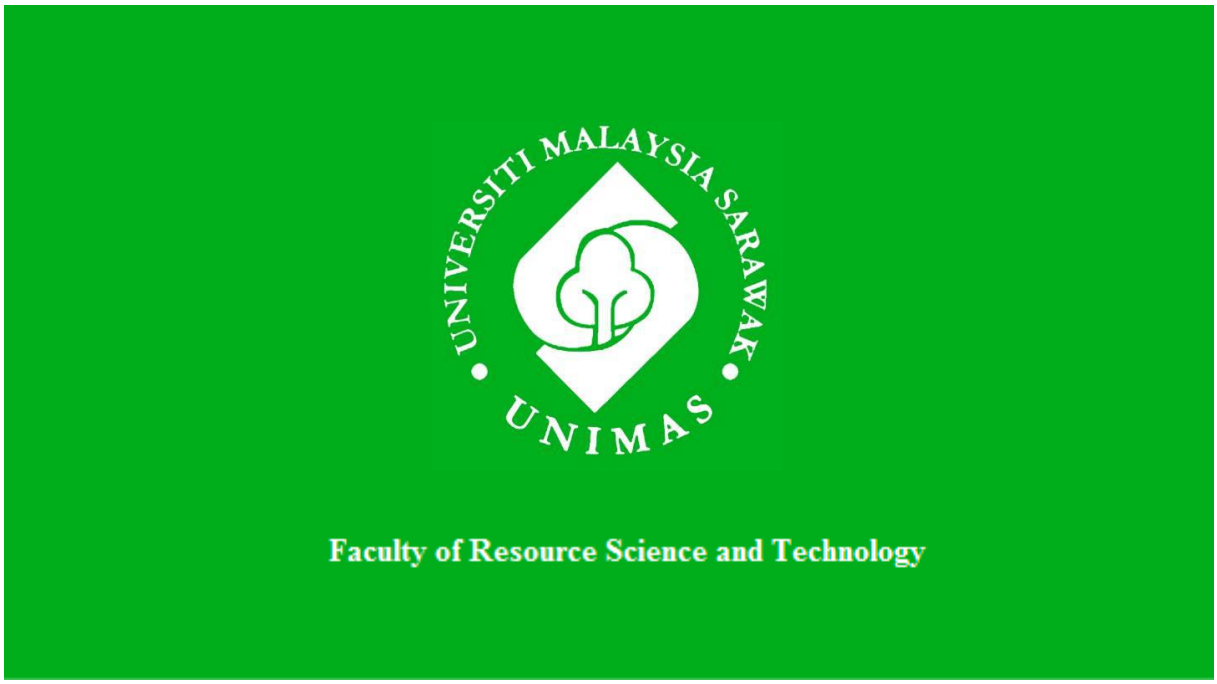

SPECIES SELECTION AND PLANTING DISTANCE OF URBAN TREES IN KUCHING NORTH CITY COUNCIL

FAHRUL RADZI BIN MOHD JALANI

Bachelor of Science with Honours
(Plant Resource Science and Management)
2015

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

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Final Year Project Report	✓
Masters	
PhD	

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This declaration is made on the 2 day of JULY year 2015

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SPECIES SELECTION AND PLANTING DISTANCE OF URBAN TREES IN KUCHING NORTH CITY COUNCIL

FAHRUL RADZI BIN MOHD JALANI

This project is submitted in partial fulfilment of the requirement for the degree of Bachelor of Science with Honours (Plant Resource Science and Management)

Faculty of Resource Science and Technology

UNIVERSITI MALAYSIA SARAWAK
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Title **Page**

Abbreviations

Name	Abbreviations
-log (H+)	pH
Less than	<
More than	>
Species	sp.
Celcius	^{0}C
Centimetre	cm
Computer aided drafting	CAD
Species diversity index	SDI
Diameter breast height	DBH
Post meridian	PM
Gram	g
Metre	m
Micro	µ
Milligram	mg
Mililitre	ml
Milimetre	mm
Percentage	%

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ABSTRACT

Urban trees play important roles in urban environment such as urban biodiversity, energy conservation, urban noise, urban hydrology, traffic calming effect, microclimate and temperature, and removal air pollutants. Species diversity index (SDI), diameter breast height (DBH) distribution, soil physical analysis, soil pH analysis, air temperature comparison between asphalt zone and under shade tree, are the ways to measure the significance impact to the environment. The main aim of this project is to assess the distance of trees and the species selection in Kuching North City Council. The diversity of trees at this place consists of the old plant which had been planted and the new planted trees and both of them will be compared. The most abundant species planted are *Cinnamomum iners, Andira surinamensis* and *Filicium decipiens* due to its ornamental attributes. The urban planted trees should full filled the main criteria to be selected and the planting distance is considered for the development of crown and root of planted trees.

Keywords: distance of trees, urban trees, species selection, diameter breast height (DBH).

ABSTRAK

Hutan bandar memainkan peranan penting dalam hutan biodiversity, pemeliharaan tenaga, pengurangan kadar bunyi, hidrologi, mikroiklim, suhu dan megurangkan pencemaran udara. Kepelbagaian spesies indeks, ukur lilit batang pokok, suhu perbandingan di zon asfalt dan di bawah teduhan pokok dalah cara untuk mengukur kepentingan inpak terhadap alam sekitar. Tujuan utama kajian ini dijalankan adalah untuk mengakses jarak di antara pokok dan pemilihan spesies di Dewan Bandaraya Kuching Utara. Kepelbagaian pokok yang terdapat di kawasan lama dan baru akan disbanding. Majority pokok yang ditanam adalah Cinnamomum iners, Andira surinamensis dan Filicium decipiens kerana sifat-sifat hiasannya. Penanaman hutan bandar perlu memenuhi segala kriteria penting yang diperlukan dan jarak penanaman pokok perlu diambil kira untuk pembangunan dahan dan akar tanaman pokok.

Kata kunci: jarak pokok, pokok hutan bandar, pemilihan spesies, ukur lilit pokok (DBH).

CHAPTER 1

INTRODUCTION

Urban and community forest can be defined as an ecosystem that includes soil, water, utilities, buildings, transportation systems, people and vegetation (Strom, 2000). Generally, it is a specialized field of forestry that refers to the planning and management of trees in the urban settings that are influenced and utilized by urban population to enhance the quality of life for all residents. According to Harris (1983), the objectives of urban forestry are the cultivation and management of trees for their present and potential contributions to the physiological, sociological and economic well-being of urban society.

What is urban forest?

Urban forest may defined as the land in and around areas of intensive human influence, ranging from small communities to dense urban centers, that is occupied or potentially occupied by trees and associated natural resources (Strom,2000). In other words, it can be defined as the involvement of people with soil, wildlife and environment in managing the city of trees to advocate the role of trees as the main part of urban infrastructure. Probably, vegetation played as critical parts which includes all plants neither woody nor herbaceous plants that can grow at private yards, roadside, cemeteries, school, parks, parking lots and so on. The purposes of urban forest are to develop urban forest as area of scientific attention, promoting the multi and inter-disciplinary research. It is also to improve the networking and enhance the exchange of information and experiences.

Problem statements

Urban trees can gives a lot of benefits toward the public but also can cause public risk (Sandviet *et* al., 2013). Based on surveyed by Hacalo (1994) on the street trees in Mexico City, Mexico concluded that problems with overall trees health could be attributed to plant in appropriate locations, overall species choice and lack of adequate planning and maintenance. In the year of 2014, two fatalities involving the public were reported in Kuching North Municipal caused by snapping of tree branches, June, 18, 2014 (Borneo Post) during thunder storm.

Therefore, this study was initiated with the aims to survey the species selection and planting space of newly planted trees and compared to that of old established ones. The data obtained will give on insights how the planting space could have affected overall tree growth and give the recommendations.

Objectives

1. To determine the suitability of tree species like *Syzygium campanulatum*, *Filicium decipiens*, *Andira surinamensis* and many other species planted along the roadsides in Kuching North City Council.
2. To measure the planting distance of trees from the roadsides and distance from one tree to the next individual trees at selected roadsides in Kuching North City Council.

CHAPTER 2

LITERATURE REVIEW

2.1 Urban road landscape and design

Roads are noted as the single most massive public space within the urban and considered as underutilized resources. They are the primary setting for public life, and their networks are threads that bind together the physical and social fabric of urban precinct (Strom, 2000). Careful planned and arranged roads designs are critical to increase the net benefits of trees and forests in urban environment (Nowak and Dwyer, 2000). Strom (2000) stated that, a good planning and management of trees can be used to create, define or reinforce spatial structure and to add a humanizing scale to the environment.

A good and well planned roads landscape and design will have the greatest impact on the public perception and increases the visual quality of not only community's residential districts, but also commercial areas and business offices. The best road is the road that contain all the utilities like electrical and telephone cables, sewerage, and drainage lines laid on one side of the road and planning trees along the other side (Chaniago and Mohd Saufi, 1980).

2.2 The benefits of urban forest

There are some environmental impacts by urban forestry development likes improving air quality, moderating climate, reducing noise levels, lowering rainfall runoff and flooding, also reduced the building energy use and the quantity of atmospheric carbon dioxide. However, if the landscape of urban forestry is not managed properly, there will caused the increase of environmental costs such as pollen production and emissions from trees and maintenance activities that contribute to air pollution, as well as increase building energy use, waste disposal, infrastructure repair and water consumption (Dwyer, 1992).

2.2.1 Urban biodiversity

A lot of additional benefits contributed by urban vegetation for a long term like enhanced biodiversity so that urban wildlife can serve as biological indicators of changes in the health of environment also provide economic benefit to individuals and society. The concept of urbanization will enhance the animal and plant habitats that increased the biodiversity ecosystem. For example, in Oakland, CA about 1.9 of Shannon index of tree species diversity in the years of 1850 and the index value increase to 5.1 more than which consists of 350 species in 1988 compared to 1850 that consists only 10 species (Nowak, 1993). As the environmental concerns are increase over the time, the urban forest also will increase in significance (Dwyer, 1992).

2.2.2 Energy conservation

The trees which are planted or naturally growth have the ability in reducing the cost of heating and cooling of the buildings. The direct effects by the trees are by reducing the radiant heat gain from the surroundings by shading the windows, walls and roofs while the indirect effects are by reducing the rate of air infiltration and reduced the heat gain in the building by the process of evapotranspiration (Huang *et* al., 2002).

2.2.3 Urban noise

The design of planting trees and shrubs in urbanization concepts can significantly reduce the urban noise. This is because, the leaves and stems can reduce the sound by scattering them while the ground will absorb the sound too. In other to make the urbanization perfectly to reduce the noise, the trees and shrubs should be plant closely to the noise source (Van Haverbeke, 1971). The 30m tall dense trees that planted on the soft ground surfaces will decrease about 50% of loudness noise (Cook, 1978). However, for the buffer plantings typically are not effective in reducing urban noise but more to screening views. In other words, the effectiveness of plants in urbanization concepts in reducing the noise is based on the loudness of sound itself, planting configuration used, and also climatic conditions.

2.2.4 Urban hydrology

The urbanization idea is very important especially in other to slow the flow of precipitation on the ground which is known as urban hydrologic process. It will react as the part of reducing the rate of storm water runoff, flooding damage, storm water and other problems which are related to water quality. It showed that the existing of tree canopy which has 22% of canopy reduced the potential runoff by 7%. In other to reduce runoff of rainfall interception, it also can decrease the costs of treating storm water by decreasing the quantity of water handled when the period of peak runoff (Sanders, 1986). The cost of water in other to sustain vegetation is great as energy savings from shade for tree which use a huge amount of water needed.

2.2.5 Traffic calming effect

The trees which are lined at streets can slow and lowering the rate speed of vehicles by making the roadways appear narrower (Bucur, 2006). The trees which are planted should provide a separation between motorists and pedestrians and also reduced the illustration width of the roadways.

2.2.6 Microclimate and temperature

The presents of trees which are the main part in urbanization ideas will affect the local climate and also influence the thermal comfort and air quality. Besides, the trees also can alter the wind speed and direction especially the dense of tree crowns which can reduce the wind speed significantly.

Trees also have the influence on solar radiation which can reduce the solar radiation about 90% (Heisler, 1986). This is because the tree canopies absorbed the radiation by the process of evaporation and transpiration of water from the leaves. This process will then cool the air of environment and gave a positive impact in reducing the air temperatures by as much as 5^0C (Akbari, 1992).

2.2.7 Removal of air pollutants

Through leaves stomates, some gases will be removed especially the toxic gaseous which can lead to air pollutants (Smith, 1990). When the toxic gaseous are diffuse into the intercellular spaces, they will be diffuse by water films in other to form acid or basically react with inner surfaces of the leaves.

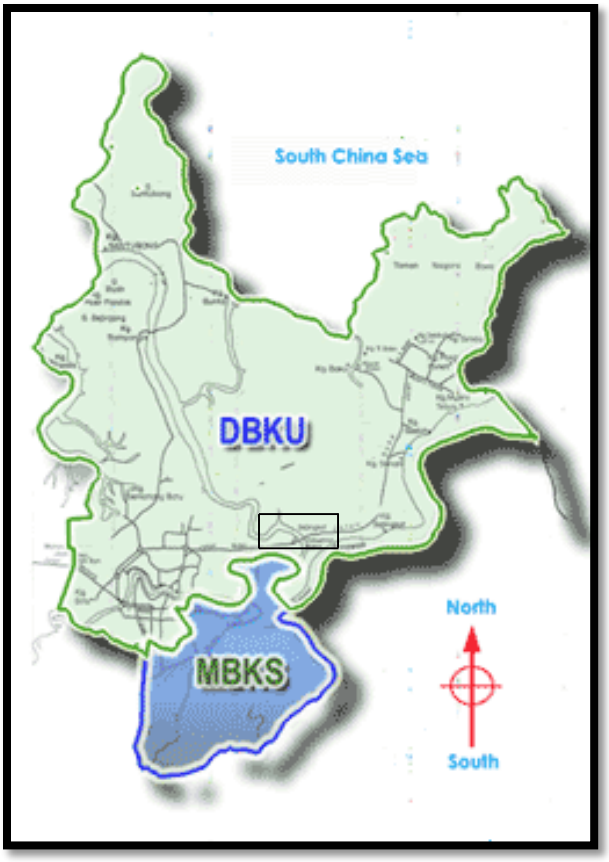
CHAPTER 3

MATERIALS AND METHODS

3.1 Study Site

Kuching city lº33’36”N 110°20’42”E is the capital of Sarawak and now emerged as one of the most developed cities in the region. It is located on the north of equator of South East Asia, covering an area of 4,566 sq. km with estimated population of 1 million in 2012. The city of Kuching is surrounded by natural landscapes and two main prominent mountains. On the north is the South China Sea with the scenic coastlines of Bako and Santubong Mountain. To the east is the Muara Tebas fishing village with large area still covered mangrove, on the west are the Kubah National Park, Kuching wetland National Park and the Serapi Mountain. At the south there is a green area of Semenggok Forest Reserve and the Wildlife Rehabilitation Centre. The city is surrounded by natural landscapes which act as green belt as most of the lands are under effective control of the government (Abang Kassim, 2004). (**Plate 1)**

Located near the equator, Kuching’s climate is categorized as equatorial, being hot and humid throughout the year. The wettest times are during the North-East Monsoon months of November to February. The temperature ranges from 28 °C to 34 °C and receives substantial rainfall with average between 330 cm to 460 cm. Being Kuching city are expected to transformed into greater metropolitan area among the largest urban area in Malaysia, after Kuala Lumpur-Klang valley, Penang and Johor Bahru.



Study Site

Plate 1 Kuching City, DBKU (light green) and MBKS (blue) City Boundary Map, 2000 (DBKU 2011)

About six residential areas located in the district of Kuching North have been selected as the study sites. All of the areas are managed by the commission of Dewan Bandaraya Kuching Utara (DBKU). The areas which are selected are:-

1. Jalan Stapok
2. Jalan Nanas and Jalan Nanas Barat
3. Jalan Rubber and Jalan Rubber Barat
4. Jalan Tun Datuk Patinggi Haji Abdul Rahman Yaakub
5. Jalan Astana
6. Jalan Masjid Jamek Negeri

In this survey, Jalan Stapok, Jalan Nanas and Jalan Nanas Barat, and Jalan Rubber and Jalan Rubber Barat are considering the old planting sites located in precint of Satok while Jalan Tun Datuk Patinggi Haji Abdul Rahman Yaakub, Jalan Astana and Jalan Masjid Jamek Petrajaya are the new planting sites located in the precint of Petra Jaya.

No.	Road sites	Length of road (km)
1.	Jalan Stapok	0.30
2.	Jalan Nanas and Jalan Rubber Barat	0.75
3.	Jalan Rubber and Jalan Rubber Barat	0.68
4.	Jalan Tun Datuk Patinggi Haji Abdul Rahman Yaakub	0.14
5.	Jalan Astana	0.32
6.	Jalan Masjid Jamek Petrajaya	0.40

Table 1: The length of road at the old and new sites in DBKU

Measuring the diameter of urban tree (DBH)

The DBH of the tree species were measured with a DBH meter at a height of 1.37 m above the ground. The conditions of the trees were also recorded.

Measuring the chlorophyll contents

The chlorophyll contents is recorded by using the chlorophyll meter. The chlorophyll content of the selected trees can be done by putting a leaf under the sample head of the chlorophyll meter. The readings of the chlorophyll content were display digitally on the tool. The readings will be taken and recorded.

CHAPTER 4

RESULTS

4.1 Jalan Stapok

Jalan Stapok is a 0.3 km two lane road that linked Kuching City to Batu Kawa. On one side of the road, the trees were planted in a single line and on the other side of the road the trees were planted densely in rows of twos and threes. The planting distance from each tree varies from 1 m to 2.5 m. There were 16 species of trees, constitute of 650 individual trees, planted at Jalan Stapok. Only seven species were accounted for the common planted trees. The percentage of the seven common planted trees was shown in Figure 1. It clearly shows that *Cinnamomum iners* were the abundant planted trees, accounting for 39%, while *Pterocarpus indicus* with only 4% were the least planted trees. The other common trees were *Milletia atropurpurea* (13%), *Khaya Senegalensis* (12%), *Tabebuia pallinda* (9%), and *Andira surinamensis* and *Lagerstroemia floribunda*, both accounted for 8% of trees planted.

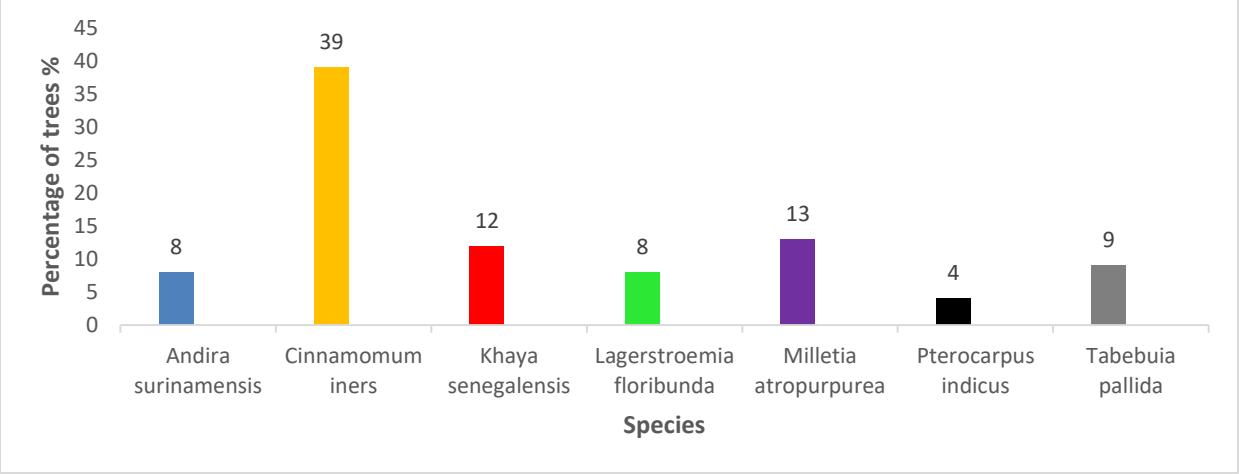


Figure 1: Percentage (%) of seven common planted trees at Jalan Stapok

No	Species	No. of trees
1	*Andira surinamensis*	53
2	*Cassia fistula*	1
3	*Casuarina equisetifolia*	6
4	*Cinnamomum iners*	252
5	*Erythrina variegate*	6
6	*Eugenia grandis*	8
7	*Eugenia oleina*	8
8	*Filicium decipiens*	4
9	*Khaya senegalensis*	78
10	*Lagerstroemia floribunda*	54
11	*Milletia atropurpurea*	83
12	*Mimusops elengi*	3
13	*Mussendra sp*	1
14	*Pterocarpus indicus*	25
15	*Spathodea campanulata*	8
16	*Tabebuia pallida*	60
	Total	**650**

Table 2: Number of trees planted at Jalan Stapok

The distribution of DBH classes for the most abundant planted trees, *Cinnamomum iners*, varied from 0.1 cm to 25.0 cm (Figure 2). DBH class of 5.1 cm to 20.0 cm is the majority of the trees recorded with greater part ranging between 10.1 cm – 15.0 cm with 68 number of trees. For *Milletia atropurpurea* in Figure 3, DBH class of 15.1 cm – 20.0 cm is the highest distribution with 36 number of trees and DBH class of 10.1 cm – 15.0 cm were in the lower with 9 trees.

The DBH class distribution of *Khaya senegalensis* in Figure 4, range from 0.1 cm to 5.0 cm is the lowest and most of the trees ranged between 15.1 cm – 20.0 cm with 32 trees. Figure 5 shows the number of *Tabebuia pallida* tree with 18 trees recorded in lower DBH class range of 10.1 cm – 15.0 cm and only 5 trees recorded in higher DBH range of 30.1 cm – 35.0 cm.