DIVERSITY OF WEED FLORA FROM DIFFERENT LAND PREPARATIONS FROM OIL PALM PLANTATION

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DIVERSITY OF WEED FLORA FROM DIFFERENT LAND PREPARATIONS FOR OIL PALM PLANTATION

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DECLARATION

I hereby declare that this Final Year Project report 2012 is based on my original work except for the quotations and citations which have been dully acknowledged also, declare that it has not been or concurrently submitted for any other degree at UNIMAS or other institutions of higher learning.

_____________________________________
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Species Diversity and Relative Abundance

\( \text{Ln} \)  
Natural log

\( p \)  
species relative abundance

\(-p \ln p\)  
Shannon Diversity Index

Species Richness and Species Evenness

\( E \)  
Eveness

\( H' \)  
Species diversity

\( S \)  
Total number of species

\( J' \)  
Eveness Index

Species Dominance

\( D \)  
Absolute Density

\( \text{Rd} \)  
Relative Density

\( F \)  
Absolute Frequency

\( \text{Rf} \)  
Relative Frequency

\( IV \)  
Important Value

\( SDR \)  
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Diversity of Weed Flora from Different Land Preparations of Oil Palm Plantation

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ABSTRACT

Weeds have brought many problems in oil palm plantation. Applied method of land preparation for oil palm plantation involved burning and zero burning. The study in this project is mainly i) to determine the diversity of weed flora, ii) to estimate total biomass and carbon stock content of weed flora in different land preparation; burned, natural burned and unburned peatland for oil palm plantation FELCRA oil palm plantation in Melur Gemilang, Gedong, Kota Samarahan. Species diversity is determined by using Shannon-Weiner Diversity Index ($H'$), Species Evenness ($J'$), Summed Dominance Ratio (SDR) and the estimation of carbon stocks is calculated by using method by Pearson. Fifty quadrats of 1m x 1m were established in each study area within March and April 2012. There were total of 48 species found belongs to 39 genera and 27 families. The species diversity in natural burned land, $H' = 1.57$ is the highest compare to unburned land ($H' = 0.65$) and burned land ($H' = 0.93$). Stenochlaena palustris is the most even species, $J' = 0.039$ in unburned land. The dominant species determined in these three sites are Nephrolepis biserrata, SDR=60.58% in burned land, SDR=46.28% in natural burned land SDR=62.44% in unburned land. Carbon stock estimation in each sites are 212.16 kg C ha$^{-1}$ in burned land, 429.95 kg C ha$^{-1}$ in natural burned land and the highest in 456.541 kg C ha$^{-1}$ in unburned land. Total carbon stock produced in peatland studied was 1098.66 kg C ha$^{-1}$ (1.01 tonne C ha$^{-1}$).

Key Words: Burned land, natural burned land, unburned land, species diversity, carbon stock

ABSTRAK

Rumpai telah membawa banyak masalah dalam penanaman kelapa sawit. Cara penyediaan tanah yang digunakan termasuklah kaedah pembakaran dan tanpa pembakaran. Kajian ini bertujuan untuk 1) menentukan kepelbagaian rumpai, 2) menentukan kadar biomass dan stok karbon di kawasan melibatkan kawasan dibakar, terbakar dan tidak dibakar di ladang kelapa sawit FELCRA, Melur Gemilang, Gedong, Kota Samarahan. Dalam kajian ini, kepelbagaian spesies dikira menggunakan Shannon-Weiner Index ($H'$), Species Evenness ($J'$) and Summed Dominance Ratio (SDR). Manakala stok karbon ditentukan menggunakan kaedah Pearson. 50 kuadrat seluas 1m x 1m diambil di setiap kawasan pada Mac dan April 2012. Melalui kajian, terdapat 48 spesies ditemui tergolong dalam 39 genera dan 27 famili. Kawasan terbakar mempunyai kepelbagaian spesies yang paling tinggi, $H' = 1.57$, diikuti dengan kawasan tidak dibakar ($H' = 0.65$) dan dibakar ($H' = 0.93$). Stenochlaena palustris mempunyai nilai spesies evenness paling tinggi, $J' = 0.039$. Spesies yang paling dominan adalah Nephrolepis biserrata, SDR=60.58%, SDR=46.28%, SDR=62.44% di setiap kawasan dibakar, terbakar dan tidak dibakar. Stok karbon yang dianggarkan di setiap kawasan adalah 212.16 kg C ha$^{-1}$ di kawasan dibakar, 429.95 kg C ha$^{-1}$ di kawasan terbakar dan paling tinggi di kawasan tidak dibakar, 456.541 kg C ha$^{-1}$ Jumlah kasar stok karbon di kawasan kajian adalah was 1098.66 kg C ha$^{-1}$ (1.01 tonne C ha$^{-1}$).

Kata Kunci: Kawasan dibakar, kawasan terbakar, kawasan tidak dibakar, kepelbagaian spesies, stok karbon
1.0 INTRODUCTION

1.1 Background of Study

Worldwide, there are approximately 25 million ha of peat land is used for oil palm plantation in growing countries. Some of this land is considered suitable for oil palm development due to its rather homogeneous soil features, its constant availability of water, and its flatness – all in support of uniform yield characteristics in oil palm (Mutert et al., 1999).

The land preparation is frequently overlooked by weed scientists and some others as a means of weed control, although it is recognized that the most important effects on weed growth in rice come from puddling and good water control. The process of puddling results in fewer weeds species, fewer weeds and a higher proportion of broadleaf weeds in the weed flora than under dryland conditions (Moody, 1984).

In Malaysia, the practice of land clearing in oil palm by the clean burn method has been largely replaced by the no-burn regime since 1993. The idea was initiated back in 1989, when large plantation houses of Malaysia began developing the zero burning (ZB) technology because of their own environmental concerns. They had come to realize that apart from preserving the environment, no-burn land clearing adds benefit through nutrient recycling, soil improvement, faster plantation establishment and cheaper private cost (Mohd Hashim et al., 1993).

Zero burning technique is strongly recommended, while burning method is classified as illegal action. Zero burning technique is important to maintain soil biodiversity, to prevent weed succession, and to prevent air pollution. With zero burning technique, felled material is stacked on row between planting rows. This is followed by the establishment of legume cover crop (LCC). Some LCC had been widely known in oil palm
plantation which recently also known as new and potential LCC for peat land. LCC plays important role in maintaining soil moisture and controlling pest and weeds (Rahutomo et al., 2009).

The majority of the world’s tropical peatlands (11 million hectares) are found in South-East Asia, mainly in coastal regions. Many of these coastal regions are identified as areas suitable for agricultural development which includes oil palm, sago and forest plantations, aquaculture, paddy and miscellaneous crops such as pineapple and vegetables. At the same time these coastal peatlands have global ecological significance, being some of the largest remaining areas of lowland rainforest in SE Asia that provide habitats for many endangered species (Diemont et al., 2002).

In addition, Diemont et al., (2002) stated that they are large stores of carbon and water and also play an important regional economic role in providing forest products and land for settlement. However due to lack of awareness and understanding of sustainable land management practices, many peatland development projects fail, resulting in serious environmental degradation and impoverishment of local communities.
1.2 Problem Statement

Diversity of weed flora can be varied in different location of peatland. Asyraf & Mansur (2002) stated that the intrusion of weedy and exotic species into disturbed and undisturbed peat swamp forests can cause major ecological successional problems that need proper attention. Their study on the diversity and ecology of weeds of peat swamp in Peninsular Malaysia showed that agricultural areas on reclaimed peat swamps have the highest diversity and composition of weedy species compared to other types of peatland forests.

The emergence of weed species may be different between burned and unburned peatland area. In agricultural land, weeds appear to be those plants that occupy the earliest of secondary succession after cultural means such as tillage or hoeing, or by use of herbicides or fire (Radosevich & Holt, 1984).

Herbicides application for weeds management greatly influences cost of plantation management. Rosli (2010) reported that in Malaysia, over 75% of the weed management involves the usage of herbicides for controlling weeds. Weeds are able to decrease land value and reduced crop choice. According to Zimdhal (1999), perennial weeds (field bindweed, johnsongrass, or quackgrass) or the annual parasitic weed dodder can decrease the value of land in which weedy land labeled a loss of productive potential.

Peatland ecosystems (including peat and vegetation) contain disproportionately more organic carbon than other terrestrial ecosystems. While covering only 3% of the world’s land area, peatlands contain 550 Gigatons (Gt) of carbon in their peat. This is equivalent to 30% of all soil carbon, 75% of all atmospheric carbon, as much carbon as all terrestrial biomass, and twice the carbon stock of all forest biomass of the world (Joosten & Couwenberg, 2007).
1.2 Objectives

Thus, knowledge of the weed flora in peatland oil palm plantation is fundamental for weed management. In the mean time, estimation of carbon stock produced in land establishment process assessment is also important. These are priorities for both weed management and research. Hence, the objectives of this study are:

i) To determine the diversity of weed flora from different land preparation in burned and unburned peatland for oil palm plantation.

ii) To estimate total biomass and carbon stock content of weed flora from different land preparation in burned and unburned peatland for oil palm plantation.
2.0 LITERATURE REVIEW

2.1 Weeds and Plantation Site Establishment

Site preparation is done to prepare the soil to receive seed or seedlings, reduce fire hazard, and or control pest and diseases. Preparation may include salvage logging, clearing, burning or breaking up slash or windfall. Removing competing vegetation or exposing mineral soil creates a favorable seedbed. Fortunately, even low intensity burns will leave partially prepared seedbeds by decreasing or removing duff layers and competing vegetation and exposing mineral soil (Barkley, 2011).

According to Tamado and Milberg (2000), the presence of each weed population in an arable field is the result of ecological reactions to previous management practices, soil characteristics of the site and the regional climate. Weed populations also reflect the effects of local weather conditions on recruitment, survival and competitive ability (Milberg et al., 2000). Cultural, chemical and biological weed control activities can also exert a strong selective influence on the weed populations (Chancellor, 1985).

Teoh et al. (1999) study stated that zero burning technique is used in land preparation for replanting oil palm is much environmentally safer. According to the ASEAN Guidelines (2003), in oil palm plantation, zero burning can be a mean as land preparation for replanting or planting oil palm in peatland. The methods used including machinery by using bulldozers and excavator, felling and shredding, stacking and withdrawing followed by planting oil palm.
2.2 Weeds Diversity in Oil Palm Plantation in Peatland Area

There are many weeds able to invade plantation areas. *I. cylindrica, P. polystachion, R. cochinenis, Mikania micrantha, A. gangetica, E. indica,* and *I. rogosum* are among the highly invasive species which are common sights in many young oil palm, rubber, cocoa, and sugar cane plantations, exposed areas along road sides, railway tracks, and other areas within the fringes of plantations (Bakar, 2004).

Malaysia has found that agricultural areas on reclaimed peat swamps have the highest diversity and composition of weedy species compared to other types of peatland forests. A total of 54 families comprising of 97 genera and 132 species have been recorded from ten peat swamps and ten freshwater swamps. Broad-leaved weeds are the most dominant type of weedy species recorded with 33 families 54 genera and 69 species. *Clidermia hirta* and *Melastoma malabathricum* (Melastomataceae) are the dominant species in term of their presence at all study sites (Asyraf & Mansur, 2002).

The diversity of weed species may be different in unburned area and burned area. According to study by Mojiol *et al.* (2010), the result of study shows that 11 species have been found in burned area while 10 species at unburned area. Medicinal plant species commonly found are *Stenochlaena palustris, Melastoma malabathricum, Lygodium flexuosum,* and *Clidemia hirta.* Simpson’s Index is higher with 0.55 in burned area compared in unburned area with only 0.14. Where when the value of Index increases, the diversity will decrease and this proved that diversity of medicinal plants in unburned area was slightly higher than the burned area. This situation might be caused by the previous land clearing due to burning and small scales landuses activities of the land.
2.3 Weeds and Fire

According to Moench and Fusaro (2008), weeds are among the first plants to recolonize after a fire. In many instances they are not a problem. However, if the weeds are listed as noxious, they must be controlled. Noxious weeds displace native plants and decrease wildlife habitat, plant productivity, and diversity. They can spread own-stream or into agricultural areas, resulting in high control costs.

Burning encourages dominance by plants with fire resistant features such as rhizomes, thick bark and the ability to regrow from the base of the plant. The predominance of *Imperata cylindrica* and *Lantana camara* as the two most serious weeds of tropical pastures is largely due to their ability to thrive in a fire subclimax. Annual low intensity fires are most damaging to the pastures system than occasional much hotter fires, since they allow the taller trees and shrubs to survive and discourage the survival of annual grasses and herbs (Swarbick & Kent, 1984).

Prescribed burning can play a role in the management of The Conservation Reserve Program (CRP) acres, both pre- and post-seeding. Weed seed, especially grass weeds such as downy brome, can be reduced by burning before seed droppage. However, although fire alone will not constitute adequate weed control, it could be used in conjunction with other measures. Prescribed burning also can be used to reduce troublesome weed residues before seeding. In general, the use of fire should be viewed as only one of several tools and should be considered in conjunction with herbicides, tillage, and seeded cover crops (Klein *et al.*, 2008)
2.4 Plant Biomass and Carbon Sequestration of Peatland

Carbon exists in every living thing on the earth where the carbon being sequestered and emitted back into the atmosphere. Land use project can decrease the emission of CO$_2$ to the atmosphere by being sequestered and emitted back into vegetation and the soil beneath vegetation. There were some activities that can reduce CO$_2$ emission such as preventing deforestation, reducing the impact of logging, and preventing the drainage of wetlands and peat lands. Besides that, planting a tree, changing agricultural tillage of cropping practices and re-establishing the grasslands help in sequester the carbon (Pearson et al., 2005). In addition, peatland fire plays very important role in global carbon balance in the atmosphere (Syaufina, 2011).

During the clearing of mineral soil, C loss mainly associates with plant biomass and necromass burning and or decompositions. On peatland, burning (if applicable) affects the aboveground biomass as well as the abundant organic matter of peat soil (Agus et al., 2009).

Davidson & Ackerman (1991) stated that world soils play role as an important reservoirs of active C and play a major role in the global carbon cycle. As such, soil can be either a source or sink for atmospheric CO2 depending on land use and the management of soil and vegetation. The conversion of native ecosystems (e.g. forests, grasslands and wetlands) to agricultural uses, and the continuous harvesting of plant materials, has led to significant losses of plant biomass and C, thereby increasing the CO2 level in the atmosphere.

Rouw (2005) study in Roder & Maniphone (1998) state that depending on the type of fallow vegetation, estimates of biomass at the time of clearing range from four to twenty tonnes/hectare (t/ha) dry weight. In addition, burning in shifting cultivation destroys a
proportion of weed seeds, permitting farmers to begin cropping with a comparatively weed-free seedbed. It has been demonstrated that the burning of 2.3 t/ha of dry weight reduces weed biomass in the rice crop by 14-60%. Moreover, grain yields are improved by 3-78% when compared to not burning and leaving all the debris on the soil surface to decay. Farmers are therefore likely to continue burning even when very little biomass is available.
3.0 MATERIALS & METHODS

3.1 Study Area

The study area selected was at Melur Gemilang oil palm plantation in Gedong, Kota Samarahan. There were three areas studied which comprised of burned land, natural burned land and unburned land. The oil palm vegetation area’s age was about one year. Burned land was land that caused by prescribed fire whereas natural burned land was land that burned because of accident fire (wildfire).

3.2 Samples Collection

The sampling was conducted by using the list or census count quadrate method (Kim & Moody, 1983). The sampling was carried out in March 2012 and April 2012. Fifty quadrats of 1m × 1m were established in each respective month. All plots within the quadrats collected, identified, counted and recorded for the evaluation of species diversity and their dominance status. A special table was prepared to organized species in each quadrate (Appendix 9).

For the biomass and carbon stocks analysis, weeds within quadrats were cut above ground level within 1m x 1 m quadrat. Pearson (2005) stated that the biomass for herbaceous plant is measured by simple harvesting technique. Quadrat of 1m x 1m will be used usually for shrubs and other herbaceous plant.

Species in each site were collected, analyzed and compared to obtain result. The differences result used to evaluate diversity value and carbon stock. The samples collection was done regardless of common species or rare species in all sites.
3.3 Data Collection & Analysis

Species identification of unknown species was done by referring experts, books and reliable resources from the internet. Books referred include *Common Weeds in Malaysia and Their Control* (Barnes & Chan, 1990) and *Weeds of Rice in Indonesia* (Soerjani et al., 1987).

3.3.1 Species Diversity

a. Species Richness

The diversity of weeds was calculated by using Shannon-Weiner Diversity Index (Shannon, 1948) to compare the diversity of weeds in different habitat. Shannon Diversity Index formula:

\[ H' = - \sum_{i=1}^{S} p_i \ln p_i \]

Where,

- \( S \) = the number of species
- \( P_i \) = the relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individual in the community: \( \frac{n_i}{N} \)
- \( n_i \) = the number of individual in species \( i \)
- \( N \) = the total number of all individuals

(Shannon-Weiner Diversity Index, 1948)
b. Species Dominance

All weeds taken from sampling area were counted and recorded. After that, species dominance was determined by using Kim & Moody (1983) method. Dominance species was calculated in term of Summed Dominance Ratio (SDR) as shown below:

Absolute Density (D) = the total number of plant for given species in all quadrates

Relatives Density (Rd)  = \frac{\text{Absolute Density (D)}}{\text{Total number of plants for all species}}

Absolute Frequency (F) = \frac{\text{The number of quadrates in which given species occurs}}{\text{Total number of quadrates used}}

Relative Frequency (Rf) = \frac{\text{Absolute frequency of a species (F)}}{\text{Total of the absolute frequency for all species}}

Important Value (I.V) = \text{Relative density (Rd) + Relative Frequency (Rf)}

Summed Dominance Ratio (SDR) = \frac{\text{Important Value (I.V)}}{2}

(Kim & Moody, 1983)
c. **Species Evenness**

From the samples collected, species evenness was calculated by using Shannon-Weiner Index (Shannon, 1948). The calculation measure of how similar the abundances of different species are. When there are similar proportions of all subspecies then evenness is one, but when the abundances are very dissimilar (some rare and some common species) then value increases. The formula is as follows:

\[
E = \frac{H'}{\ln S}
\]

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<thead>
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<tr>
<td>H'</td>
<td>=</td>
<td>Species Diversity</td>
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<tr>
<td>S</td>
<td>=</td>
<td>Total number of species</td>
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(Shannon-Wiener Evenness, 1948)