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IDENTIFYING FACTORS OF TREE RISK MANAGEMENT FOR LOCAL AUTHORITIES IN SELANGOR

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Abstract: *The increasing tree risks in Selangor are a sign of unattended issues, lack of maintenance, and absence of standards. The local authorities may keep planting more trees because the intention was to make their city greener or attractive. However, as the Brundtland Commission conceptualized in 1987, "sustainable development" as; paths of human progress which meet the needs and aspirations of the present generation without compromising the ability of future generations to meet their needs; the need to make the environment safe is likely the balance to the core aspiration. This study aims to identify factors of tree risk management. The research explored the relationship between the local governing factors and tree risk management, considered their understanding of the role of tree risk management in governance. These differences shed those six aspects have criteria that are able to affect tree risk management and thus become important factors in managing tree risk in local authorities of Selangor. The research finding suggested the measures and indicators in determining the level of efficiency in the tree risk management of a local leader in Selangor. This study is hoped to offer knowledge contribution to the body of literature in determining the Tree Risk Management to be used by all the local authorities in Selangor.*

Keywords: *Tree Risk, Risk Management, Local Authorities, Selangor*

Introduction

Most recently, in 2021, a motorcyclist was injured, and a car was damaged when a massive tree uprooted and fell in front of National Museum, Kuala Lumpur (The Star, 2021). In 2018, another two pillion riders succumbed after being crushed by a large tree at Jalan Ampang, Kuala Lumpur (News Straits Times, 2018). In 2010 based on records by Majlis Bandaraya Subang Jaya (MBSJ, 2011), a tree fell onto a car at Persiaran Kewajipan, Subang Jaya, slightly missed killing the driver. Rapid development over the years has resulted in beautiful landscaping and green urban living throughout the cities in Malaysia. These maturing trees have grown to such heights that they start to increase risks to the public. In 2017, a written policy on Trees Conservation and Management was mentioned in the *Mesyuarat Pertama Penggal Kelima Dewan Negeri Selangor Tahun 2017*. It comprises 12 new guidelines which should have been followed by the local councils. Meanwhile, the New Urban Agenda

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introduced by the United Nations in 2018 outlined Sustainable Cities and Communities as one of its crucial visions. As trees are part of the development and are naturally alive, trees need to be managed to ensure their functions are not deprived by their conditions. Sustainability is about trees and us being able to live and grow together, symbiotically. All trees in an area are managed by the local government, represented by the local authorities. In local authorities, Landscape Department headed by Landscape Architects are abided by the following:

a) National Landscape Guidelines, which provide the standards for tree planning, development, and maintenance, by the Landscape Departments
b) Organizational aspects in terms of budget, logistic and human resource

In Subang Jaya, records in Majlis Bandaraya Subang Jaya (MBSJ) have shown that 29,491 complaints have been received from the public concerning the well-being of trees around them from 2006 to December 2020 in Figure 1. This signals the awareness and concern of the public about the existence of trees around their living environment.

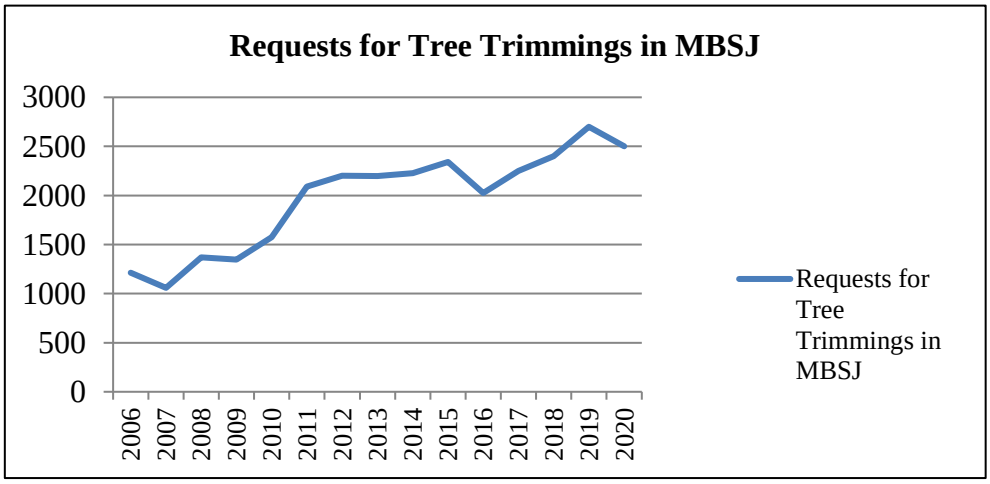

Figure 1: The pattern of requests for tree trimmings for MBSJ from 2006-2020

Source: MBSJ Landscape Department, 2021

Tree risk management is newly regulated by public authorities in developed countries, namely the United Kingdom, the United States, and Australia. Among established work on the subject has been found in the Tree Risk Management, documented by USDA Forest Services and Common Sense Risk of Management Trees by the National Tree Safety Group, which offers a guideline for local authorities to manage trees' risks. MBSJ, a 5-star government organization, situates itself in a bold and vocal community where public service delivery is highly expected. Many complaints have been received since 2006, as shown in Figure 1. as the community demands comfortable living. Unfortunately, in MBSJ, tree risk management is not attained systematically and requires improvement.

The study is concerned over the risk caused by trees to the Local Authority in Selangor. There is a manual on handling tree risk circulated by the *Jabatan Landskap Negara* in 2011, titled '*Manual Pengurusan Risiko Pokok Ameniti'*. However, the guide expanses on horticultural practices and very lack of actual management requirements, thus resulting in lack attention towards this issue from the upper management of local authorities, state and federal government. Among the problems resulting from this are identified as follows;

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a) Annual funding for tree maintenance is entirely by the Local Authorities
b) High rate of complaints regarding trees from the residents
c) Losses claim due to tree fell mishap
d) Lack of trained workers
e) Irregular tree maintenance

MBSJ has 97303 public trees inventoried in 2015, excluding public trees that have yet been documented, estimated as twice the number. For the financial year of 2019, only 2.85 percent of the overall Council fund is being planned for tree management, while 40 percent is being spent on cleansing exercises. In 2019, around 45000 trees could be maintained; thus, the ideal budget required to maintain the inventoried public tree would be twice the given budget for 2019. *Garis Panduan Landskap Negara* (2011) states that by 2020, the country is to become a Beautiful Garden Nation. However, the lack of attention, enforcement, and assistance from the Federal government to the local authorities leave the agencies to operate by themselves. To become a garden nation, trees need to be maintained, and through this research, it will be found that trees have multi-ways of being risky.

The objective of this study is to identify available factors in the process of tree risk management and to determine the essential factors in tree risk management to be adapted into the governance of Local Authorities in Selangor and to suggest the criteria in determining the level of efficiency the tree risk management of a local authority in Selangor.

Literature Review

Fundamentals of Tree Risk Management

The negative impacts of city trees are more widely discussed than the positive aspects mentioned by Auch et al. (2016). "We have to be more willing to pay for control measures or risk serious consequences for our familiar landscapes and gardens, according to researchers carrying out investigations for the U.K. Research Councils' Rural Economy and Land Use Programme", quoted by an online journal ScienceDaily (January 2011). One of the most significant parts of decision-making processes in tree maintenance is its risk management. Nowak et al., 2010 indicated that all publicly and privately owned trees within an urban area—including individual trees along streets and in backyards and stands of remnant forest- are termed 'urban forest.' Trees planted in parks in urban areas are known as urban forests (Justice, 1986). Most people prefer to live, recreate, and work in communities of healthy and well-maintained urban forests. Thus, the well-maintained and risk-free urban forest is a desire for modern urban communities as it increases the quality of life. Risk has been explained as the potential for unwanted or negative consequences of an event or activity (Rowe, 1977). According to the United Nations Office for Disaster Risk Reduction UNISDR (2011), the acceptable risk is also used to assess and define the structural and non-structural measures that are needed to reduce possible harm to people, property, services, and systems to a chosen tolerated level, according to codes or "accepted practice" which are based on known probabilities of hazards and other factors. Duntemann (2006) defined Tree Risk Management as a concept in tree management by identifying levels of risk and managing according to acceptable levels of risk specified within written policies or enacted through management practices. Barrell (2021) states that the proximity of rapid development growth in the modern era has forced an increasing intensity of proactive tree management, i.e., manipulation of trees to reduce their harmful impact on people and optimise the benefits they provide. He suggests

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that duty holders be mindful of this changing tree risk management landscape and adjust their approach accordingly to refute allegations of negligence in their works. When a failure that causes harm results in legal proceedings, Local Authorities as duty holders will be expected to have considered all pertaining matters, updated their risk management processes, and taken reasonable and proportionate measures to reduce significant risks of harm. National Tree Safety Group, U.K. (2011) designed a Tree Risk Management Process model that shows the relationship between risk and the factors that support it throughout the process. It stressed that the property owners have a duty to inspect and remove limbs or trees under their jurisdiction. It is not feasible for an organization with limited financial and personnel resources to remove every potentially hazardous tree. A systematic procedure in writing is the best defense against negligence.

Tree Risk Identification

The process of planning the tree's location is essential to consider its potential risk when it grows in the future. However, for the local authorities, the guidelines by *Jabatan Landskap Negara*, 2008 focus on design matters about aesthetic and function values. Shigo (1991) emphasized that the suitable trees need to be planted at the right place, and 19 years after that, the Hong Kong Tree Management Office, in its Guideline for Tree Risk Assessment and Management Arrangement (2019), reiterated that quality tree starts when a tree is selected and planted. Lazim (2014) mentioned that there are species that are not suitable to be planted near buildings; this can be easily recognized through the numbers and types of trees involved in complaints received by the city. This, in actuality, can become a good base data in zoning the risk. Greening, Landscape and Tree Management Section Development Bureau of The Government of Hong Kong Special Administrative Region (2020) simplifies it as a tree cannot be a hazard without the presence of a target. Tree risk management zones can be determined based mainly on the frequency of use of the area by the target. VALID (2021), a non-profit organization, divided the zones of tree risks into Passive and Active in which ratings are given to trees before a decision is made. Being a guideline, the manual by *Jabatan Landskap Negara* (2011) is not being fully utilised in city tree management.

Tree Risk Analysis

Whenever an issue arises whether to cut a tree or trim, the local authorities often have to decide an action that does not trigger public complaints. Yaman (2011) mentioned that a tree with a single sign of defect is already a start of a tree failure. That is a mark of value. None of the guidelines or articles locally discussed valuing of trees. Only the arborist groups are familiar with tree values, and some local authorities are hiring the arborists to value specific trees related to their local issues. In 2017, MBSJ issued a letter to the Federal government asking for the standard guide on tree valuing, but there is no feedback. The Local Authority had by itself calculated the value using methods derived from professionals abroad. It used it in an insurance claim towards a case where an accident caused a car to wreck a tree in the middle of a public road. The Local Authority succeed and will continue henceforward. Abroad, Coder (1996) mentions that values will be shown in costs, which derives from impacts of specific and important values. Doncaster Council of UK in 2021 mentioned that the local Town and Country Planning Act introduced the concept of trees having public amenity value but does not prescribe how the values should be estimated.

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Tree Risk Evaluation

None of the guidelines from the Federal Government or state government speaks about liability from trees risk. But the number of claims due to fallen trees in Subang Jaya keeps rising throughout the year. Some claims were rejected, and these invited questions from the public. Greening, Landscape and Tree Management Section Development Bureau of The Government of Hong Kong Special Administrative Region (2020) mentioned that if not adequately planted when trees are getting bigger with time, they may become liabilities instead of assets. Independent Inquiry into Management of Trees on Public Land by Local Government Association (L.G.A.) of South Australia indicated the multitude of cases of tree failures have proven that there is a liability that needs to be contained by defined authorities, which in turn need to ensure it had covered the public with insurance at all times.

How a failure is being responded to is an essential aspect of risk management. This is to deter the loss being repeated and jeopardizing the whole system of works. At this moment, some of the local authorities of Selangor are developing a response team for local ad hoc disasters, e.g., fire, fallen trees, flood. However, not all the local authorities are dealing with it the same way. Lazim (2014) suggests that Emergency Action should be established to ensure that when tree failure occurs causing property damage, prompt action needs to be undertaken by the Local Authority to reduce pressure on the victim.

Public trees may be located within some areas under other agencies, management of private sectors. When a mishap occurs, there is always a chance that it will involve more than a single party. Sometimes, the tree that is at risk of falling is not under the jurisdiction of the city or the City tree at risk of falling onto land belonging to another. Different land may be under other stakeholders and require a different technique of clearing. It is proven under the case of Ahmad Jaafar Abdul Latif v. Dato' Bandar Kuala Lumpur [2014] 9 CLJ 861 [FC] read in the Journal Of The Malaysian Judiciary (2016). This is a clear result of local authorities in Malaysia limiting themselves to trees in their maintenance area. Yaman et al. (2011) mentioned that the responsibility to manage the risk of public trees belongs to the Local Authorities and related agencies. Lazim (2014) indicates that landscape planning and policy need to involve stakeholders and the public in tree risk. Abdul Hadi et al. (2015) suggested that the authority or landowner needs to be made aware and educated on their jurisdiction towards the trees within their area and the rights of the public. Judice et al. (2021) stressed that tree risk management is not just a concern for municipalities. There is a need to increase awareness on tree assessments and preventive care among private landowners.

Tree Risk Treatment

A local authority has a general power to execute the capabilities needed to manage the risk of trees in public, but the controls are 'grey' within private premises. The local authority needs to go in-depth on the general laws (create by-laws) to provide a solid base to execute the power within private premises. Abdul Hadi et al. (2015) insisted that as landowner, the local authority will not escape any claims with defense' Act of God' if the injury could have been prevented by reasonable diligence or ordinary care or was an injury contributed to by the human agency.

Comparison of numbers of trees and budget allocated for all local authorities in Selangor and findings from the Laporan Tahunan from various Local Authorities shows that the Local Authorities' commitment towards tree risks lacks fiscal support as only less than 3 % of the Council's fund goes to tree maintenance. Based on the MBSJ records (2020), only 3% funds is budgeted for tree maintenance, which suffices only for 30,000 trees (30% from the number of

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trees in inventory). It seems that Singapore, Hong Kong, and many developed nations have embarked on tree management and ensure risk factors are covered within their structures. These are nations that can be seen effectively managing their greens to meet the Sustainable Development Goals by 2030.

Current Trend in Tree Risk Management Researches

The Tree Risk Management Strategy for Torbay (2017) indicates that the city has a duty to take reasonable care to avoid acts and omissions that cause a reasonably foreseeable risk of injury to persons or property entails the following; site zoning, frequency of inspections, level of inspections, level of competence, the timescale for remedial works, personnel and record-keeping. Research on Hazard Evaluation of Mature Urban Street Trees in Kuala Lumpur by Murad Abd. Ghani (2000) is found to support the issue of Tree Risk Management as it explains the problems of hazards in trees that require a form of management to achieve a better service delivery to the public. The management of urban street trees involves three primary operations: establishing, maintaining, and removing trees (Miller. 1988). According to Nowak (1990), on average, 30% of a city's total tree care budget was allocated to trimming activities and 28% to tree removal and disposal. These were due to the status of urban street trees that have reached the mature and over-matured size and their proximity to urban communities. For the municipal workers to discharge their duties effectively and systematically, a thorough understanding of the resource base is needed. This can be carried out through inventory of its resource base. Checklists are essential to provide a current record of resources being managed and assist in management decision-making.

A survey in the United States (Bassett and Lawrence. 1975) found that only one-third of 172 cities had an inventory of their street trees. Kielbaso and Giedraitis (1982) reported that tree managers in the United States spent on average 64% of their budget on the management of street trees. Still, only 22% of them knew the number of street trees under their care with any degree of accuracy by having their street trees inventoried and inspected and recorded. The authority can avoid legal suits against them for negligence in the event of injury or damage (Grainger and Thompson. 1981). Research on the identification of criteria and indicators to Evaluate hazardous street trees: A Delphi Study, Sreetheran Maruthaveeran, U.P.M. 2002 was done to develop suitable criteria and indicators for the evaluation of dangerous street trees in Kuala Lumpur. His research stated that to overcome problems of hazardous trees, and there should be proper management of hazardous trees where it requires experience, good judgment, a thorough knowledge of tree biology, and a basic understanding of the legal responsibility. With the urban trees that are getting matured and some are in a declining stage with some potential of tree failure, the society is becoming more litigious. Factors such as budgetary considerations, questions of liability, and conflicting community goals often play as important a role in the decision-making process as the arborist's expertise in tree care (Smiley et al., 2000).

The public's safety in highways and streets with roadside trees is a primary concern of local authorities and agencies. Roadway safety is impossible without an excellent management and maintenance program to manage roadside trees. The landscape department, arborist, and expert person at the Local Authority are responsible for reviewing their roadside tree conditions, identifying hazards, and making conditions safer. Roadside trees are a potential hazard. Avoiding fallen trees at the roadside becomes a priority for local authorities, especially during raining season. Local authorities will be directly blamed for those incidents, even though those trees belong to other parties. This situation gives a wrong perception of how local authorities manage the roadside trees for public safety. According to Murad (2000), for the maintenance

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personnel of municipalities to work effectively, a thorough understanding of the resource base is needed to enable the municipalities or the tree manager to manage systematically. It prioritizes tree work activities such as pruning and removal of hazard trees.

Impact of Insignificant Tree Risk Management

A storm wrecked the roof of 100 houses at Bukit Jelutong, Shah Alam, on September 30, 2014, where trees fell down and caused a massive impact on public property. Many roads were obstructed with trees, and some had to be closed temporarily to give way for tree clearing works. A tree struck a car with two passengers, and the passenger had to wait for the fire brigade to come and extract them out. In an incident in Kampung Attap, Kuala Lumpur, on October 12, 2014, a tree had fallen on a police booth, crushing two police officers in it to death. Rawang Commuter Railway line was blocked by fallen trees on August 14, 2015, resulting in train delay for a few hours. Not only the failure of trees detriment the environment the most, but its effects on people are also tremendously significant. According to the National Tree Safety Group, 2011, tree risk management is needed to manage undesirable impacts (such as damage to property and risk to human safety).

Intensive tree management is conducted by the Singaporean Government, very much similar to the practice in Hong Kong. In the United Kingdom, a principle of English Common and statute Law is that land/tree owners have a duty of care to visitors, residents, passers-by, and indeed trespassers when on their land. In Australia, the policy is directed at establishing a framework/guide for managing trees planted on Council streets and public land. It assists in determining acceptable levels of risk through the development of a tree. The management of trees on public land is subject to legislation concerned with the protection of the public. Common law has recognised that damage or injury caused by the planting or the existence of trees and vegetation is actionable in nuisance and negligence. In Hong Kong, it is stressed that the sustainable tree management policy should incorporate the following principles; public safety must always come first, the establishment of a database and standardized work procedures to improve the monitoring system, and planting the appropriate species of vegetation at the appropriate locations.

Research framework

A research framework has been established between the independent variables and the dependent variable to answer these two questions

a) What determines the managing of tree risk in local authorities of Selangor?
b) What will become the criteria in determining the level of efficiency of the tree risk management of a local authority in Selangor?

A hypothesis is designed to predict that by recognizing and implementing the most accepted governance factor, trees risks will be minimized. The results are hoped to increase the performance of the Local Authorities in Selangor in tree management as the end result. The followings shown in Figure 2 are the variables for the study;

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Variables (Cause) (**Independent**/Manipulated/Predictor /Indicator/Experiment)	Variables (Effect) (**Dependent**/Outcome/Product)
Locating of Trees Maintenance of Trees Zoning of Trees Valuation of Trees Protection of Liability Response Action Roles of Stakeholder Roles of Law Roles of Fund	Level of Tree Risks in Local Councils of Selangor

Figure 2: Variables in this study.

Methodology

Research design

This study focused on the nine variables: the locating of trees, maintenance of trees, zoning of trees, valuation of trees, protection of liability, response action, roles of stakeholders, functions of law, and roles of fund among local councils Selangor. This study used the deductive method, starting with the hypothesis and ends result would be confirmed or rejected. A quantitative research approach was used in this study which is a Cause and Effect. The research focuses on collecting the information to answer the level of tree risks in Local Councils of Selangor through surveys. What does show the level of tree risk in a City? Determination of the factor will produce the indicator for the level of risk, and at the end, it can be measured.

Figure 3: the Cause and Effect of the Variables.

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Data collection

The population encompassed all the 12 local authorities in Selangor. The sampling size was 131; in total, 181 staff working in the Landscape Departments in Selangor; according to the table suggested by Krejcie and Morgan (1970), the ideal amount of sampling is 123, or 68% of the population in each agency. Considering this population size is small, the large proportion has lessened the potential error and increased statistical efficiency.

The data to be collected in this study are facts and professional and technical opinions, as the population is those dealing with administering trees in the area. All the questions listed are the need to understand what the others are facing, how they handle the risks, and what they believe should be done instead of or additionally. A set of 35 questions seemed to be a suitable instrument to gather the information required. However, there was no precedent questionnaire available to be studied. This questionnaire is self-developed based on the Independent Variables caused to the Dependent Variable. Close-ended questions are designed using the approach of the Likert scale.

Data analysis and findings

50.4 % of the sampling were the Assistant Landscape Architect and 35.9 % are those of Assistant Agriculture Officer. Meanwhile, 13.7% were Landscape Architects. 57.3 % was from the Municipal Council, while only 8.4% involved District Council. 34.4 % were the City Council in which has more manpower than the latter. The analysis shows that most of the tree managing personnel are of Landscape Architectural background and the rest are of Agricultural background. Both backgrounds have limited knowledge on tree risk management and management based on the experience of working. This shows that the administration is generated by a group of people with moderate knowledge of the subject. Among the affirmed data are the following;

a) 88.5 % agreed that trees planted near the roadside would be a significant risk. The management is aware that locating trees near people impose a form of risk and right locating of tree in the initial stage is the utmost essential matter in tree development.
b) The findings from the second variable confirmed that the Local Authorities must accept diligent routine maintenance is required to ensure trees risks are controlled and further minimize.
c) 87 % of the Local Authorities of Selangor agrees that inventorying of trees should be in the tree risk management and detail trees inspection should be conducted by qualified personnel, which currently need to be engaged by the Local Authorities. However, cost constraint becomes the hinder points to many local authorities to proceed.
d) The findings from the regression is that the Local Authorities have not fully recognized this fourth variable. When Subject Matter Experts are asked on the aspects of tree valuation, it is agreed that a common understanding needs to be pursued top to bottom in the entire governance. At this point, tree valuation may then be integrated into the framework.
e) While 81 % agree that claims on public trees destroying public properties have increased in the last five years, some worry that increasing claims demands increase initial insurance payment, which will incur the cost.
f) The local authorities illustrate a great need to structure the response to tree risk matters between agencies and instigate collaboration efforts at needful times.
g) The survey on the seventh variable demonstrate that the Local Authorities have yet found that other agencies are important in risk matter pertaining to trees and believes that it is solely their responsibility, thus has yet manifest the aspects of Tree Risk

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Management in which coordinated effort from various counterparts are needed at difficult times. These results demonstrate that the Local Authority is the lacks in the initiative of conveying to the people about their surroundings and their rights.

h) Some agree that a specific guideline may be necessary to prevent increased legal issues such as controlling plant height within premises. This survey proves that agencies need to understand their own roles and work together on the issues pertaining to tree risk management.

i) The findings explain that they generally find the cost given to them as insufficient at the level they are expected to perform.

Proposed Framework

The Local Authorities of Selangor need to ensure the imperative governance characteristic examined from this research are adapted to the tree risk management as in the following nine factors;

Causing Factors	Indicator
Planning of Trees	Trees need to be locate right at first; an agreed distance to be determined
Maintenance of Trees	Inspection needs to be done in a routine, and treatment to be conducted
Zoning of Trees	Inventory of trees is deemed required but not yet being done
Valuation of Trees	It is essential but yet to recognize by the national and local council
Public Liability	Public liability needs to be assured
Response Action	Response systems need to be systematically established
Roles of Stakeholder	Agencies and private owners need to be educated on their liability
Roles of Law	Act 133 and 171 need to be exercised
Roles of Costs	Funds must be provided for tree risk management

Figure 4: The Outcome of this Analysis

The analysis was aimed to identify the relationships between the predicted factor of tree risks and the level of tree risk management in local councils of Selangor. No tree risk assessment method is being standardized in local authorities in Malaysia (MBSJ, 2017). A standard would allow for consistency among assessments, potentially lowering liability and better equipping the managers in making decisions that change the face of our city.

Checking for Normality

Before testing the hypothesis, the model had to fulfill the classical assumptions of multiple regression analysis: normality. The table presented the test on normality using skewness and kurtosis statistics. Starting with the normality test, this research presents that all variables must have a normal distribution. The skewness and kurtosis values in Table 1 are within the threshold values, indicating that the data is normal.

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Table 1 Skewness and Kurtosis Statistics

Number	Variable	Skewness Value	Kurtosis Value
1	Tree Risks in Local Authorities (DV)	-0.486	-0.824
2	Planning of Trees	-0.449	-0.690
3	Maintenance of Trees	-0.260	-0.685
4	Zoning of Trees	-0.506	-0.372
5	Valuation of Trees	-0.276	-0.723
6	Public Liability	-0.251	-0.888
7	Response Action	-0.403	-0.537
8	Roles of Stakeholder	-0.296	-1.171
9	Roles of Law	-0.330	-0.747
10	Roles of Costs	-0.509	-1.029

The results of the skewness and kurtosis above show that all the variables had values between -2 to +2, meaning that all the variables have a normal distribution.

Reliability Test

After checking the normality, the next test is the test of the instrument to obtain a reliable analysis empirically. The closer the reliability coefficient to 1.0 is the better result. The reliability of less than 0.60 is considered poor, while over 0.80 is deemed to be good. Table 2 represents the variables of reliability test conducted throughout Cronbach's Alpha test to test data consistency. The Cronbach's Alpha confirmed that one of the variables pertaining valuation of trees was unreliable.

Table 2 Reliability Test

Number	Variable	Item Total	Cronbach's Alpha	Description
1	Tree Risks in Local Authorities (DV)	4	0.942	Reliable
2	Planning of Trees	4	0.779	Reliable
3	Maintenance of Trees	4	0.714	Reliable
4	Zoning of Trees	4	0.481	Unreliable
5	Valuation of Trees	3	0.390	Unreliable
6	Public Liability	3	0.649	Reliable
7	Response Action	3	0.717	Reliable
8	Roles of Stakeholder	3	0.663	Reliable
9	Roles of Law	4	0.738	Reliable
10	Roles of Costs	3	0.817	Reliable

Regression Analysis

Regression analysis is a way of mathematically sorting out which of those variables has an impact and can be used to identify factors of tree risk management for local authorities in Selangor.

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Table 3 Regression Analysis

Variable	Coefficients		
	Beta (β)	t statistics	Significance
Planning of Trees	0.291	3.584	0.000
Maintenance of Trees	0.153	.276	0.020
Zoning of Trees	-0.036	-0.489	0.625
Valuation of Trees	0.034	0.412	0.681
Public Liability	0.220	3.229	0.002
Response Action	-0.149	-1.707	0.090
Roles of Stakeholder	0.330	4.778	0.000
Roles of Law	0.494	7.556	0.000
Roles of Costs	-0.312	-3.123	0.002
R^2	0.885		
Adjusted R^2	0.877		
F statistics	`103.824		
Significance of F	0.000		

a. Predictors: (Constant), Planning of Trees, Maintenance of Trees, Public Liability, Roles of Stakeholder, Roles of Law, Roles of Costs
b. Dependent Variable: Tree Risks in Local Authorities

In the final analysis, a standard multiple regression was performed between the planning of trees, maintenance of trees, zoning of trees, valuation of trees, public liability, response action, roles of stakeholder, roles of law, roles of costs, and tree risks in local authorities as to the dependent variable. Table 3 explains the regression analysis of correlations between the variables. The standardized Regression (β), R2, and adjusted R2 were discussed. The results support the overall model with a high F value of 103.824 (p <. 000). Adjusted R square (.877) indicates that the seven variables substantially explain the variance in the tree risks in local authorities. Among the nine relationships tested in the model, the standardized coefficient indicates statistically high significance between the planning of trees, public liability, roles of stakeholders, roles of law, roles of costs, and tree risks in local authorities. Considering the nine hypotheses discussed earlier, all the hypotheses except H3, H4, and H6 are supported.

The figures derived summarize that trees valuation, tree zoning, and response action do not affect tree risk management in the Local Authorities in Selangor. For the first, the trees valuation exercise is not being widely practiced in Malaysia. The MBSJ has imposed questions to the *Jabatan Landskap Negara* on the approach of trees valuation in Malaysia, and up till now, there has been no feedback. At the same time, the aspect of tree zoning may need to be explored more for the local authorities to understand. Meanwhile, emergency and response have yet been the focus of most cities, but this does not eliminate the dire need. The other six factors affect tree risk management in the current Local Authorities of Selangor and should be accentuated in the day's state governance.

The public's safety in highways and streets with roadside trees is a primary concern of local authorities and agencies. The landscape department, arborist, and expert person at the local authority are responsible for reviewing their roadside tree conditions, identifying hazards, and making conditions safer. The finding of this study is in line with some previous studies on local authorities needing to control the tree planted at roadsides to ensure the comfort of pedestrian users and safety of motorists along the particular roads (Mohd Akmal & Noriah, 2011).

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Roadside tree management is a reduction of the hazard through inspection and mitigation, balancing the degree of risk against the need to maintain large, beautiful trees on the site. This study reaffirms Hasan & Othman, Noriah & Ismail, Faridah (2016) when they wrote that public awareness of the risk of the roadside tree among the public needs to improve to create a better understanding of roadside tree management and improve public safety. Holistically, this study is concurrent with The Tree Risk Management Strategy for Torbay (2017) that indicates that the city has to take reasonable care to avoid acts and omissions that cause a reasonably foreseeable risk of injury to persons or property and entails the following; site zoning, frequency of inspections, level of assessments, level of competence, the timescale for remedial works, personnel and record-keeping. This research coincides with Barrell (2021), which states that the proximity of rapid development growth in the modern era has forced an increasing intensity of proactive tree management, i.e., manipulation of trees to reduce their harmful impact on people and optimise benefits they provide. He suggests that duty holders be mindful of this changing tree risk management landscape and adjust their approach accordingly in order to be able to refute allegations of negligence in their works. When a failure that causes harm results in legal proceedings, Local Authorities as duty holders will be expected to have considered all pertaining matters, updated their risk management processes, and taken reasonable and proportionate measures to reduce significant risks of harm.

Discussion and conclusions

Limitation of the research

The limitations of the research are to obtain data from local authorities in Selangor only in which management of records is lacking. To overcome the limitation, the research scope will be delimited to all local authorities in Selangor only to ensure that the research confines its objectives. It is delimited to trees planted within open space and roads only. Trees in private premises example, houses, factories, shops, are not included. Data from the Local Authorities related to the number of trees maintained, trees felled/removed, public complaints and compensation claims received, and other related data will be collected through formal survey and literature review and analyzed.

Recommendation for the future research

Out of the six accepted factors, four are most significant based on the highest t statistics. For the local authorities to initiate tree risk management, it is recommended to establish the following:

a) All locations for tree plantings in the Council must be determined by the department with a careful review on these criteria; location must be 12 meters further from the roadside. This is stated in Act 133 Road, Drainage and Building, but not being followed due to the tight spaces available for planting. It is best to plant trees where they can live longer to serve their whole purpose Shigo (1991), Zakaria (2012). Trees are encouraged to be planted and maintained in open spaces, buffer areas, and reserves. Trees that need to be planted near public paths or buildings must be small to medium-height trees, as Abdul Hadi et al. (2015) mentioned.

b) All public trees need to be inspected, maintained and recorded, annually, Kane & Mortimer (2008) and Lazim (2014). The local authority must hold the responsibility of keeping all the trees they had eagerly planted all these years. Tree planting programs have to pre-requisite the maintenance need into its component. Sustainable cities are about balancing the needs of trees in the cities while being able to maintain them at the same time.

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c) General public must be insured against any liability that occurs by, of, or from any public tree as long as the public has abode all Malaysian laws or Council's Regulation that pertains to its existence in the setting as Hong Kong Tree Management Office (2019), Council of Torbay (2017) As such, the local authority must be alert on all public trees, trees that resides on public reserves or trees that may fall into the public realm.
d) General public and stakeholders need to be informed on the cities needs for trees and the consequences of not maintaining the trees in a holistic approach as a sustainable city. All private sectors need to be aware of the need to protect the general public in their compound, as Beering (2006) indicated. Information may be relayed through focus group discussions, awareness programs, or campaigns.

Adding value to this study, it is suggested that the criteria in determining the level of efficiency of the tree risk management of a local authority in Selangor to be structured from the governing tasks discussed throughout the report, with all data to be set against an agreed baseline, for each City as follows :

Factors	Level Of Efficiency
Planning of Trees	Percentage of street trees located at a distance from public activity
Maintenance of Trees	Percentage of trees inspected and treated in routine
Public Liability	Numbers of general liability cases processed
Roles of Stakeholder	Numbers of awareness initiatives
Roles of Law	Numbers of cases solved using rules of law
Roles of Costs	Percentage of city fund provided for tree risk management

Figure 5: Factors and Level of Efficiency in Determining Tree Risk in Local Authorities of Selangor

The brief study into the existing literature review has concluded the understanding that tree risk management is about the principle of providing a safe urban environment to the people of the city. The local authorities may keep planting more trees because the intention was to make their city greener or attractive. As the principle is 'safe,' this research has outlined the governing framework to enable trees' existence in the city to be safe for all. Selangor is a developed state in which trees are being planted throughout to escalate greenness in a fast track. This research found that there is a lack of system, information, and documents in Selaisr and Malaysia about the tree, management, especially on its risks. Tree risk, when kept unattended, gives significant consequences, especially during windy and stormy weather; when the earth is engulfed with global warming and its impact, keeping our eyes close on trees is inevitable to minimize storm damage to human built infrastructure. It is rightful for this research to be administered as a to search for the imperative factors of the Tree Management in Selangor. Through the evaluation of the authorities' data and understanding of tree risk management, the objectives have been achieved as follows:

a) The researchers have identified available factors in tree risk management from the local and abroad resources.
b) The researchers have explored the relationship between the local governing factors and tree risk management, considering the capacity and capability of the Local Authorities to understand the role of tree risk management in governance. The managers were influenced by their organization's standards, human resource capacity,

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and physical capability, and their decisions were affected by how their attention was focused on simple daily tasks. These differences, along with data on the Council activities, have shed that six aspects have criteria that can affect tree risk management and thus become essential factors in managing tree risk in local authorities of Selangor.

Figure 6: Model for Factors of Tree Risk Management for Local Authorities in Selangor

c) The researchers have suggested the criteria and indicators in determining the level of efficiency of the tree risk management of a local authority in Selangor

This study is hoped to offer knowledge contribution to the body of literature in determining the Tree Risk Management to be used by all the local authorities in Selangor.

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