WASTE UTILISATION OF URBAN TREES FOR ALTERNATIVE FURNITURE MATERIAL

By

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

December 2021

FRSB 2022 5

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Understanding the benefits provided by urban trees is important to justify the investment and to improve stewardship. Most of the end life of urban trees are either use as mulched or landfilled. As part of a commitment to sustainable urban trees, there is now a movement to use the entire tree. Thus, this research aims to identify the value of urban tree species and examine their waste that can be utilised as an alternative for furniture material. Seven major roads were selected in Kuala Lumpur, Malaysia as the areas for the case study. Methods such as literature review, tree inventory, observation and survey through questionnaire were performed to gather the significant data. The result acknowledged several valuable urban tree species whereas their waste can be transformed as furniture lumber. Towards the ends, prototype furniture has been made to show the value of material from the waste of urban trees based on selected tree species. The study also concluded with recommendations of good practice in managing the waste of urban trees for economic worth and sustainability for urban environments.

Keywords: Sustainability and wealth, green waste, environmentally friendly product, and furniture design

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

MENGGUNAPAKAI BUANGAN POKOK BANDARAN SEBAGAI ALTERNATIF BAHAN PERABOT

Oleh

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Memahami faedah yang diberikan oleh pokok bandaran adalah penting untuk mewajarkan perlaburan dan meningkatkan pengurusan. Kebiasaannya, diakhir hayat pokok bandaran adalah sama ada sebagai sungkupan atau ditimbus. Sebagai sebahagian daripada komitmen terhadap kelestarian pokok bandaran, kini terdapat usaha untuk memanfaatkan keseluruhan pokok tersebut. Sehubungan dengan itu, penyelidikan ini bertujuan untuk mengenal pasti nilai spesies pokok bandaran dan meneliti buangan yang boleh digunakan sebagai alternatif kepada bahan perabot. Tujuh jalan utama telah diplih di Kuala Lumpur, Malaysia sebagai kawasan untuk kajian kes. Kaedah seperti kajian literatur, inventori pokok, pemerhatian dan tinjauan melalui soal selidik telah dilakukan untuk mengumpul signifikan data. Hasil kajian mengiktiraf beberapa spesies pokok bandaran yang berharga dan buangannya boleh dijadikan sebagai kayu perabot. Di akhir kajian, prototaip perabot dihasilkan untuk menunjukkan nilai bahan daripada buangan pokok bandaran berdasarkan kepada spesies pokok terpilih. Kajian ini juga, diakhiri dengan cadangan amalan baik dalam menguruskan buangan pokok bandaran untuk nilai ekonomi dan kelestarian persekitaran bandar.

Kata kunci: Kelestarian dan kekayaan, buangan hijau, produk mesra alam dan reka bentuk perabot

ACKNOWLEDGEMENTS

With the name of Allah, the Most Compassionate and Most Merciful

First and foremost, praises and thanks to God, the Almighty, for His showers of blessings throughout my research work to complete the research successfully.

I would like to express my deep and sincere gratitude to my research supervisor, Associate Professor Ts. Dr. Hassan Hj. Alli from the Department of Industrial Design, Faculty of Design and Architecture, Universiti Putra Malaysia for giving me the opportunity to do research and providing invaluable guidance throughout this research. His dynamism, vision, sincerity, and motivation have deeply inspired me. He has taught me the methodology to carry out the research and to present the research works as clearly as possible. It was a great privilege and honour to work and study under his guidance. I am extremely grateful for what he has offered me. I would also like to thank Professor LAr. Ts. Dr. Osman Mohd Tahir from the Department of Landscape Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia for co-assisting me on research work and thesis preparation.

I am extremely grateful to my parents for their love, prayers, caring and sacrifices for educating and preparing me for my future. Also, I express my thanks to my sister, her support, and valuable prayers.

I would like to say thanks to my friends for their genuine support throughout this research work. I thank the management of the Faculty of Design and Architecture, Universiti Putra Malaysia for their support to do this work.

Finally, my thanks go to all the people who have supported me to complete the research work directly or indirectly.

Respectfully yours with sincere gratitude,

Ummu Aiman Hishammuddin
December 2021

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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Declaration by Members of Supervisory Committee

This is to confirm that:

- the research and the writing of this thesis were done under our supervision;
- supervisory responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2015-2016) are adhered to.

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LIST OF ABBREVIATIONS

bf	Board Foot
DBH	Diameter at the Breast
DIB	Diameter Inside the Bark
cu-ft	Cubic Feet
cu-yd	Cubic Yards
CO2	Carbon Dioxide
DBKL	Kuala Lumpur City Hall
ft.	Feet
NaOH	Sodium Hydroxide
TPO	Tree Preservation Order
VTI	The Veteran Tree Initiative
EPA	United States Environmental Protection Agency
MSW	Municipal Solid Waste
USFS	United States Forest Service
UFW	United Farm Worker

CHAPTER 1

INTRODUCTION

1.1 Introduction

The introduction chapter highlights and establishes the significance of research following with the aim, objectives, scope, and area of study. Finally, the research contribution and structure of the thesis are explained.

1.2 Research Background

Trees play an essential purpose in the urban environment and have a variety of symbolic implications for urbanites. As many reasons as there are types of trees to plant, there are numerous reasons to plant a tree. Trees are an important part of our city's green infrastructure, providing a variety of functions that help to sustain life, improve well-being, and provide economic benefits. Previous studies state that the trees were planted because of aesthetic reasons. Urban trees come in shapes and sizes, and each is suited for different conditions (Sreetheren et. al., 2006; Abd Kadir et al., 2011; Seamans, 2013; Hasan et al., 2018). Urban plants are good filters for urban and fine particulate pollutants. Fruits, nuts, and leaves, among other things, can be found on trees. Spending time near trees can improve mental and physical health, helping increase energy and speed recovery while reducing blood pressure and stress. Trees strategically positioned around a building will minimise the need for air conditioning by 30 percentage and save 20-50 percent on heating oil. The urban trees also provide urban residents with a range of services, including improving urban air quality, reducing floods by storm, energy conservation, noise reduction, and providing urban wildlife habitats (Sreetheran et al., 2011; Mullaney, Trueman & Lucke, 2015; Abdullah et al., 2018). In recent decades, the scientific understanding of how trees benefit people in towns and cities has expanded economic domains.

Urban trees have their highest value when alive. Urban trees are significant investment for municipalities and undoubtedly their benefits far outweigh their costs. The trees need to be well maintained, well planted, safety precautions step, well preserved aesthetics, and long-lived to provide these services. Approximately, the damage of construction, weather damage, invasive insect or disease infection, and old-age death caused the removal from urban municipalities of tens of thousands of trees annually. The growing number of ageing urban trees aided in the removal of many trees. An estimated 200 million cubic metres of wooden waste is obtained every year from removing the largest trees due to ageing or urban damage. Most of the end life of urban trees are either mulched or landfilled. Most cities dispose of their urban tree waste in landfills, which reduces the projected potential of these facilities. The wastes of urban trees are mostly dried leaves, trimmed-tree scraps or twigs and trunks. Earlier research has shown that waste from these trees is typically regarded as a costly waste problem. It is due to the space of the landfills is limited and mulch has relatively little economic value.

Nowadays, natural sources are preferable to be used for furniture rather than synthetic materials. The wood-based industries and products have high demand due to diverse applications of woods for interior and exterior use such as furniture. However, raw resources to produce consumer goods are no longer abundant. As part of a commitment to sustainable urban trees, there is now a movement to use the entire tree. Some tree parts are better suited to being turned into wood chips or firewood. Furthermore, tree trunks can be saved and transformed into lumber. According to Tinua and LaMana (2013), indeed, tree wood has market value and can be milled for end uses. Only a few wood processing plants are currently using massive branches and bolewood from urban sites to create solid products. Most sawmill operations convert logs into solid wood that can be used for furniture, flooring, cabinetry, and other specialty or high-end market products. However, urban logs are still mostly an under-utilised resource. Moreover, less studies mentioned the potential for the urban trees to provide marketable lumber.

1.2.1 Statement of Issues

Once urban trees are injured or die, the cost of removing them may be prohibitive for a responsible government entity. Utilisation of urban tree waste from tree trimming and removal activity can reduce the economic and environmental costs of disposal, promote the sustainability of urban trees, and even give commercial opportunities for green industry professionals extracting residual value from the waste. Some of the urban tree waste is valuable for furniture materials such as their larger limbs and bolewood and even can provide business opportunities for green industry professional seeking to extract residual value form the waste (Alli et al., 2021). In addition, utilising such as larger limbs and bolewood for valuable furniture material would not only reduce the amount of green waste that goes to landfills but also can reach significant value for an economic benefit. According to Khudyakova, Danilova and Khasanov (2017), urban tree waste is usually dumped in the landfill by transporting it into specific trucks and separating it from domestic garbage collection that entails a higher cost. In addition, they also stated that the waste wood from the cities lately constitutes 10 to 20 percent of the volume of materials going into landfills.

According to Tinua and LaMana (2013); Nitoslawski (2016); Nowak, Greefield and Ash (2019); Alli et al., (2021), the wood of the urban trees has market value and can be milled for end uses. However, only a little is known about the utilisation of urban tree waste, and to extend, there are many local authorities don't have adequate inventories to acknowledge value of urban trees and it potential for economic objective. There are many issues need to be considered in this study such as profiting from urban wood waste which has good quality because many of urban tree's flourish in an open environment, leading to shorter trunks and more branches than those of their forest grown counterparts.

Therefore, the dominant issue here is why the valuable and quality of urban trees waste being disposed of at the landfill if it can utilise such as converting into furniture lumber? According to Alli et al., (2021), wood product is good for our environment and help prevent climate change. Since this waste is mostly an under-utilised resource with limited studies mentioning potential as furniture lumber, it required further study and significant to identify the urban trees species and utilise their waste for alternative raw

material of furniture as well as reduce them to the landfills and provide an economic return.

1.3 Aim

Thesis study aimed to identify the value of urban tree species and examine their waste that can be utilised as an alternative for furniture material in Malaysia. The end of research was developing a furniture prototype made from urban trees waste based on selected and recommended species in sites.

1.3.1 Research Questions

The following research questions are proposed in line with the problem statement and research objective:

RQ1) What are the most popular trees planted and their populations in the urban area?
RQ2) How much waste and its types are produced from urban trees?
RQ3) What is the most suitable and valuable waste of urban trees that can be utilised as alternative furniture material?

1.3.2 Research Objectives

In this regard, the researcher proposes the following research objective and questions to bridge the gap between the research objective and the problem statement. The main objectives to be achieved in this thesis were:

RO1) To identify and analyse the most popular tree species planted and its population in the urban areas.
RO2) To define volume and types of waste produced from urban trees.
RO3) To promote a new alternative furniture material from urban trees waste based on selected and recommended species located in site.

1.3.3 Scope and Area of Research

Malaysia has trees planting programmes to enhance urban green spatial protection of the environment in local municipalities. Unfortunately, there are only few studies conducted on the utilisation of urban tree wastes into other economic benefits such as converting them into lumber. The value of this study is particularly to investigate the most well-known tree species planted in urban areas. The observation has begun with understanding the urban trees and their behaviour. Meanwhile, the specific survey is gained from the case study and information from industry related.

Several trees in Kuala Lumpur's urban streets or roads were chosen for this research. The decision was based on the premise that trees on public property are under the control of the appropriate municipality. Thus, tree selection is presumably carried out by local professionals such as arborists, urban foresters, or landscape architects who are hired for their expertise in tree selection and whose tree standards are collectively decided upon by council policies or strategies. The sampling site used in this study work is located around the city of Kuala Lumpur.

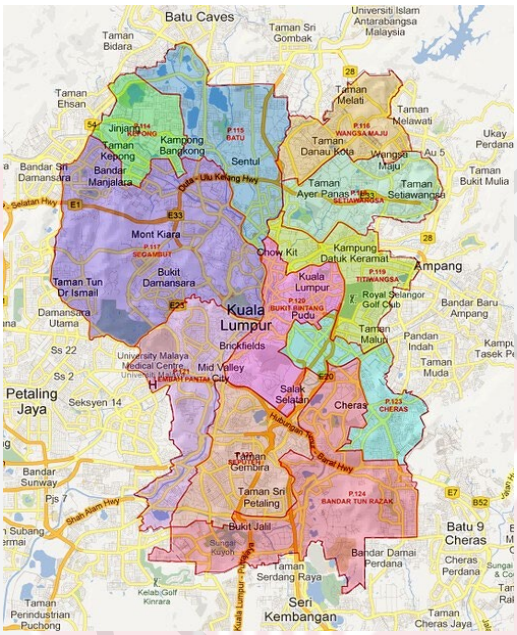

Figure 1.1: Kuala Lumpur territory
(Source: Author)

Kuala Lumpur was chosen as the research site since it is Malaysia's capital and largest metropolis (see Figure 1.0). Kuala Lumpur, Malaysia, grew from a minor unknown state in the 1870s to a thriving mining town and finally became Malaysia's capital city (Nor Akmar et al., 2011). The city has a total area of 244 km2 (94 sq mi) and a population of more than 1.6 million people. Kuala Lumpur is the capital of Peninsular Malaysia and is governed by the Kuala Lumpur City Hall (DBKL). The Kuala Lumpur Structure Plan (2004-2020) divides the city into six zones in order to develop Kuala Lumpur in a sustainable way by focusing on land use distribution, new growth areas, infrastructure building, and environmental sustainability (DBKL, 2004). The zones are City Centre, Bukit Jalil-Seputeh, Bandar Tun Razak-Sungai Besi, Wangsa Maju Maluri, Sentul-Menjalara, and Damansara-Penchala. DBKL has undertaken various efforts to improve urban greenery in Kuala Lumpur, with one project seeking to make the city one of the top twenty most liveable in the world.

1.3.4 Expectation of Research

This research is an initial step toward determining the significance of urban tree waste that can be utilised as a furniture material. The result of this research will lead to these possible outcomes:

a) Promote a new alternative furniture material.
b) Increase the economic value from the waste of urban trees by transforming it into high-value wood products.
c) Extend the value of several urban tree species to become expensive lumber for furniture.
d) Propose a good understanding of urban tree waste management toward its sustainability and wealth.

1.4 Outline of The Thesis

There are six chapters in total, each of which corresponds to a different stage of the research process. The thesis is organized as follows:

Chapter 1 Introduction - This chapter covers the introduction, the objectives of the study, scope of the study, and thesis structure.

Chapter 2 Literature Review - This chapter describes a study of the literature on significant issues in conducting research. The research gaps are established, and a new approach is introduced at the end of this chapter.

Chapter 3 Research Method - This chapter explained the research strategy with a chosen methodology that has been used for data collection. All the protocols and data conduction procedures also described in detail.

Chapter 4 Results and Discussion - This chapter deal with data analysis and results. The valuable urban tree species and their waste are further investigated. A few qualities urban trees woods are identified. An in-depth study is conducted to validate the valuable urban tree species that can be converted into new alternative furniture lumber.

Chapter 5 The Potential of Urban Tree Waste as Furniture Material - In this chapter, the results from Chapter 4 are being given a rigorous description. Several urban tree species were identified and discussed because they can be utilised as a new alternative for lumber furniture. A pilot furniture prototype is built to prove the value and quality of urban tree waste from *Samanea saman* or Raintree.

Chapter 6 Conclusion - A summary of the completed work conducted through this research together with analyses of the research objectives. Recommendations are made from the analyses found in Chapter 5 and for potential future work to be done.

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