It is essential to take the effects of that failure into account when estimating the likelihood of a tree failing. Damage to infrastructure may have small repercussions, such as simple repairs. They may, however, have serious ramifications in terms of public safety [3]. With 19 occurrences, most of the assessed outcomes are in the "Minor" category. Additionally, there are 15 instances of "Negligible Consequences" and 6 instances of "Significant" consequences. This implies that most of the tree dangers examined

have rather minimal impacts. The three species that stand out as having the most occurrences are *Tectona grandis*, *Garcinia celebica* and *Mimusops elengi.*

The likelihood of failure impacts varies, with 43% being "Very Likely," 42% being "Likely," and 15% being "Somewhat Likely." The relatively high likelihood of failure impacts in the assessed tree risks can be attributed to several reasons, particularly when considering tropical trees such as species characteristic (e.g: wide crowns, large leaves, and expansive root systems) [4,5] and environmental conditions (e.g: heavy rainfall, strong winds and storms). These traits can make them more susceptible to failure impacts, as their large size and weight can increase the likelihood of branch or stem failures during extreme weather events or other stressors [6]. In addition, the environmental conditions can exert significant mechanical stress on trees, potentially leading to failure impacts.

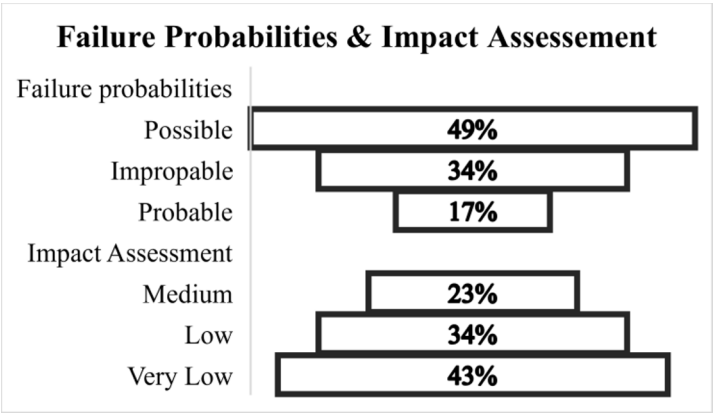

Fig. 6: Failure Probabilities and Impact Assessment

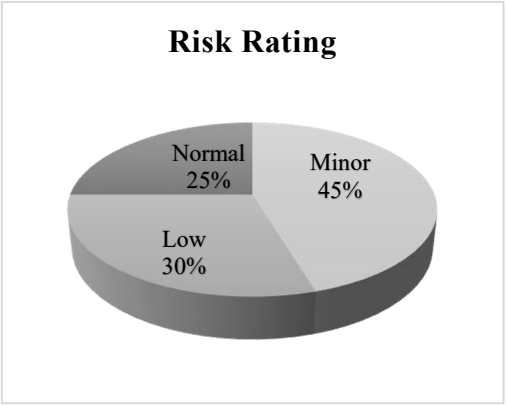

Fig. 7: Risk Rating

The assessment of failure probabilities (Figure 6) reveals that in 49% of cases, there is a "Possible" chance of breaking any root, branch, or stem of the tree. In 34% of cases, the probability is assessed as "Improbable," while in 17% of cases, it is considered "Probable." This indicates a range of potential failure scenarios, with varying likelihoods (Figure 6). In terms of impact assessment, 43% of cases are categorized as having a "Very Low" impact, suggesting minimal consequences in the event of failure. Additionally, 34% of cases are classified as having a "Low" impact, while 23% are considered to have a "Medium" impact.

These impact assessments (Figure 6) consider the potential consequences of failure on the surrounding environment, structures, and safety. These findings emphasize the

importance of considering both the likelihood of failure and the potential impact when evaluating tree risks. The genera Felicium, Tectona, Garcinia, and Mimusops are the most noticeable. By understanding the probabilities and consequences associated with tree failures, appropriate risk management strategies can be implemented to minimize potential hazards and ensure the safety and well-being of individuals and the surrounding environment.

Figure 7 shows the average risk rating for the assessed tree risks provides an overall picture of the risks involved. 29% of the assessed risks are classified as "Minor," indicating a low level of concern. 19% fall into the "Low" risk category, while 16% fall into the "Normal" risk category. This distribution suggests that the majority of the assessed tree risks are generally manageable with routine monitoring and maintenance.

4. Conclusion

In conclusion, the assessment of tree risks based on the data suggests that most assessed risks have small effects and relatively low to very low impacts. With a sizable portion falling into the "Very Likely" and "Likely" categories, the risk of failure repercussions is comparatively high. The likelihood of breaking any root, branch, or stem of the tree is rated as "Possible" in the vast majority of cases.

Considering these findings, it is crucial to implement appropriate management strategies for tree risk mitigation, particularly in the context of urban tropical trees. Regular inspections, monitoring of tree health and structural stability, and targeted pruning or removal of potential hazards are essential practices. By doing so, potential risks can be effectively managed, ensuring the safety of individuals and the surrounding environment. Therefore, by prioritizing tree risk management, communities can create safer and more sustainable environments while enjoying the numerous benefits that trees provide.

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