UNIVERSITI PUTRA MALAYSIA

TREE HEALTH OF MIXED SPECIES IN URBAN FOREST OF TAMAN RIMBA ALAM, PUTRAJAYA, MALAYSIA

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillments of the Requirements for the Degree of Master of Science

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TREE HEALTH OF MIXED SPECIES IN URBAN FOREST OF TAMAN RIMBA ALAM, PUTRAJAYA, MALAYSIA

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March 2017

Chairman : Associate Professor.Mohd Nazre Saleh, Phd
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Taman Rimba Alam (TRA) is a hidden gem located in Malaysia's administrative capital, Putrajaya. It was initially conceptualised as an urban forestry showcase that is a combination of a sustainable tropical forest ecosystem and a metropolitan recreational park. This homogenous, man–made forest was created with the intention to reap the same benefits as that of a natural forest especially for communities in urban areas. However, the status of the trees planted in TRA is unknown. Hence, in order to ensure TRA realises its functional capacity to the fullest, the health status of its trees is one major element that must be monitored. This study explores the status of planted trees in TRA, and has two underlying objectives; to assess the health of the trees using physical appearance evaluation and to evaluate the growth performance as well as the mortality rate of the planted trees in the urban forest of TRA, Putrajaya. Subsequent to this, 644 individual trees from various species and sizes were selected and assessed. The tree health inspections were conducted using modified Visual Tree Assessment (VTA) method that was previously established by the International Society of Arboriculture (ISA). In order to obtain tree growth performance, the tree increment rate was determined. This was done by measuring the diameter breast height (DBH) and height on trees that have been planted for nine years. Mortality rate was measured by counting the number of dead trees in an established sample plot (20 x 50m). The assessment of tree health, conducted using the modified VTA method, showed that 92.78% of all the trees were healthy, i.e. they are in good condition and live normally without problems. The remaining 7.22% were found to be problematic; ranging from minor to extremely problematic. The assessment on mortality recorded a low mortality rate with 6.8% of total mortality happening in the nine-year period and 0.8% mortality occurring annually. TRA growth performance yielded good results with average tree

mean annual increment (MAI) of DBH 0.98cm (10.07%) annually and MAI of height of 0.73m (9.1%) annually. The tree DBH and height increment recorded a fast increment growth with 90.7% and 81.9% increment rate after nine years. Thus, the high percentage of trees in good condition with low mortality rates, and the success in tree growth performance shows that the health status of planted trees in TRA is classified as “good”. To enhance positive TRA health and to control tree health problems, the TRA planted trees should be continuously and comprehensively monitored.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESIHATAN POKOK PADA SPESIS CAMPURAN DI HUTAN BANDAR TAMAN RIMBA ALAM, PUTRAJAYA, MALAYSIA

Oleh

NORBAIAH BINTI MAT YAACOB

Mac 2017

Pengerusi : Profesor Madya Mohd Nazre Saleh, PhD
Faculty : Perhutanan

Taman Rimba Alam (TRA), adalah permata yang tersembunyi di pusat pentadbiran negara di Putrajaya, ia diilhamkan sebagai perhutanan bandar dengan menggabungkan ekosistem hutan tropika yang mampan dan taman rekreasi di kawasan metropolitan. Hutan buatan manusia ini diwujudkan dengan harapan dapat memberikan manfaat yang sama sebagai mana fungsi yang disampaikan oleh hutan semulajadi kepada masyarakat di kawasan bandar khususnya. Walaubagaimanapun pokok-pokok yang ditanam di TRA tidak diketahui statusnya sejak ia ditanam. Dalam usaha untuk memastikan kawasan TRA ini dapat berfungsi sebagaimana yang sepatutnya, status kesihatan pokok adalah salah satu elemen utama yang perlu dipantau untuk mengenalpasti status pokok yang ditanam di TRA, kajian ini dibuat berdasarkan dua objektif; menilai kesihatan pokok dengan menggunakan penilaian penampilan fizikal dan menilai prestasi pertumbuhan dan juga kadar kematian pokok yang ditanam di hutan bandar di TRA, Putrajaya. Oleh itu sebanyak 644 individu pokok dari pelbagai spesies dan saiz yang berbeza dipilih dan dinilai. Pemeriksaan kesihatan pokok telah dijalankan dengan menggunakan kaedah penilaian pokok secara penglihatan (VTA) yang dimodifikasi yang dipekenalkan oleh Pertubuhan Arborikultur Antarabangsa (ISA). Untuk mendapatkan prestasi pertumbuhan pokok yang ditanam dalam jangka masa sembilan tahun itu kadar kenaikan pokok di ukur dengan menyukat diameter paras dada (DBH) dan juga ketinggian pokok, manakala kadar kematian pokok di sukat dengan mengira jumlah kematian pokok yang mati di dalam petak sampel kajian (20 x 50m) yang di buat. Penilaian kesihatan pokok dijalankan dengan menggunakan kaedah modifikasi VTA menunjukkan 92.78% daripada jumlah pokok adalah pokok yang sihat iaitu berada dalam keadaan baik yang hidup dalam keadaan normal tanpa

masalah, dan baki 7.22% daripada keseluruhan pokok direkodkan sebagai bermasalah merangkumi masalah kecil sehingga masalah melampau. Penilaian ke atas kematian pokok mencatatkan kadar kematian rendah yang berlaku sepanjang tempoh sembilan tahun tersebut dengan kadar kematian sebanyak 6.8% dengan 0.8% kadar kematian setiap tahun.Prestasi Pertumbuhan TRA menunjukkan prestasi yang baik dengan kadar purata Min Peningkatan Tahunan (MAI) pada bahagian DBH adalah sebanyak 0.98cm (10.07%) setahun dan MAI ketinggian adalah 0.73m (9.1%) setahun. Peningkatan DBH dan ketinggian pokok menunjukkan peningkatan pertumbuhan yang pesat dengan 90.7% dan 81.9% daripada kadar kenaikan sepanjang sembilan tahun ia ditanam. Pokok yang ditanam di kawasan TRA adalah dalam kesihatan yang baik yang mana ia ditunjukkan dengan kadar peratusan yang tinggi untuk keadaan pokok yang sihat, kadar kematian yang rendah dan kadar pertumbuhan pokok yang berjaya. Untuk memastikan pokok yang ditanam kekal dalam keadaan kesihatan yang positif diharapkan terdapatnya pemantauan secara berterusan dan komperihensif dilaksanakan untuk mengawal masalah terhadap kesihatan pokok.

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Thank you.

I certify that a Thesis Examination Committee has met on 16 March 2017 to conduct the final examination of Norbaiah binti Mat Yaacob on her thesis entitled "Tree Health of Mixed Species in Urban Forest of Taman Rimba Alam, Putrajaya, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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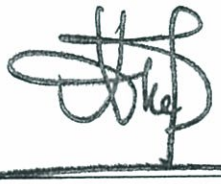

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

TRA	Taman Rimba Alam
ANOVA	Analysis of Variance
CFP	Community Forest Park
cm	Centimetres
CO	Carbon Monoxide
DBH	Diameter at Breast Height
FAO	Food and Agriculture Organization
Fq.	Frequencies
FR	Forest Reserve
FRIM	Forest Research Institute Malaysia
ISA	International Society of Arboriculture
m	Meter
MAI	Mean Annual Increment
MCF	Main Core Forest
NCFS	North Carolina Forest Services
NEFC	North Eastern Forest Corridor
NO	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NUFU	National Urban Forestry Unit
SO_2	Sulphur Dioxide
SPF	Sun Protection Factor
UFB	Urban Forest Branch
VTA	Visual Tree Assessments

CHAPTER 1

INTRODUCTION

1.1 General Background

In the current urbanised era, the management of natural resources, especially trees in cities is an important activity that should be taken care of. As the awareness to improve healthy urban living conditions has increased, a successful tree management is required to maximise the trees' values and desired benefits.

Trees are one of the most important elements among living things in the urban landscapes since trees create shaded areas, refreshing landscapes, variety of colours, spaces covered with soil, and littered leaves. Trees also play an important role in enhancing the quality of rather than merely providing variety in the landscaping art. They work as filters to clean the air for the respiratory use of living things, conserve energy, shelters for wildlife, and contribute to the economic development (Rosenow and Yager, 2007). The need to have trees in our urban environment should not be underestimated as they showed a consistent effect on the microclimate by reducing the surrounding temperature and elevating humidity (Souch, 1993). Besides that, trees in an urban environment create a food chain system. Thus, it is able to attract insects and animals into the system. Moreover, a scattered arrangement of trees is proven to be able to reduce wind speed at an additional 46% as compared to houses (Heisler, 1990).

Other than stabilising the quality of life, trees also provide economic development to the communities. A single tree itself is valuable due to the high demand in natural resources, especially in the wood industry. In a community, trees are able to create opportunities for businesses which attract people to be the clients, for example, building a recreational park. Job opportunities are also created once a business has started since manpower is needed to operate the business and for trees maintenance as well.

Nowadays, the global awareness on the importance of trees to communities' viability has caused an enhancement in developing urban areas as green landscape is included in the development. Thus, urban parks and wayside tress have been widely created. The first urban trees planting in Malaysia was recorded towards the end of the previous century (Sreetheran *et al*. 2011). In 1992, former Prime Minister, Datuk Seri Tun Dr Mahathir Mohamad has decided to turn Malaysia into a garden nation and targeted 20 million trees to be planted across the country by the year 2020 (Ministry of Foreign Affair, 1993). He wanted full commitment from Malaysians in maintaining 50% of the

land surface to be covered by green or forest cover. The government's intention is not just for the beautification or establishment of green areas in the cities and the country, but also to create a healthy environment for future generations to live in.

In line with Malaysia's commitment in becoming a garden nation, many tree planting programme were widely launched within the urban areas. Putrajaya is an example of the most successful urban green area developed in Malaysia. Nine urban parks were established with various plants species and habitats. The parks are Taman Botani, Taman Rimba Alam, Taman Warisan Pertanian, Taman Wetland, Taman Saujana Hijau, Taman Putra Perdana, Taman Selatan, Taman Wawasan, and Taman Ekuestarian Putrajaya. Putrajaya covered 161.8ha of land and is situated in a strategic location within the Multimedia Super Corridor (MSC). It is approximately 25km from the south of Kuala Lumpur and 20km from the north of Kuala Lumpur International Airport (KLIA). The establishment of Putrajaya had begun in 1995 and about 35% of Putrajaya is developed as green areas while the rest is reserved for government offices, commercial and residential areas, and public utilities and amenities (PJC, 2014).

Taman Rimba Alam (TRA) is one of the available parks in Putrajaya and it is under the management of Putrajaya Corporation (PJC). Previously, TRA was originally a rubber estate and an oil palm plantation, known as Sedgeley and Prang Besar Estates. TRA is divided into several areas which are Instant Forest Display (for large trees like palms), International Tropical Arboretum (for forest trees originating from South East Asia), Red Meranti-Keruing Forest (for dominant dipterocarp species in Malaysian forests), Ridge Top Hillside Forest (for trees in hilly areas), Chengal-Kempas Forest (for two important species that are currently dwindling in numbers), Indigenous Forest Fruit Trees (for trees that help in balancing the eco-system), Plants Around Water Bodies (for high moisture species), Kasai-Merawan Stand (represented by wide leaf trees), Mixed Species Matrix (for fast growing species), and Avenue Trees. Other than opening this park to the public for outdoor activities, it is also promoted to higher educational institutions and government agencies for research and educational purposes (Geetha, 2008).

Trees that are valuable in greening and sterilising urban places such as in TRA should be well-maintained. Proper maintenance should be performed continuously as the trees help to beautify and provide benefits to the communities. Regular care and proper maintenance are crucial tasks for planted trees in ensuring good growth and healthy state. Consequently, it will be able to achieve a specific purpose and avoid any undesired effect (Shigo, 1982).

Unhealthy trees will negatively influence the beauty of an urban landscape. It also contributes to various problems such as hazardousness and the decline of tree growth. Thus, this study is conducted to identify the health and growth status of trees planted in TRA, Putrajaya so that any health and growth problem that may occur on any of the trees in TRA can be determined as the current concept of urban park maintenance for TRA is natural growth and natural survival after being planted.

1.2 Problem Statement

The idea to build TRA Putrajaya as an exhibition centre showcasing the combination of an urban forest metropolitan recreational park with sustainable tropical forest ecosystems is extremely valuable and a concept that many should be proud of. Studies on the health status of trees are important to adopt appropriate methods of maintenance plan for planted trees. However, an acceptable tree health evaluation approach should be identified in order to obtain the health level status of a tree.. Currently, tree health status is not a criterion put into consideration in evaluating the success of parks or areas such as TRA in Putrajaya. Although maintenance programme in TRA is done periodically, tree health status is not really known. The performance of the tree growth was also not available by the authorities in TRA although the number of tree loss is recorded. By evaluating the tree health, this study is expected to be the trigger for a better urban tree management plan in TRA.

The monitoring of tree growth rate in TRA is also an important part of this study because it is an essential activity for early planning in tree management practices (Mcpherson, 1992). The current idea of natural growth for planted trees in TRA is interesting because all trees are planted. The forest dynamics in a natural stand and in a planted tree could be similar or different. In addition, the planted trees in TRA are considered homogenous in terms of their ages and size. Most trees were planted in the same year, within the year of 2007. Hence, the average age of saplings during the first stage of planted programme is almost similar amongst the species. Therefore, the forest dynamic in TRA might either occur differently from natural forest or would not happen at all. Furthermore, this study should also act as the starting point for other studies, especially on the growth rate as the data collected could measure the success of TRA as an urban mixed tropical species park.

1.3 Objectives

Based on the argument outlined above, the objectives of this study are as follows:

1. To assess the health status of planted trees using physical appearances in Taman Rimba Alam, Putrajaya.

2. To evaluate the growth rate of planted trees in Taman Rimba Alam, Putrajaya

1.4 Significance of Study.

In Malaysia, the study of tree health in urban park is still limited as compared to the street trees or ornamental trees. In mixed planting species stand such as TRA, the only indicator on the success of such programme is the rate of tree mortality. However, a different perspective can be obtained by conducting tree health assessment. The outcome from this study will provide a necessary guide and reference to the management in order to upgrade the tree care and maintenance, especially TRA. Growth data in TRA will provide information about various growth species and can be simultaneously used to identify which species should be taken care of and put into consideration.

1.5 Limitations of the Study.

This present study will only highlight the planted trees in TRA, while natural existing trees, palms, shrubs, and herbaceous are excluded. Furthermore, specific information about the tree planting history which affect tree growth such as fertilisation and watering practices were not readily available from the park management and are not considered in this study. The tree health status is determined based on modified visual tree assessment that was done from April 2013 to May 2014.

TRA covers a wide land area and some places have limited accessibility and posed security concerns. Hence, the maximize sample size was randomly chosen in order to fully represent TRA . In addition, this study was conducted with limited funding and time. Hence, growth measurement could only be done twice or within a one-year period of growth.

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