IMPACT OF WIND ON URBAN TREES FOR SELECTED AREAS IN KUALA LUMPUR

AFIQ BIN ZAKARIA

FH 2018 1

IMPACT OF WIND ON URBAN TREES FOR SELECTED AREAS IN KUALA LUMPUR

By

AFIQ BIN ZAKARIA

FACULTY OF FORESTRY

UNIVERSITY PUTRA MALAYSIA

2018

IMPACT OF WIND ON URBAN TREES FOR SELECTED AREAS IN KUALA LUMPUR

By

AFIQ BIN ZAKARIA

A Project Report Submitted in Partial Fulfillment of the Requirements

for the Degree of Bachelor of Forestry Science in the

Faculty of Forestry

University Putra Malaysia

2018

DEDICATION

For my beloved family:

Zakaria bin Ishak

Siti Khadijah binti Jaafar

Also my siblings.

To all my friends,

Thank you for your encouragements supports

And the sacrifices that you have given.

Thank you for everything. May Allah Bless All of us.

ABSTRACT

Wind is one of the nature's unique phenomena, which when occurred in a strong form, may cause tremendous effect and major problems causing impact to human and trees, especially in an urban area such as Kuala Lumpur. The main objective of this study was to investigate the winds' seasonal characteristics and its impact on trees. Daily wind data was obtained from the Malaysian Meteorology Services (MMS) Petaling Jaya station and categorized using descriptive statistics and frequency analysis. Damage tree data from three different areas was obtained from the Landscape and Recreation Development Department, Dewan Bandaraya Kuala Lumpur (DBKL). Result from this study showed that mean maximum wind gust or mean wind velocity ranged between 20.7 m/s and 20.9 m/s throughout from 2012 to 2016 and usually occurred in the month of November and December. The highest mean wind speed from 2012 to 2016 was in month of December with speed reaching 19.26 m/s. September and November were the second highest with speed reaching at 17.36 m/s. Branch breakage was the main type of tree damage followed by stem breakage and uprooting. Tree species most commonly damaged was Rhu *(Casuarina nobile)* with total 531 incidence (33.27%) within the three district followed by also Rhu tree but different species *(Casuarina equisetifolia)* with 180 incidence (11.28%) and Tan wattle *(Acacia auriculiformis)* with 81 incidencee (5.08%).This study concluded that there was no significant relationship between the wind speed and the frequency of urban tree damage in the selected areas in Kuala Lumpur after being tested with Pearson's Correlation analysis.

ABSTRAK

Angin adalah salah satu fenomena semulajadi yang unik, yang mana terjadi dalam bentuk angin kencang dan akan menyebabkan kesan yang dahsyat dan memberi kesan terhadap manusia dan pokok terutama di kawasan bandar seperti Kuala Lumpur. Objektif utama bagi kajian ini adalah untuk mengkaji ciri-ciri angin bermusim dan kesannya kepada pokok. Data harian bagi angin diperolehi dari Jabatan Meteorologi Malaysia (MMS), stesen Petaling Jaya dan di analisa menggunakan statistik deskriptif dan analisis kekerapan. Data kerosakan pokok dari tiga daerah berbeza diperoleh daripada Jabatan Pembangunan Lanskap dan Rekreasi, Dewan Bandaraya Kuala Lumpur (DBKL). Hasil daripada kajian ini menunjukkan bahawa purata kelajuan angin maksimum adalah antara 20.7m/s dan 20.9m/s sepanjang tahun 2012 hingga 2016 dan biasanya berlaku pada bulan November dan Disember. Purata kelajuan angin yang tertinggi dari tahun 2012 hingga 2016 adalah pada bulan Disember dengan kelajuan mencapai 19.26m/s. September dan November adalah yang kedua tertinggi dengan kelajuan mencapai 17.36 m/s. Dahan patah adalah jenis kerosakan pokok yang utama diikuti oleh kerosakan batang pokok dan pangkal pokok. Spesies pokok yang paling banyak rosak ialah pokok Rhu *(Casuarina nobile)* dengan jumlah 531 kejadian (33.27) di dalam tiga daerah diikuti oleh pokok Rhu juga tetapi berlainan spesies *(Casuarina equisetifolia)* dengan 180 kejadian (11.28%) dan Tan wattle *(Acacia auriculiformis)* dengan 81 kejadian (5.08%). Kesimpulan daripada kajian ini ialah tidak terdapat hubungan yang signifikan antara kelajuan angin dan kekerapan kerosakan pokok bandar di kawasan terpilih di Kuala Lumpur selepas diuji dengan analisis Korelasi Pearson.

ACKNOWLEDGEMENTS

Alhamdulillah and thanks to the Almighty for bestowing me with strength for enabling me to successfully complete my Final Year Project dissertation. Firstly, I would like to dedicate my grateful appreciation to Prof. Dr. Ainuddin Bin Nuruddin, my project supervisor for his excellent guidance and blissful encouragement throughout period of the project. I am also thankful for his support, patience and time spent until the end of my project.

My gratitude extends to Malaysian Meteorology Services (MMS) especially Mrs. Mariam bte Satiman. A note of my gratitude goes to the Landscape and Recreational Development Department, Dewan Bandaraya Kuala Lumpur (DBKL) especially Haji Norazam Bin Mohamed Nor for their moral support during my study and all officers of the target district, who supported me during the data collection.

Finally, this Final Year Project dissertation could not have been completed without the pray, help and understanding from my parents, Zakaria bin Ishak and Siti Khadijah binti Jaafar. I am very grateful to have them who keep supporting and trusting me in whatever decisions that I have made in my life. Thank you for always standing by my side.

APPROVAL SHEET

I certify that this research project report entitled “Impact of Wind on Urban Tree for Selected Areas in Kuala Lumpur**”** by Afiq bin Zakaria has been examined and approved as a partial fulfillment of the requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry, Universiti Putra Malaysia.

_____

Prof. Dr. Ahmad Ainuddin bin Nuruddin
Faculty of Forestry
Universiti Putra Malaysia
(Supervisor)

_____

Prof. Dr. Mohamed Zakaria Bin Hussin
Dean
Faculty of Forestry
Universiti Putra Malaysia

Date: …….

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

MMS	Malaysian Meteorological Services
DBKL	Dewan Bandaraya Kuala Lumpur
M.S.L	Mean Sea Level
MSW	Maximum Sustained Surface Wind Speed

CHAPTER ONE

INTRODUCTION

1.1 General Background

Wind is one of the God unique creation on this earth. Wind contribute many benefit to human and also to the other living things. It helps in the cloud movement and this will induce to rainfall, helps in pollination process, important source of energy and others. But, not all the wind existence give benefit. For example, strong wind, will mostly cause problem to human and other living things such as tree. It will cause damage and destruction to property such as buildings, houses and others.

Wind is caused by differences in the atmospheric pressure. When a difference in atmospheric pressure exists, air moves from the higher to the lower pressure area, resulting in winds of various speeds. Globally, the two major driving factors of large-scale wind patterns (the atmospheric circulation) are the differential heating between the equator and the poles (difference in absorption of solar energy leading to buoyancy forces) and the rotation of the planet. Strong wind such as hurricane, monsoon, typhoon and cyclone are the major forces of causes of destruction to human life and also to the environment.

Large infrequent disturbances can have a substantial role in structuring plant communities and research on the impacts of extreme events is an expanding area of ecological research (Cook & Goyens, 2008). In the lands adjoining the seven basins in which tropical cyclones form globally, extreme winds are a major agent

of disturbance, capable of destroying entire forests in a day. Understanding the impact of infrequent disturbances such as tropical wind on ecosystems is essential for valid estimates of Net Ecosystem Productivity and Net Biome Productivity (Cook & Goyens, 2008).

Wind is a major source of disturbance to European forests (Dupont et al., 2015). Damage due to the wind has increased since the mid-twentieth century in relation to changes in forest management activities, and possibly climatic changes (Dupont et al., 2015). This trend is expected to continue, reducing the carbon storage potential of forests and leading to severe loss in their economic value (Dupont et al., 2015).

Apart from Malaysia, other countries also facing the similar problem of damage and impact due to the wind effect phenomenon. For example, on 9 December 2005, a catastrophic windstorm that affected a small section of Cape Cod, in Massachusetts, USA, provided an opportunity to study the effects of maintenance and defects on the tree failure. Although the area affected by the storm was comparatively small wind speeds of approximately 45 m/s (100 mph) resulted in thousands of tree failures (Kane, 2008) .Wind damage would be expected to be drastically higher today because numerous forests are in a mature stage due to the lack of harvesting (Kamimura & Shiraishi, 2007) Based on this fact, this study is carried out to see wind damage to the tree and also to relate the wind speed and type of damage to the tree.

Tree damage impacted by the wind in an urban area such as in Kuala Lumpur, possess great danger to life and valuable properties. Zulfakar (1990) reported that a storm followed by strong wind had uprooted 40 tree in April 1998 and also 29 tree with stem and branch breakage in Kuala Lumpur area .While in 13 July 2016, it is reported that storms that hit the capital resulted in 10 trees uprooted and crushed several cars and houses in several locations in Kuala Lumpur itself.

1.2 Problem Statement and Justification

Wind impact on urban tree in an urban area plays a major role in property damage and endangering lives physically injured or damage tree. There are many urban tree that are planted do not have the ability to stand under strong wind.

For this study, the data collected will be expected to help the planners or specifically Dewan Bandaraya Kuala Lumpur (DBKL) to organise or develop appropriate tree selection and tree maintenance schedule in the urban area in future.

1.3 Objective

The objectives of this study were:

a) To study seasonal wind pattern for selected area in Kuala Lumpur.
b) To relate wind speed and frequency of damaged urban trees for selected area in Kuala Lumpur.

REFERENCES

Abdullah, I. bin. (2007).Impact Of Wind On Tree In Melaka Tengah.Serdang: Universiti Putra Malaysia.

Cook, G. D., & Goyens, C. M. A. C. (2008). The impact of wind on trees in Australian tropical savannas: Lessons from Cyclone Monica. *Austral Ecology*, *33*(4), 462–470.

Dupont, S., Pivato, D., & Brunet, Y. (2015). Wind damage propagation in forests. *Agricultural and Forest Meteorology*, *214–215*, 243–251. Elsevier B.V.

Duryea, M., & Kampf, E. (2007). Wind and Trees: Lessons Learned from Hurricanes, 17.

Ellis, K. N., Sylvester, L. M., & Trepanier, J. C. (2014). Spatiotemporal patterns of extreme hurricanes impacting US coastal cities. *Natural Hazards*, *75*(3), 2733–2749.

Eric Brady. (2009). Development of an Urban Tree Inventory for the City of Crossville , Tennessee, (December), 41.

Gardiner, B., Berry, P., & Moulia, B. (2016). Review: Wind impacts on plant growth, mechanics and damage. *Plant Science*, *245*, 94–118. Elsevier Ireland Ltd.

Hale, S. E., Gardiner, B. A., Wellpott, A., Nicoll, B. C., & Achim, A. (2012). Wind loading of trees: Influence of tree size and competition. *European Journal of Forest Research*, *131*(1), 203–217.

Hanisah, M. H. N., Hitchmough, J. D., & Muda, A. (2012). The Perception of Kuala Lumpur Publics' on Tree Retention and Urban Development. *Procedia - Social and Behavioral Sciences*, *49*, 215–226.

Kamimura, K., & Shiraishi, N. (2007). A review of strategies for wind damage assessment in Japanese forests. *Journal of Forest Research*, *12*(3), 162–176.

Kane, B. (2008). Tree failure following a windstorm in Brewster, Massachusetts, USA. *Urban Forestry and Urban Greening*, *7*(1), 15–23.

Kašpar, J., Hošek, J., & Treml, V. (2017). How wind affects growth in treeline Picea abies. *Alpine Botany*. Springer International Publishing.

Kim, J. Y., Kim, G. Y., Do, Y., & Joo, G. J. (2014). Effects of Monsoon on Topography, Soil Variables, and Coastal Plants. *Estuaries and Coasts*, *38*(2), 494–505.

Knight, R. I., & Khalid, F. (2015). Evaluation of the potential of friction surface analysis in modelling hurricane wind damage in an urban environment. *Natural Hazards*, *76*(2), 891–911.

de Langre, E. (2008). Effects of Wind on Plants. *Annual Review of Fluid Mechanics*, *40*(1), 141–168.

Lanza, K., & Stone, B. (2016). Climate adaptation in cities: What trees are suitable for urban heat management? *Landscape and Urban Planning*, *153*, 74–82. Elsevier B.V.

Meaden, G. T., Kochev, S., Kolendowicz, L., Kosa-Kiss, A., Marcinoniene, I., Sioutas, M., Tooming, H., et al. (2007). Comparing the theoretical versions of the Beaufort scale, the T-Scale and the Fujita scale. *Atmospheric Research*, *83*(2–4 SPEC. ISS.), 446–449.

Mortimer, M. J., & Kane, B. (2004). Hazard tree liability in the United States: Uncertain risks for owners and professionals. *Urban Forestry & Urban Greening*, *2*(3), 159–165.

Pukkala, T., Laiho, O., & Lähde, E. (2016). Continuous cover management reduces wind damage. *Forest Ecology and Management*, *372*, 120–127. Elsevier B.V.

Roslan, R. B. I. N. (2011). Universiti Teknologi Mara Urban Tree Management : Towards Best Practices and Applications, (May).

Sæbo, A., Borzan, Ž., Ducatillion, C., Hatzistathis, A., Lagerström, T., Supuka, J., García-Valdecantos, J. L., et al. (2005). The selection of plant materials for street trees, park trees and urban woodland. *Urban Forests and Trees: A Reference Book*, 257–280.

Schelhaas, M. J., Kramer, K., Peltola, H., van der Werf, D. C., & Wijdeven, S. M. J. (2007). Introducing tree interactions in wind damage simulation. *Ecological Modelling*, *207*(2–4), 197–209.

Schindler, D., Bauhus, J., & Mayer, H. (2012). Wind effects on trees. *European Journal of Forest Research*, *131*(1), 159–163.

Vailshery, L. S., Jaganmohan, M., & Nagendra, H. (2013). Effect of street trees on microclimate and air pollution in a tropical city. *Urban Forestry and Urban Greening*, *12*(3), 408–415. Elsevier GmbH.

Vodde, F., Jorgiste, K., Engelhart, J., Frelich, L. E., Moser, W. K., Sims, A., & Metslaid, M. (2015). Impact of wind-induced microsites and disturbance severity on tree regeneration patterns: Results from the first post-storm decade. *Forest Ecology and Management*, *348*, 174–185. Elsevier B.V.

Yang, M., Défossez, P., Danjon, F., & Fourcaud, T. (2014). Tree stability under wind: Simulating uprooting with root breakage using a finite element method. *Annals of Botany*, *114*(4), 695–709.