



***CARBON DIOXIDE EMISSION ON BURNT PEAT SWAMP FOREST IN  
RAJA MUSA FOREST RESERVE, SELANGOR***

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By

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for the Degree of Bachelor of Forestry Science in the  
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## **DEDICATION**

**With lovely and specially dedicated to my beloved family**

**Asari, Sarbanum, Amir**

**A lot thanks to**

**My supervisor and all of my friends**

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

**May Allah bless you all**

**Thank you**

## ABSTRACT

Peatlands area was known as one of the largest carbon pools. However, burnt in peatlands area caused emission of carbon dioxide which leads to global warming. Environmental factors such as soil temperature and soil humidity affect the carbon dioxide emission. This study was carried out to investigate the trend of carbon dioxide emission on burnt peat swamp, located at Raja Musa Forest Reserve. This area had experienced forest fire since 1996. Soil CO<sub>2</sub> emission was measured using Li-COR 8100 Automated Soil CO<sub>2</sub> Flux System. Based on the measurements, emission rates were ranged from 2.13 to 8.50  $\mu\text{mol m}^{-2} \text{s}^{-1}$  for three months from August until October. Correlation analysis between soil CO<sub>2</sub> emission with environmental factors showed that soil CO<sub>2</sub> emission was significantly correlated with soil temperature, soil humidity and peat water level. This study shows that environmental factors significantly affect the increased in soil CO<sub>2</sub> emission.

## ABSTRAK

Tanah gambut dikenali sebagai salah satu tempat menyimpan karbon yang terbesar. Walaubagaimanapun, kebakaran di kawasan tanah gambut menyebabkan pembebasan karbon dioksida yang mengakibatkan pemanasan global. Faktor persekitaran seperti suhu tanah dan kelembapan tanah mempengaruhi pengeluaran karbon dioksida. Kajian ini telah dijalankan untuk menyiasat arah aliran pelepasan karbon dioksida di kawasan tanah gambut yang terbakar, di Hutan Simpan Raja Musa. Kawasan ini telah mengalami kebakaran sejak tahun 1996. Pelepasan karbon dioksida diukur menggunakan mesin Li-COR 8100 Automated Soil CO<sub>2</sub> System Flux. Berdasarkan ukuran, purata kadar pelepasan karbon dioksida adalah 2.13 hingga 8.50  $\mu\text{mol m}^{-2} \text{s}^{-1}$  bagi tempoh tiga bulan iaitu dari bulan Ogos hingga Oktober. Analisis korelasi pekali antara pembebasan karbon dioksida dengan faktor persekitaran menunjukkan bahawa pembebasan karbon dioksida mempunyai hubungan yang signifikan dengan suhu tanah, kelembapan tanah dan paras air. Kajian ini menunjukkan bahawa faktor persekitaran ketara memberi kesan kepada peningkatan dalam pelepasan karbon dioksida.

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## APPROVAL SHEET

I certify that this research project report entitled “Carbon dioxide emission on burnt peat swamp forest in Raja Musa Forest Reserve, Selangor” by Nur Haifaa’ Izwa Binti Asari 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, University Putra Malaysia.

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## LIST OF ABBREVIATION

A.M	ante meridiem (before noon)
BD	Bulk density
C	Carbon
CDC	Closed Dynamic Chamber
CO <sub>2</sub>	Carbon dioxide
FAO	Food and Agriculture Organization
m	meter
NSPSF	North Selangor Peat Swamp Forest
P.M	post meridiem (after noon)
PVC	Polyvinyl chloride
RMFR	Raja Musa Forest Reserve
SOC	Soil organic carbon
TOC	Total organic carbon
%	Percentage
°C	Celcius
$\mu \text{ mol m}^{-2}\text{s}^{-1}$	Micromoles per square meter per second

# CHAPTER ONE

## INTRODUCTION

### 1.1 General Background

Tropical peat swamp forest is known as one of the edaphic forests in Malaysia. Peat swamp forest can be found at lowland area, especially below 30 m. Peat swamp forest is the areas under waterlogged that prevent accumulate organic materials from decomposing. Carbon is stored in peatlands. How peat deposit formed? According to Andriesse (1988), peatlands deposit formed when organic materials accumulate and the production of biomass is faster than its chemical breakdown that helps in carbon store. Southeast Asia is known as a global centre of biodiversity as it contains many endemic species and ecosystem including peat swamp area. Maltby & Immirzi (1993) states that the peat swamp forests only cover a small area of the earth, but it can store up to 525 Gt of carbon. More than 50% of peatlands are found in Indonesia and Malaysia (Page *et al.*, 2011). Over past 50 years, most of the peatland forests in Peninsular Malaysia have been degraded.

It important in regulate and controlling function on the hydrology of that area. It can act as natural filters in catchments and help in control the flooding (Ellison, 2008). Besides, it also can absorb elements and compounds which have been released in toxic amounts into the environment. Next, peat swamps also important in carbon reservoir especially the deep peat. How peat swamp store high amount of carbon? Firstly, understanding about carbon cycle is important

because there are source and sink element. Carbon is being circulated back and forth between environment and living organism (Figure 1.1). Carbon dioxide is being produced by respiration of living things, decomposition and combustion. Carbon dioxide is absorbed by plant or vegetation and changes it to carbohydrate by processes of photosynthesis.

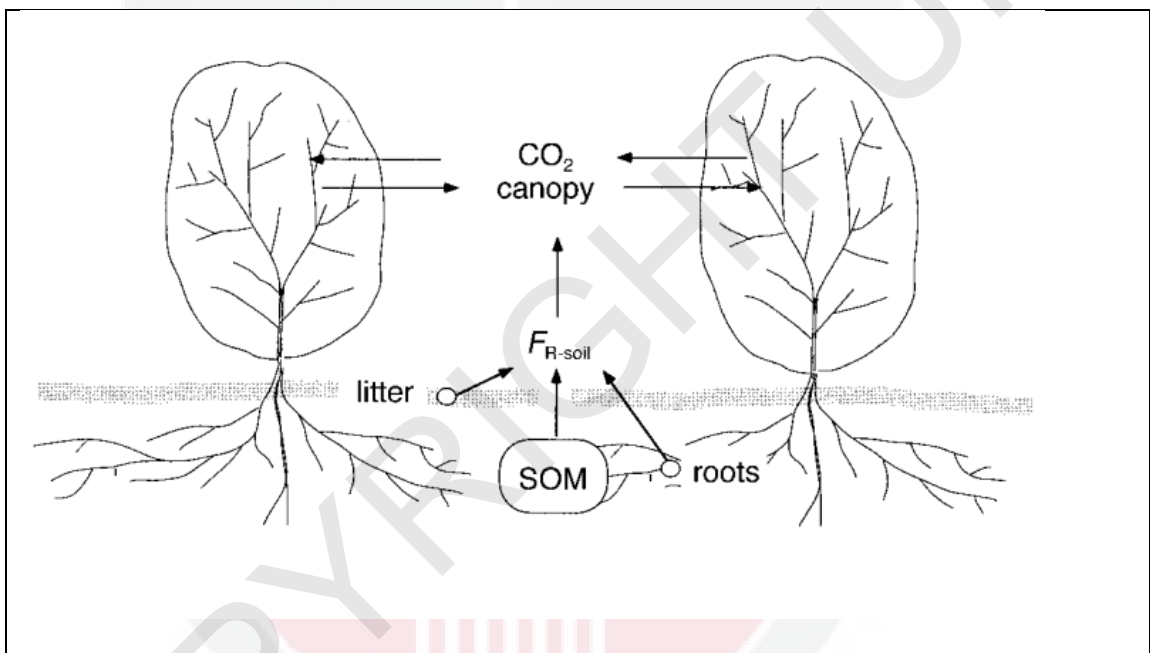


Figure 1.1: Various sources for carbon dioxide within a forest ecosystem (Source: Ehleringer *et al.*, 2000)

The main component for photosynthesis is carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O). Carbon dioxide comes from the surrounding atmosphere from many sources and uptake of water from soil via root and being converted into carbohydrate and oxygen. Carbohydrates will be used by the plant for growth, assimilation, storage and respiration. In respiration, oxygen will be turning back to CO<sub>2</sub>. Litter that being produced are decomposed by microorganism and CO<sub>2</sub> will be released. In peat swamp area, biomass of plant will be

accumulated in large water saturated which result in slow down the organic matter decay. This cause peat swamp acts as carbon sequestration.

According to previous study, 46% of plant biomass contains carbon. However, peatland area becomes vulnerable due to anthropogenic activity. Nowadays, peatland area being cleared for agricultural sector but there is a need to do the cleaning and being drained before agricultural sector used the area, this will lead to decomposition of the peat (Couwenberg, 2011). Peat will become high flammable when peat is drained.

Various studies have been conducted due to the understanding the main contribution to climate change is soil respiration. Ecosystem and distribution type of vegetation influenced the soil respiration and vary.

## **1.2 Problem Statement**

Carbon dioxide emission is the major cause of global warming. Solomon *et al.* (2009) reported that levels of global carbon dioxide emissions tend to increase by year. There are many factors that lead to an increase in carbon dioxide emission such as flaring of unused gas during oil production, increase in oil consumption, cement production and with no exception is a human activity (deforestation). Kyoto protocol is one of the initiatives that being made to decrease the annual carbon dioxide emission. This initiative shows that nowadays most people tend to realize the importance to decrease carbon dioxide emission. One of the ways to mitigate climate change is by enhancing

the metabolism of tropical biotas such as doing the tree planting (Myers & Goreau, 1991). Carbon dioxide emission on soil is greater than at the atmosphere (Pacala *et al.*, 2001). To investigate the major source of carbon dioxide, much attention needs to be on soil carbon dioxide emission.

Peat swamp forest is a unique ecosystem, even though it only covers a small area of the earth but it can store large carbon (Maltby & Immirzi, 1993; Rieley & Setiadi, 1997). Peat swamp can store carbon more because the areas under waterlogged prevent the further decomposition of organic material. It can be a strong indicator for biological activity which reflects the condition of an ecosystem whether that area store or release more carbon. As we know the importance of soil respiration, there is a need to understanding the contributing factors to soil carbon dioxide emission.

Tropic cover 1/3 of the global land area and have a high diversity of biome and also high rates of soil respiration. However, only a few measurements had only been conducted in this area and also but ecosystem at temperate already being present well (Andriesse, 1988). According to Mande *et al.* (2015), environmental factors (abiotic and biotic) factors are important in controlling carbon dioxide emission in the forest. Abiotic and biotic factor such as temperature, relative humidity, type and number of microorganism and others play a crucial role during soil respiration. As a result from this finding, there is a need to quantify the changing in the soil respiration in a peat swamp forest.

Different biomes and vegetation will affect the soil carbon dioxide emission by changing the soil climate and soil carbon dioxide emission (Akburak & Makineci, 2013). Peat swamp known as carbon sequestration but changing in peat swamp forests such as conversion of land, drainage or forest fire will affect the carbon dioxide emission (Syaufina *et al.*, 2004). Changing in the land will give impact on carbon dioxide emission because of changing in vegetation. The research on stand structure after the forest fire in RMFR that being done by Ainuddin & Goh (2010) describes that in RMFR on burnt area only has 10 families while on the unburnt area has 22 families means that most of the tree had been burnt during the forest fire event. This will contribute to CO<sub>2</sub> emission and drain in peatlands.

Therefore, it is important to understand the condition of carbon balance in that ecosystem through soil respiration. Some of the findings conclude that the net emission can be approximated as the balance between photosynthesis and respiration. Hence, this study is conducted because there is a need to understand the influence of changes in soil respiration and environmental factor to the soil respiration after burning.



### 1.3 Objectives

This study aims to:

- i) To analyse the hourly- and weekly trend of carbon dioxide emission on burnt area.
- ii) To determine the relationship between environmental factors and the rate of carbon dioxide emission on burnt area.



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