
# *FOREST FUEL INVENTORY IN ACACIA MANGIUM AND HEVEA BRASILIENSIS AT ULU SEDILI FOREST PLANTATION, KOTA TINGGI, JOHOR*

**INSAN NURKAMIL BIN IDRIS**

**FH 2018 12**

# Forest Fuel Inventory in *Acacia mangium* and *Hevea brasiliensis* at Ulu Sedili Forest Plantation, Kota Tinggi, Johor

**By**

**INSAN NURKAMIL BIN IDRIS**

**A Project Report Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry Universiti Putra Malaysia**

**2018**

## DEDICATION

Specially dedicated to my beloved family

Idris, Anita, Azlan, Mashitah

A lot thanks to

My supervisor and all my friends including my comrade, Afiq & Nadzeem

For their untiring efforts and support me to complete this study successfully

May Allah bless you all

Thank you

## ABSTRACT

Forest plantation has become increasingly important where it could provide wood supply and many services. However, every forest plantation is risked to forest fire which could decrease the wood production and damage the environment. Forest fire management plan needs to be established in the plantation to reduce the risk of forest fire. Before the plan could be established, the fuel components of the particular plantation need to be characterised. *Acacia mangium* and *Hevea brasiliensis* species are fast growing species that have currently been planted in the forest plantations in Malaysia. The aim of the study was to characterise the forest fuel components that are available in the *Acacia mangium* and *Hevea brasiliensis* stands and compare the fuel loading between these two stands. This study was conducted at Hulu Sedili Forest Plantation. Six fuel components were measured: downed woody material, litter, duff depth, herbaceous, shrubs and small trees (< 3m height). The result showed that *A. mangium* stand had higher quantity and density of fuels compared to *H. brasiliensis* stand. The result of t-test analysis showed that *Acacia mangium* stand had significantly higher fuel loading compared to *Hevea brasiliensis* stand. This difference occurred due to the physiological characteristics of the stand species and silviculture treatment of the site. Forest plantation managers need to take precaution to reduce or avoid forest fire from happening by reducing the fuel in the hazardous area and also monitored frequently around the plantation area.

## ABSTRAK

Kepentingan ladang hutan semakin meningkat dari semasa ke semasa disebabkan kemampuannya dalam membekalkan kayu dan memberikan pelbagai khidmat kepada alam sekitar. Walau bagaimanapun, setiap ladang hutan terdedah kepada kebakaran hutan di mana akan mengakibatkan penghasilan kayu berkurangan dan merosakkan alam sekitar. Oleh yang demikian, Pelan Pengurusan Kebakaran Hutan perlu diwujudkan bagi mengurangkan risiko terhadap kebakaran hutan. Sebelum pelan dapat diwujudkan, komponen bahan bakar di sesuatu kawasan perlu dikenal pasti terlebih dahulu. *Acacia mangium* dan *Hevea brasiliensis* merupakan spesies yang tumbuh pantas yang sedang ditanam di kebanyakan ladang hutan di Malaysia. Oleh itu, tujuan kajian ini dijalankan adalah untuk mencirikan komponen bahan bakar yang terdapat di dirian *Acacia mangium* dan *Hevea brasiliensis* serta membandingkan berat bahan bakar yang terdapat di kedua-dua dirian ini. Kajian ini dijalankan di Ladang Hutan Hulu Sedili. Terdapat enam komponen bahan bakar yang telah diukur di dalam inventori ini iaitu jatuhan kayu, sampah hutan, kedalaman humus, herba, pokok-pokok renek dan pokok kecil (< 3m tinggi). Hasil dapatan kajian menunjukan dirian *A. mangium* memiliki bahan bakar yang lebih tinggi berbanding dirian *H. brasiliensis*. Daripada analisis t-test menunjukkan dirian *A. mangium* mempunyai berat bahan bakar yang lebih tinggi berbanding dirian *H. brasiliensis.* Hal ini disebabkan perbezaan ciri-ciri fisiologi pokok dan rawatan silvikultur antara kedua-dua dirian. Pengurus ladang hutan hendaklah mengambil langkah berjaga-jaga bagi mengurangkan atau mengelakkan kebakaran hutan dari berlaku dengan mengurangkan bahan bakar di kawasan yang dikenal pasti mempunyai bahan bakar yang tinggi. Selain itu, pemantauan berkala perlu lebih kerap dijalankan di sekitar kawasan ladang hutan.

## ACKNOWLEDGEMENTS

Alhamdulillah, praise to the Almighty Allah for the blessing and strength to accomplish this project successfully. First and foremost, I would like to express my deepest, sincere gratitude and appreciation to my supervisor Prof. Dr. Ahmad Ainuddin Bin Nuruddin throughout the project undertaking and completion of this report.

Mr. Ng Tong Loon, The Forest Plantation Manager of Hulu Sedili Forest Plantation, Kota Tinggi, Johor, for his permission to enter and collecting the data in the plantation. Also, really appreciated with the necessary assistance provided during the study conducted.

Not forgotten, the kindly assist from Aramijaya staff members who helped me collecting data and brought me into the study site which is Mr. Mohd Fathan Sobree b. Sukiman, Mr. Mohamad Razi b. Suhailee, Mr. Mohd Azani b. Alim, Mr. Raizal b. Jemali and Mr. Muhammad Ariff Hakim b. Jainudeen.

Last but not least, my deepest gratitude to all my family for being understanding, supporting especially my brother Mohd Azlan Idris who give a moral and financial support from the beginning until the end of this study.

## APPROVAL SHEET

I certify that this research project report entitled “Forest Fuel Inventory *in Acacia mangium* and *Hevea brasiliensis* at Hulu Sedili Forest Plantation, Kota Tinggi, Johor” by Insan Nurkamil Bin Idris has been examined and approved as a partial fulfilment of the requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry, Univeristi 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: January 2018

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| DBH | Diameter at breast height |
| % | Percentage |
| $^{o}C$ | Celsius |
| km | Kilometres |
| TLC | Timber Latex Clone |
| YPJH | Yayasan Pelajaran Johor Holdings |
| PLS | Pembinaan Limbongan Setia Berhad |
| cm | centimetres |
| m | metre |
| ha | hectare |
| am | *Acacia mangium* |
| hb | *Hevea brasiliensis* |
| $m^2$ | metre square |
| S.D | Standard Deviation |

# CHAPTER 1

# INTRODUCTION

## 1.1 General background

Forest plantation become increasingly important around the world. Forest plantation produces wood supply, environmental services, land restoration and carbon sequester (Nambiar, 1999). In future, forest plantation is expected to become main resources of wood despite of natural forest in order to reduce the dependability of natural forest resources. Some of the forest plantation plant with homogenous species which risk to forest fire (Ainuddin & Pangalin, 2007).

Forest fire phenomenon happen frequently around the world. Either it is man-made or natural and the severity of forest fire depends on the certain aspect which is vegetation, fuel loading, and weather (Ye et. al., 2017). The fire could may injure or kill the entire tree depending on how intense the fire and how long the trees are exposed to the heat.

Forest fuel inventory is needed to be carried out in the plantation to provide estimates of fuel loading. Study about forest fuel loading could help forest manager to determine the fuel components and characteristic. The information from this inventory could help forest manager to predict the severity and behaviour of fire when forest fire occurs (Fuller, 1991). From the prediction, they could develop prevention plan to avoid forest fire to happen. Fire intensity

could be differ among different stand. The data from this inventory would be analysed to compare the differences of fuel loading between the two-different stands.

## 1.2 Problem Statement

Since 1975-1999, there is total 7,396.3 hectare of forest plantation area are affected by wildfire disaster in Malaysia (Koh, 1982; Liew, 1985*;* Aziz *et al.,* 1996; Thai, 1996) and 12,739.8 hectare forest was burned from 2003-2017 (Arkib, 2007; Arkib, 2009; Arkib, 2010; Yatimin, 2013; FAO, 2015; Farah, 2016; Balqis, 2016; Ramli, 2016; Kumar, 2016; BERNAMA, 2016; Rosli, 2016; Nur, 2017; Ruwaida, 2017). Forest fire is a disaster which need to be avoid. Its cause a lot of small and medium size (DBH) of trees dead (Nieuwstadt & Sheil, 2005). This will cause loss of profits to the forest plantation and shortage of wood since the wood cannot be harvest due to the fire damage.

In order to minimize the potential of wildfire, Forest Fire Management Plan should be established for each forest management unit (Ainuddin & Pangalin, 2007). Fire environment consist of three factor which is fuel, topography and weather (Cochrane & Ryan, 2009). Since the topography and weather is a factor that hard to manipulate, fire manager usually will focus on fuel (Omi, 2005). Therefore, in order to avoid or minimize the severity of the forest fire, forest fuel inventory need to be conducted to measure and characterise the fuel loading in the forest plantation (Certini, 2005).

The fuel characters and fuel loading might be different among different vegetation. Even the same tree is different one another which resulting a different amount of fuel loading which react differently to fire (Fuller, 1991). Therefore, from the inventories, the fuel loading can be compared from different species stand.

*Hevea brasiliensis* and *Acacia mangium* is currently been planting as a fast-growing species in plantation (Krishnapillay, 2010). The forest fuel inventory can provide the useful information that need by forest fire manager in the plantation to be used as a reference or guideline in fire management plan for the particular plantation.

## 1.3 Objectives

The general objective was to evaluate forest fuel in *Hevea brasiliensis* and *Acacia mangium* plantations. The specific objectives were:

i. To investigate different fuel components in *Hevea brasiliensis* and *Acacia mangium* plantations.

ii. To determine characteristics of different fuel components in *Hevea brasiliensis* and *Acacia mangium* plantations.

## REFERENCES


Ainuddin, A. N., & Pangalin, D. (2007). Forest Fuel Inventory in 5 and 9-year-old Acacia Mangium Plantation. *Journal of Applied Sciences*, 7: 1596-1601.

Arkib. (2007, April 9). Kebakaran Hutan Gambut di Pahang Hampir Padam. *Utusan Online*. Retrieved from http://ww1.utusan.com.my/utusan/info.asp?y=2007&dt=0409&pub=utusan_malaysia&sec=Dalam_Negeri&pg=dn_10.htm

Arkib. (2009, January 30). Hutan Taman Negara Pulau Pinang Terbakar. *Utusan Online*. Retrieved from http://ww1.utusan.com.my/utusan/info.asp?y=2009&dt=0130&pub=utusan_malaysia&sec=Dalam_Negeri&pg=dn_28.htm

Arkib. (2010, March 24). 288 Hektar Hutan Terbakar Diselamatkan. *Utusan Online*. Retrieved from http://ww1.utusan.com.my/utusan/info.asp?y=2010&dt=0324&pub=utusan_malaysia&sec=Timur&pg=wt_05.htm

Arkib. (2010, May 11). Operasi Padam Kebakaran Hutan Hadapi Masalah Bekalan Air. *Utusan Online*. Retrieved from http://ww1.utusan.com.my/utusan/info.asp?y=2010&dt=0511&pub=utusan_malaysia&sec=Terkini&pg=bt_39.htm

Balqis, J.Z. (2016, March 16). Hutan Terbakar di Sungai Siput Berjaya Dipadamkan. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/134331

Balqis, J.Z. (2016, March 31). Kebakaran Hutan di Gunung Korbu Dipadamkan. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/139277

BERNAMA. (2016, April 23). 10 Hektar Hutan Gambut Terbakar di Nenasi. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/146678

Beyers, J. L., Neary, D. G., Ryan, K. C., & DeBano, L. F. (2005). Introduction. In *Wildland Fire in Ecosystems* (p. 25). Fort Collins, Co: United States Dept. of Agriculture, Forest Service, Rocky Mountain Research Station.

Brown, J.K., R.D. Oberheu, and C.M. Johnston. 1982. *Handbook for Inventorying Surface Fuels and Biomass in The Interior West*. USDA For. Serv. Gen. Tech. Rep. INT-GTR-129. 48 p.

Cables, R. D. (2005). Affected Environment & Environmental Consequences. In *Bighorn National Forest: Revised Land and resource management plan* (p. 165). Sheridan: U.S. Dept. of Agriculture, Forest Service.

Certini, G. (2005). Effects of Fire on Properties of Forest Soils: A Review. *Oecologia*, *143*(1), 1-10.

Chen, H. (2014). Chemical Composition and Structure of Natural Lignocellulose. In *Biotechnology of Lignocellulose* (pp. 25-71). Springer Netherlands.

Cochrane, M. A., & Ryan, K. C. (2009). Fire and Fire Ecology: Concepts and Principles. In *Tropical Fire Ecology* (pp. 25-62). Springer Berlin Heidelberg.

FRA, F. (2015). Global Forest Resources Assessment 2015 Desk Reference. *Food and Agriculture Organization of The United Nations, Rome*.

Farah, S.O. (2016, March 1). Kebakaran Hutan Padam Sepenuhnya. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/129648

Fuller, M. (1991). *Forest Fires: An Introduction to Wildland Fire Behavior, Management, Firefighting, And Prevention*. John Wiley & Sons, Inc.

De, R. C., & Goldammer, J. G. (2004). *Wildland Fire Management Handbook for Sub-Sahara Africa*. Freiburg: Global Fire Management Center.

Hegde, M., Palanisamy, K., & Yi, J. S. (2013). *Acacia mangium* Willd. - A Fast Growing Tree for Tropical Plantation. *Journal of Forest and Environmental Science*, 29(1), 1–14.

International Association of Fire Chiefs, & National Fire Protection Association. (2017). Wildland and Ground Fire. In *Fundamentals of Fire Fighter Skills: Evidence-based Practices* (3rd ed., p. 663). Burlington: Jones & Bartlett Learning.

Jacob J., Thulaseedharan A., R.G., K., Narayanan, C., Mydin, K. K., & Idicula, S. P. (2011). *Biology of Hevea brasiliensis*. New Delhi: MoEF&CC.

Johnson, E. A., & Miyanishi, K. (2007). *Forest Fires: Behavior and Ecological Effects*. San Diego, Academic Press.

Keane, R. E. (2013). Describing Wildland Surface Fuel Loading for Fire Management: A Review of Approaches, Methods And Systems. *International Journal of Wildland Fire*, *22*(1), 51-62.

Keane, R. E. (2015). Basic Terminology. *Wildland Fuel Fundamentals and Applications*. New York: Springer.

Krishnapillay, D. B., & Varmola, M. (2010). Case Study of The Tropical Forest Plantations in Malaysia. *Forest Plantations Thematic Papers. Working Paper (FAO)*.

Kumar, S.A. (2016, April 21). Hutan Simpan Gunung Arong Terbakar Akibat Cuaca Panas. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/146007

Nambiar, E. S. (1999). Productivity and Sustainability of Plantation Forests. *Bosque*, *20*(1), 9-21.

Nieuwstadt, M. G., & Sheil, D. (2005). Drought, Fire and Tree Survival in A Borneo Rain Forest, East Kalimantan, Indonesia. *Journal of Ecology*, 93(1), 191-201.

Nur, A.A. (2017, May 17). Usaha Padam Kebakaran Hutan Diteruskan. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/283574

Omi, P. N. (2005). *Forest Fires a Reference Handbook*. Santa Barbara, ABC-CLIO.

Osman, K. T. (2013). Organic Matter of Forest Soils. In *Forest Soils Properties and Management* (pp. 63-76). New Delhi, India: Springer International Publishing.

Ramli, N.S. (2016, April 12). Pemadaman Kebakaran Hutan Punca Jerebu di Kuantan. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/143118

Rao, B. S. (1972). Chemical defoliation of *Hevea brasiliensis* for avoiding secondary leaf fall. *Journal of the Rubber Research Institute of Malaya*, *23*(3), 248-256.

Rosli, I. (2016, May 1). Bomba Terengganu Bergelut Padam Kebakaran Hutan. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/node/149290

Ruwaida, M.Z. (2017, August 16). Kebakaran di Hutan Simpan Kuala Langat Utara. *Berita Harian Online*. Retrieved from https://www.bharian.com.my/berita/kes/2017/08/313237/kebakaran-hutan-simpan-padam

Spellman, F. R. (2012). *Forest-Based Biomass Energy: Concepts and Applications* (p. 74). Boca Raton: CRC Press.

Telmo, C., & Lousada, J. (2011). The Explained Variation by Lignin and Extractive Contents on Higher Heating Value of Wood. *Biomass and Bioenergy*, 35(5), 1663–1667.

Thomas, P. A., McAlpine, R. S., Hirsch, K., & Hobson, P. (2010). *Fire in the Forest*. Cambridge: Cambridge University Press.

Uthup, T. K., Saha, T., Ravindran, M., & Bini, K. (2013). Impact of An Intragenic Retrotransposon on The Structural Integrity and Evolution of a Major Isoprenoid Biosynthesis Pathway Gene in *Hevea brasiliensis*. *Plant Physiology and Biochemistry*, *73*, 176-188.

Van Wagner, C. E. (1968). The Line Intersect Method in Forest Fuel Sampling. *Forest Science*, *14*(1), 20-26.

Wade, D. (2013). Fuel Moisture and Prescribed Burning. *SFE Fact Sheet*, *5*.

Whiteman, C. D. (2000). Fire Weather and Smoke Management. In *Mountain Meteorology: Fundamentals and Applications* (p. 241). New York: Oxford University Press.

Yatimin, A. (2013, March 31). Bomba Kelantan Berjaya Kawal Kebakaran Tanah Gambut di Bachok. *Utusan Online*. Retrieved from http://ww1.utusan.com.my/utusan/Dalam_Negeri/20130331/dn_27/Bomba-Kelantan-berjaya-kawal-kebakaran-tanah-gambut-di-Bachok

Ye, T., Wang, Y., Guo, Z., & Li, Y. (2017). *Factor Contribution to Fire Occurrence, Size, And Burn Probability in A Subtropical Coniferous Forest in East China*. *PloS one*, *12*(2), e0172110.