



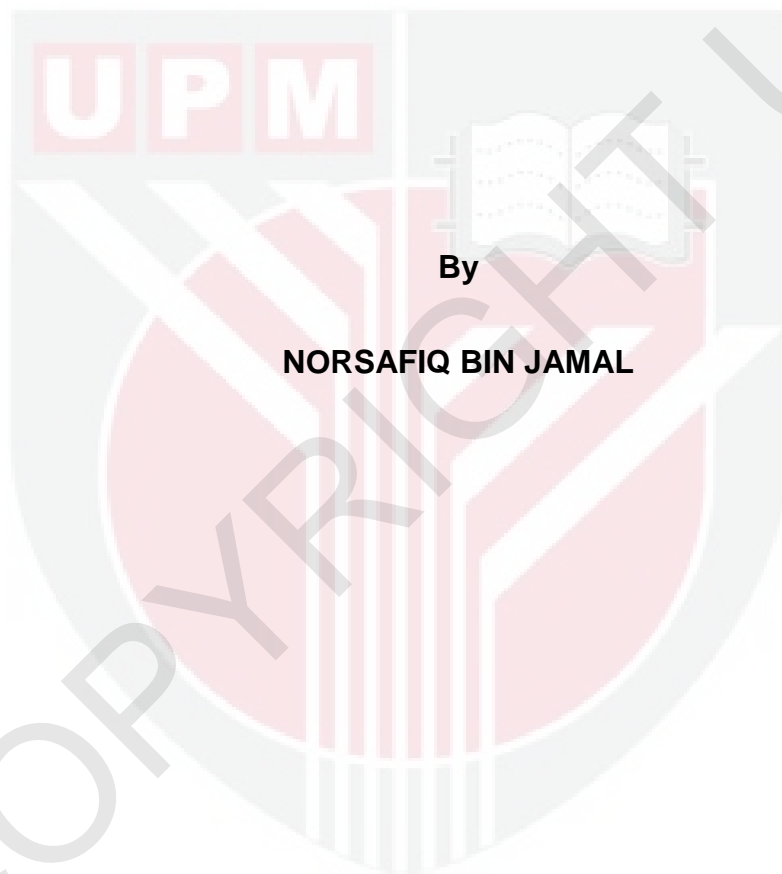
***BULK DENSITY, ORGANIC MATTER AND TEXTURE OF SOIL ON
FOREST ROAD AT SAPULUT, SABAH***

NORSAFIQ BIN JAMAL

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BULK DENSITY, ORGANIC MATTER AND TEXTURE OF SOIL ON

FOREST ROAD AT SAPULUT, SABAH



By

NORSAFIQ BIN JAMAL

**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**

2019

DEDICATION

For my beloved parents:

Jamal Jaeland

Suwati Sugio

Also, my siblings.

To all my best friends,

My team during data collection at Sapulut Forest Reserve.

Thank you for your encouragements and supports

And the sacrifices that you have given.

Thank you for everything. May Allah bless us all.

ABSTRACT

Forest road and trail are needed in order to do forest harvesting operation. Construction and usage of forest road causes increase in soil bulk density. High soil bulk density causes increase in soil compaction. It causes adverse effect on plant growth. Therefore, this study is crucial in order to show the degree of damage done by the current conventional harvesting system. It is important so that it can be revised to reduce damage that otherwise it will inflict to the forest soil. In this study, bulk density, content of organic matter and soil texture of operational forest road soil in Sapulut, Sabah were determined and being compared, that is between primary road, secondary road, and skid road. In this study, it was shown that the soil texture of Sapulut operation area was sandy clay loam while bulk density of soil on forest road ranged from 1.25g/cm³ on skid road to 1.94g/cm³ on primary road. Primary road had the highest soil bulk density compared to secondary road and followed by skid road. However, surprisingly, the data analysis showed that there was different bulk density between the middle of the road and the side of the road. It was shown that the middle of the road had lower bulk density compared to the side of the road which the tire track was always on. Other than that, it was also shown that soil organic matter and organic carbon content was significantly lower on the primary road compared to secondary road and skid road. This shows that the primary road is the most severely degraded followed by secondary road and skid road. This study shows how forest harvesting operation can cause adverse effect to the soil.

ABSTRAK

Jalan hutan dan laluan hutan diperlukan untuk menjalankan operasi penuaian hutan. Pembinaan dan penggunaan jalan hutan menyebabkan ketumpatan pukal tanah semakin meningkat. Ketumpatan tanah yang tinggi menyebabkan tanah menjadi padat. Ia mendatangkan kesan yang buruk kepada kadar pertumbuhan tumbuhan. Oleh itu, kajian ini adalah penting untuk menunjukkan tahap kerosakan yang disebabkan oleh sistem penuaian konvensional supaya dapat dikenal pasti dan disemak semula untuk meminimalkan kerosakan keatas tanah hutan. Dalam kajian ini, ketumpatan pukal, kandungan bahan organik dan tekstur tanah dikawasan operasi di Sapulut, Sabah akan dikenalpasti dan dibandingkan iaitu Kawasan jalan utama, jalan sekunder dan lorong penarik. Dalam kajian ini, menunjukkan bahawa tekstur tanah di kawasan operasi Sapulut adalah berjenis tanah liat berpasir manakala ketumpatan tanah pukal tanah di jalan hutan adalah dari 1.25g/cm³ dan di jalan penarik hingga 1.94g/cm³ di jalan utama. Jalan utama mempunyai ketumpatan pukal tanah tertinggi berbanding jalan sekunder dan jalan penarik. Walaupun bagaimanapun, analisis data menunjukkan bahawa terdapat ketumpatan pukal yang berbeza antara tengah jalan dan sisi jalan. Selain itu, ia menunjukkan bahawa bahan organik tanah dan kandungan karbon organik adalah lebih rendah di jalan utama berbanding jalan sekunder dan jalan penarik. Ini menunjukkan kesan operasi perhutanan menyebabkan kerosakan yang ketara pada tanah.

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APPROVAL SHEET

I certify that this research project report entitled “Bulk Density, Organic Matter and Texture of Soil on Forest Road at Sapulut, Sabah” by Norsafiq Bin Jamal 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.

Assoc. Prof. Dr. Seca Gandaseca
Faculty of Forestry
Universiti Putra Malaysia
(Supervisor)

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

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
Km	Kilometre
FR	Forest reserve
OM	Organic matter
TOC	Total organic carbon
USDA	United States Department of Agriculture
SPSS	Statistical Package for the Social Science



CHAPTER 1

INTRODUCTION

1.1 Background of Study

Forest road is a track in the forest in which its intended use is to carry motorised vehicles being used mainly for forestry purposes (Sessions, 2006). As an example, harvesting purposes, management purposes or even conservation purposes.

The most commonly used forest harvesting system that is considered conventional in Malaysia, is the system that used crawler tractor to make a skid trail that is then used to winch log out of the forest to the feeder road.

This conventional method setup requires the construction of a complex road or trail and a few structures to support the harvesting process. The type of road that is usually constructed mainly of primary road, secondary road, feeder road and skid trail.

Construction of roads causes an increase in the bulk density of a soil, as said on an article by Soil Quality Organisation of Australia, as soil bulk density reflects its ability to function physical support for structure. As some of us might not be familiar with the term soil bulk density, it can be explained as the calculated weight of dry soil per unit volume (Andrew & Wander, 2011). It is

typically expressed as g/cm^3 . This includes the volume of pores in-between the soil particles and the volume of soil itself.

High bulk density is the indicator of high soil compaction and low soil porosity. This, causes restriction in air and water movement through the soil and causes restriction of root growth. This leads to the reduce in vegetative covers available to protect soil from erosion (Andrew & Wander, 2011).

This in effect causes a cutback in the infiltration of water into the soil. This leads to increase in water runoff which erodes sloping land into waterlogged soils in flatter area. Generally speaking, increase in bulk density restricts water and air movement through the soil and causes adverse effect in plants and the environment. Other method to reduce overall area soil bulk density increase, is with the use of log-fisher which eliminate the needs to build a complex roadwork design as in the one used on commercial harvesting system. This cutback the damage done to the forest floor up to only 10%-15% compared to 60%-80% damage using the conventional method (Yusof, 2018).

1.2 Problem Statement

Forest road and trail is needed in order to do forest harvesting operation (Sessions, 2006). The construction and usage of said forest road causes increase in soil bulk density. High soil bulk density causes increase in soil compaction. It causes adverse effect on plant growth.

Plant growth is very crucial for the success of forest harvesting planning in Malaysia. By causing soil compaction on forest soil, plant growth may be stunted, or worse plant may not grow at all (Kozlowski, 1998).

There are many studies done on soil bulk density effect on plant growth. However, almost all of them are focused in agriculture aspect. There is little study were done regarding soil bulk density effect on the growth of forest plant (Allison, 2006).

Especially in Malaysia, based on my experience, it is very hard to source for previous study on soil bulk density of forest road. Publics are aware that forest harvesting operation causes heavy soil compaction on forest land area. However, it is very difficult to see a report or even study that shows numbers that can reflect the degree of its impact on the forest soil.

Sustainable management system (SMS) of forest in Malaysia currently shows that the growth of tree with crop rotation even after 30 years does not meet the

previous expectation (Zaki, 2017). This may be the effect of high soil bulk density on forest trees, but no study was done to show that.

Therefore, this study is crucial in order to show the degree of damage done by the current conventional harvesting system so that it can be revised to reduce damage that otherwise it will inflict to the forest soil.

1.3 Objectives

The aim of this study is to gain information on the status of soil in forest with operating harvesting process. The specific objectives are:

- i. To determine and compare soil bulk density on three different type of forest roads.
- ii. To determine and compare soil organic matter content and organic carbon between the different type of forest road.
- iii. To determine and compare soil texture between the different types of forest road.

1.4 Hypothesis

Hypothesis for this study was that the bulk density is greater in primary road followed by secondary road, then skid road. Other than that, the number of traffic passing the forest road will affect the soil bulk density on the road. As for the organic matter and organic carbon, it will be higher in forest road with less traffic.

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