



**UNIVERSITI PUTRA MALAYSIA**

**THE IDENTIFICATION OF CRITERIA AND INDICATORS TO  
EVALUATE HAZARDOUS STREET TREES:  
A DELPHI STUDY**

**SREETHERAN MARUTHAVEERAN**

**FH 2002 21**



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EVALUATE HAZARDOUS STREET TREES:  
A DELPHI STUDY**

**By**

**SREETHERAN MARUTHAVEERAN**

**A project report submitted in partial fulfillment of the requirements for  
the Masters of Tropical Forest Resource Management in the  
Faculty of Forestry, University Putra Malaysia**

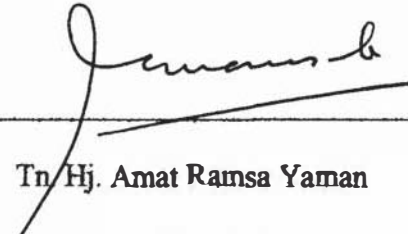
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## APPROVAL SHEET

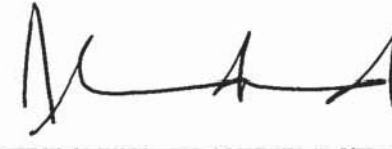
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Evaluate Hazardous Street Trees: A Delphi Study



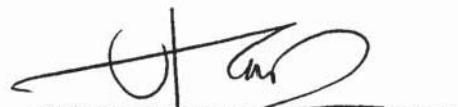
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Date: May, 2002

**Specially  
dedicated  
to all  
tree lovers ...**

I think that I shall never see  
A poem lovely as a tree.  
A tree whose hungry mouth is pressed  
Against the earth's sweet flowing breast:  
A tree that looks to God all day,  
And lifts her leafy arms to pray;  
A tree that may in summer wear  
A nest of robins in her hair;  
Upon whose bosom snow has lain;  
Who intimately lives with rain.  
Poems are made by fools like me,  
But only God can make a tree.

~ Alfred Joyce Kilmer ~



## ABSTRACT

Trees have been playing an important roles in our lives for centuries, however too often we are unaware of the risk associated with the trees. Trees with defects may become hazard and cause personal injury or property damage. Structural defects such as decay, cavities, dead limbs, splits and shakes and injured roots, heavy horizontal limbs, wind and vehicle damage, leaning trees are some of the factors that predisposes a tree to failure such as property damage and personal injury. Interest in hazard tree management has increased in recent years due to safety and liability concerns. Recognizing hazardous trees and taking proper corrective actions can protect property and save lives. To achieve the initial step especially for the hazard tree management, a study was conducted to identify the criteria and indicators for evaluating and identifying hazardous street trees. The purpose of this study were: (1) to develop a reliable set of criteria for evaluating hazardous street in urban areas, (2) to develop a reliable set of indicators for evaluating hazardous street trees in urban areas and (3) to examine the relationship between group of experts in the Delphi process. Delphi method was used in this study to solicit the opinion from the expert. It is an iterative process for soliciting and collating opinions on a particular topic through a series of questionnaire. Finally, this study has been successful in using the Delphi method that generated and identified six criteria and 38 indicators that need to evaluate and identify hazardous street trees. Besides developing the criteria and indicators, this study also indicated that there were no any differences in opinion between the lecturers and officers from the government agencies and even between respondents from different education levels. Hopefully the generated criteria and indicators will be an initial step for the Shade Tree Unit of DBKL to implement their hazard tree management programme.



## ABSTRAK

Pokok telah memainkan pelbagai peranan dalam kehidupan manusia berabad-abad lamanya. Walau bagaimanapun, kita kerap kali alpa akan bahaya pokok terhadap kita. Pokok yang mempunyai sebarang kerosakan dari segi struktur boleh membahayakan nyawa dan juga harta benda. Kerosakan pokok dari segi struktur adalah seperti, pereputan, dahan mati, rekah dan kerosakan akar, kerosakan disebabkan oleh angin dan kenderaan dan beberapa faktor lagi yang mendedahkan pokok kepada bahaya seperti kehilangan nyawa dan harta benda. Sejak kebelakangan ini terdapat minat dalam pengurusan pokok berbahaya ekoran kepada kesedaran terhadap undang-undang dan keselamatan. Kebolehan untuk mengenalpasti pokok berbahaya serta mengambil langkah yang betul boleh menyelamatkan nyawa dan harta benda. Bagi mencapai tujuan ini, satu kajian telah dijalankan untuk mengenalpasti kriteria dan petunjuk bagi membolehkan pengenalan serta penilaian ke atas pokok berbahaya. Tujuan kajian ini adalah untuk: (1) mengubal sebuah set kriteria yang sesuai untuk memberi penilaian ke atas pokok tepi jalan yang berbahaya di kawasan bandar, (2) mengubal sebuah set petunjuk yang sesuai untuk memberi penilaian ke atas pokok tepi jalan berbahaya di kawasan bandar dan (3) untuk mengenalpasti samada hubungan di antara responden dalam kaedah Delphi. Kaedah ini digunakan untuk mungumpul maklumat daripada golongan pakar yang melibatkan beberapa siri soal selidik. Akhirnya, kajian ini telah berjaya mengenalpasti enam kriteria serta 34 petunjuk yang dapat digunakan untuk mengenal serta menilai pokok tepi jalan berbahaya. Di samping itu, kajian ini juga dapat menunjukkan tidak ada sebarang perbezaan dari segi pendapat daripada para responden yang terdiri daripada para pensyarah dengan pegawai daripada agensi kerajaan serta responden yang mempunyai taraf pendidikan yang berlainan. Semoga kriteria dan petunjuk yang telah dihasilkan dapat dijadikan langkah pertama oleh unit Pokok Rendang dari DBKL untuk melaksanakan program pengurusan pokok berbahaya.

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## **LIST OF ABBREVIATIONS**

<b>DBKL</b>	<b>Dewan Bandaraya Kuala Lumpur</b>
<b>FRIM</b>	<b>Forest Research Institute of Malaysia</b>
<b>MPSJ</b>	<b>Majlis Perbandaran Subang Jaya</b>
<b>UPM</b>	<b>Universiti Putra Malaysia</b>

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background

Trees have been playing a very important role in human life. However, artificial we may live, we still depend on trees directly or indirectly for our well being from the past to the future. Trees are very precious resource, because they perform many valuable functions in environmental, sociological, physiological and economical aspects for the communities especially in urban areas.

National Tree Planting Campaign on the 3 March 1997, was the stepping stone towards a more serious and effective greening campaign. At the launch of this campaign the Prime Minister of Malaysia called upon all parties, especially state governments and local authorities, to take landscaping seriously and make it mandatory in all development projects (Hishamuddin, 1999). The programme has targeted 3 million trees to be planted by the new millennium and 20 million trees by 2020, with 75, 000 trees to be planted annually (Jabatan Landskap Negara, 1997). Therefore, there is now a tremendous amount of interest in tree planting than ever before.

While we are enthusiastic about planting more trees to beautify our cities and environment, a major aspect that has always been neglected is the need for proper tree maintenance and management (Hishamuddin, 1999). There is always a misconception that once a tree is planted it can grow on its own (Hishamuddin, 1999). In a harsh environment, such as urban settings, trees generally grow with much difficulty. Shade trees are subjected to a wide variety of environmental stresses which decrease growth and cause injury and mortality (Kozlowski, 1985). There are several restraints or stresses or even different degrees of stress which effect the growth, and these restraints can be categorized as biotic and abiotic. The biotic factors, including the insect and disease problems are frequently important only after the city trees have been adversely affected by abiotic factors such as moisture, temperature, light etc. (Roberts, B. 1977). Thus proper care is needed to help trees to reach their fullest potential.

It is common to see that planted trees and beautiful landscape that had been developed with substantial costs are left unattended and have in some cases become an eyesore or even hazardous. This can be seen in the increasing number of complaints received by the Shade Tree Unit of DBKL pertaining to trees under their jurisdiction with a total of 1686 complaints in 1996 to 2605 complaints in the year 1998 (Murad, 2000). Besides that, according to Murad (2000) the lack of relevant information on urban trees in term of its history, location, composition, status, condition and management needs are other indicators of problems in terms of growth and maintenance of the newly planted as well as mature trees. We have to realise that the aspiration of a garden nation that we are aiming for would not materialise just by planting trees. Instead we need to ensure that



these trees and parks that we have created are well cared for and maintained (Hishamuddin, 1999).

## 1.2 Statement of Problems

Although trees have been playing an important roles in our lives for centuries, too often we are unaware of the risks associated with the trees. Trees with defects may become hazard and cause personal injury or property damage. Structural defects such as decay, cavities, dead limbs, splits and shakes and injured roots, heavy horizontal limbs, wind and vehicle damage, leaning trees are some of the factors that predisposes a tree to failure such as property damage and personal injury (Harris *et al.*, 1999). The extent of possible property damage depends on the likelihood of a tree striking the property and how serious the damage might be, while the injury to people depends on the likelihood of a tree striking a specific area when people are present (Harris *et al.*, 1999).

With the urban trees that are getting matured and some are in declining stage with some potential of tree failure, the society are 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 does the arborist's expertise in tree care (Smiley *et al.*, 2000). Interest in hazard tree management has increased in recent years due to safety and liability concerns resulting from preventable accidents (Smiley *et al.*, 2000). Recognizing hazardous trees and taking proper corrective actions can protect

property and save lives. Besides that, at present we are living in an era of increasing lawsuits. Whenever there is any form of property damage or personal injury the question that arises is 'who will pay for the damage'? Normally our society turns to the law to answer this question (Anderson and Eaton, 1986).

To overcome such problems, there should be a proper management of hazardous trees where it requires experience, good judgement, a thorough knowledge of tree biology and a basic understanding of the legal responsibility. According to Murad (2000) for the maintenance personnel of municipalities to work effectively, a thorough understanding of the resource base is needed to enable the municipalities or the tree manager to systematically manage and prioritises tree work activities such as pruning and removal of hazard trees. Any tree denoted as hazardous should be promptly cared for, using the best arboricultural techniques, to eliminate the hazardous status of the tree. If it cannot be made safe, or if the effort to make it safe would be too costly in terms of manpower or expenses, then the tree should be removed. Safe and healthy trees are required in urban streets, parks and gardens. This is very important because it will tend to reduce the potential for personal injury and property damage resulting from tree failure. As a result, the detection, evaluation and management of hazardous tree have become a major concern for urban foresters and park managers (Smiley, 2000).

In order to assess proper tree management and arboricultural practices, suitable criteria and indicators for detecting and evaluating hazardous trees should be developed. With such suitably developed criteria and indicators, then the evaluation and the status of

hazardous trees and the management needs can be done. In this study, through a Delphi process all of the criteria and indicators are developed from the opinions that were attained from a group of experts from various aspects of arboriculture. The first step involves the identification of a broad scale of criteria and indicators. Through several rounds of consensus building the responses from the initial group of experts are then compiled and be transformed into a series of statements that form the basis of a questionnaire to be sent to a broader group of respondents (Renz and Greg, 2000) till the summarized results from several round are generally taken as the conclusion of the group.

### **1.3 Objectives**

The goal of this study is to develop suitable criteria and indicators for the evaluation of hazardous street trees in urban areas. The DBKL needs these indicators to enhance the management of hazardous street trees. This study will specifically answer the following objectives:

1. Identify the problem of hazard trees and risk
2. Develop criteria for evaluating hazardous street trees in urban areas.
3. Develop indicators to evaluate hazardous street trees in urban areas.
4. Examine relationship between groups of experts in the Delphi process.

#### **1.4 Assumptions**

The following assumptions were considered in this study:

- The Delphi method was considered as the most appropriate way for gathering consensus on the identification of criteria and indicators to evaluate hazardous trees.
- The panel of members that were selected is considered experts in their respective field and is knowledgeable about tree pest management, landscape architect, landscape design, tree ecology, urban forestry and other arboricultural practices.
- The Delphi panel of members were sincere in identifying and ranking the criteria and indicators to evaluate hazardous street trees.

#### **1.5 Scope and Limitations of the Study**

The limitations of this study are:

- Urban street trees are defined as trees under the control and maintenance of Kuala Lumpur City Hall (DBKL), with distance of approximately three meters from the road edge, comprising the public right-of-way (Murad, 2000).
- This study only involves the opinions from the experts. The perceptions from the public are not included.

- ‘Experts’ in this study are defined as those who have tertiary education in fields of tree management which includes tree pest management, landscape architect, landscape design, tree ecology, urban forestry and other arboricultural practices.
  
- The local experts on the Delphi process limited to officers from Kuala Lumpur City Hall (DBKL), Forest Research Institute of Malaysia (FRIM), Subang Jaya Municipal Council (MPSJ), National Landscape Department and the academicians from local universities.
  
- The criteria and indicators that are developed are for urban street trees in general. There is no any specification on the species of trees.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Definition

##### 2.1.1 Street Trees

Trees growing along a street or road, usually between the curb and sidewalk are known as street trees (Kalmbach, K.L,1985). Besides that according to Murad (2000), street trees can also be defined as trees under the control and maintained by the City Hall of Kuala Lumpur (DBKL), with a distance of approximately three meters from the road edge, comprising the public right-of-way.

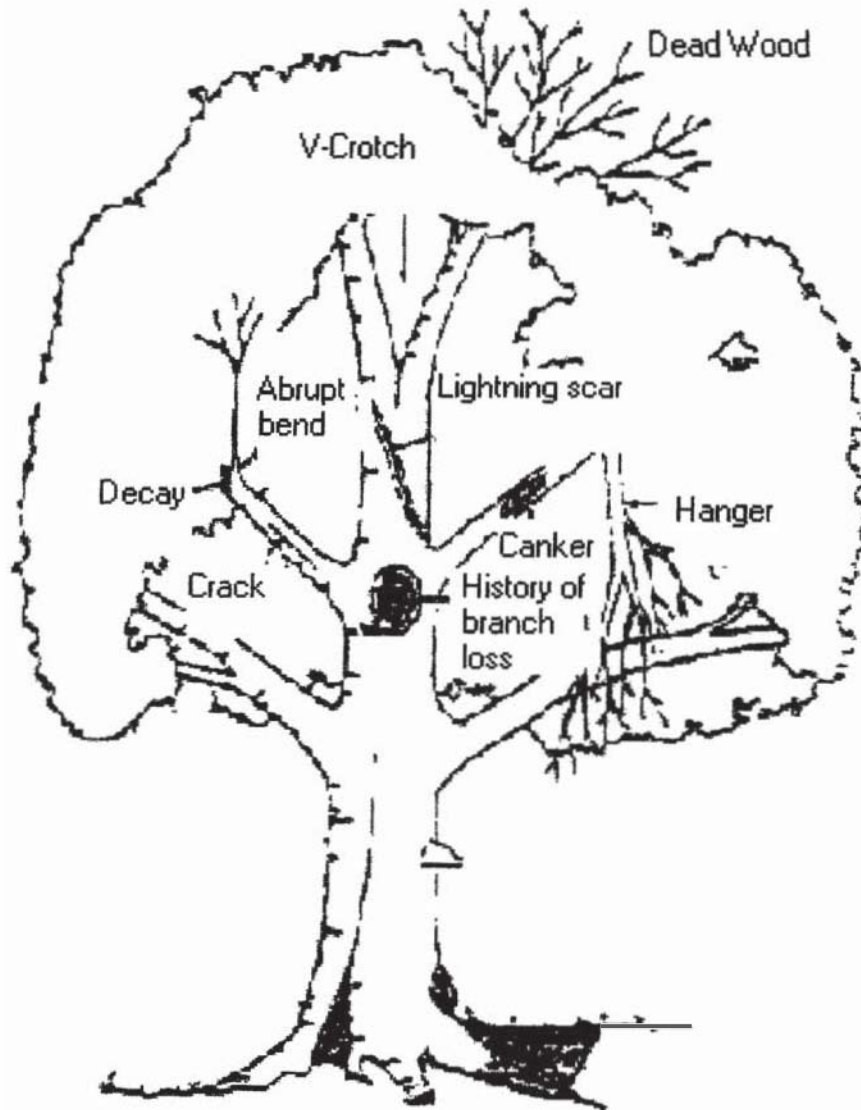
##### 2.1.2 Hazardous trees

According to Smiley *et al.* (2000), for a tree to be considered hazardous to the public, it must meet either of the following criteria: (1) It must possess some type of structural defects (Fig. 2.1) that predisposes it to failure and it must be associated with a target such as a building, road, walkway or recreational area where there are people or property present.(2) On the other hand, a tree that is structurally sound also may be considered hazardous if it interferes with the routine activities of people. Examples of such activities:

- Tree stems or branches obstructing motorists' vision.
- Tree roots raising along sidewalks.
- The interruption of utility services resulting from branches contacting the wires.

Therefore, a tree is considered hazardous if it is structurally unsound and there is a possible target (Miller, 1988). A tree without a *target* will not be considered hazard. A target can be a playground, residential area, public, vehicles or anything where a tree would come in contact with the public. The safety of a target is the major reason for a tree-hazard management program (Harris *et al.*, 1999). The extent of possible property damage depends on the likelihood of a tree or a part of a tree striking the property and how serious the damage might be. Injury on people depends on the likelihood of a tree striking a specific area when people are present (Harris *et al.*, 1999). Views of road signs and interactions obstructed by plants can result in serious accidents. Chances of an accident increase as occupancy of a site increases. Moving a target, such as picnic table, may be the best answer for minimizing hazard from a defective tree (Harris *et al.* 1999).





(Source: Smiley, *et al.* 2000)

**Figure 2.1:** Schematic diagram of defects associated with hazardous trees.



## 2.2 Hazardous Tree Management

For centuries trees have been playing vital roles in our lives from giving source of food to shelter and even amenity values. Especially in urban areas which are harsh and unfavourable environment for any living things to live. Trees are something that is very valuable to us, where they ameliorate the air temperature, control the solar radiation, humidity, reducing air and noise pollution, soil erosion, give visual aesthetics and shade to the city dwellers.

Apart from this, we must remember that the trees as other living creatures tend to get older with time. So trees that have been planted several decades ago are now have matured and some are declining in vigour. These trees are potentially hazardous to the public and property due to weak structures, decay of trunk and branches, cankers and canker rot and root loss or root decay (Harris *et al.*, 1999). Unfortunately, these potentially hazardous trees are often overlooked and usually noticed only after some parts or the whole tree has fallen (Murad, 2000). However, trees cannot be neatly separated into hazardous and non hazardous group, where nearly every tree has some potential to fail (Harris *et al.* 1999).

According to Coate (1996) there are several proactive options in urban tree hazard reduction. Firstly, careful inspection of on-site trees, where in projects which have mature trees on site, consultation with design professional at early stages, including city planners, engineers, the site architect and the owner is critical to avoidance of short and long term damage. Second, the identification of the existing trees which deserve