SOIL CHARGE CHARACTERISTICS AND SESQUIOXIDE PROPERTIES IN DIFFERENT LAND USES IN UNIVERSITI PUTRA MALAYSIA BINTULU CAMPUS, SARAWAK

SITI ZUBAIDAH BINTI JAMALUDDIN

FH 2018 44

SOIL CHARGE CHARACTERISTICS AND SESQUIOXIDE PROPERTIES IN DIFFERENT LAND USES IN UNIVERSITI PUTRA MALAYSIA BINTULU CAMPUS, SARAWAK.

By

SITI ZUBAIDAH BINTI JAMALUDDIN

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

This thesis were dedicated for my beloved parents;

Jamaluddin Abd Aziz and Siti Khalimah Jamil and also

for my lovely siblings

Siti Mardhiah, Abdul Khaliq and Abdul Khaidir

as my final year project for my bachelor.

This thesis also were dedicated to my fellow friends as a guidance for basic information of soil science.

ABSTRACT

A research was conducted to determine the sesquioxide properties and charge characteristics in secondary forest and agriculture land (oil palm and rubber plantation) of Universiti Putra Malaysia (UPM), Bintulu Campus Sarawak. Six subplots were established in a 20 m x 20 m plot and soil sampling of different depth were carried out for topsoil (0 cm – 15 cm) and subsoil (15 cm – 30 cm). The charge characteristics of the three different soils were determined by the Point of Zero Charge Effect (PZSE). The soil samples were prepared for seven sets of different HCl concentration. The pH value before and after NaCl were added was recorded. The sesquioxide properties in the soil were extracted using method dithionate and oxalate extractable Al and Fe. The concentration of Al and Fe were determined by using atomic absorption spectroscopy (AAS). For charge characteristics, the result shows that there were significant difference value among the sites with the highest mean of 3.193 ± 0.234 in secondary forest. This was because, the soil in secondary forest development activity was higher compared to oil palm and rubber plantation due to the richness of organic matter in the topsoil. The sesquioxides properties results showed that there were no significant difference between the three different land uses that indicated that these lands received same amount of organic matter . Small difference in Al and Fe value indicates that the soil experienced desilication due to weathering and leaching in all land used. Overall, secondary forest has lower rate of weathering compared to oil palm and rubber plantation due to the higher PZSE value in that site. But in sesquioxide properties, there were not much difference in the three sites which means that desilication in soil because of weathering and leaching process were similar for the three sites.

ABSTRAK

Satu kajian telah dijalankan untuk menentukan ciri-ciri sesquioxide dan ciri-ciri caj di hutan sekunder dan tanah pertanian (ladang kelapa sawit dan getah) Universiti Putra Malaysia (UPM), Kampus Bintulu Sarawak. Enam subplot ditubuhkan dalam plot 20m x 20m dan sampel tanah kedalaman yang berbeza dilakukan untuk lapisan atas (0cm - 15cm) dan lapisan bawah (15cm - 30cm). Ciri-ciri caj bagi tiga tanah berbeza ditentukan oleh Point of Zero Salt Effect (PZSE). Sampel tanah untuk tujuh set kepekatan HCl yang berlainan disediakan. Nilai pH sebelum dan selepas NaCl ditambah telah direkodkan. Sifat sesquioxide di dalam tanah telah diekstrak menggunakan kaedah ekstrak *dithionate* dan *oxalate* bagi Al dan Fe. Kepekatan Al dan Fe ditentukan dengan menggunakan mesin spektroskopi penyerapan atom (AAS). Bagi ciri-ciri caj, hasil menunjukkan terdapat perbezaan nilai yang signifikan di antara tapak dengan purata tertinggi iaitu 3.193 ± 0.234 di hutan sekunder. Ini kerana, tanah dalam hutan sekunder mengalami aktiviti pembangunan lebih tinggi berbanding ladang kelapa sawit dan getah kerana kekayaan bahan organik di atas tanah. Hasil sifat sesquioxides menunjukkan bahawa tidak terdapat perbezaan yang ketara antara tiga penggunaan tanah yang berbeza menunjukkan bahawa tanah-tanah ini menerima jumlah bahan organic yang sama. Perbezaan kecil dalam nilai Al dan Fe menunjukkan bahawa tanah mengalami disilikasi akibat cuaca dan larut lesap di semua tanah yang digunakan. Secara keseluruhannya, hutan sekunder mempunyai tahap lulurhawa yang lebih rendah berbanding ladang kelapa sawit dan getah kerana nilai PZSE yang lebih tinggi di lokasi tersebut. Tetapi dalam sifat sesquioxide, tidak terdapat banyak perbezaan di ketiga-tiga tapak kerana proses disilikasi dalam tanah adalah sama disebabkan oleh proses lulurhawa dan larut lesap adalah sama untuk ketiga-tiga kawasan.

ACKNOWLEDGEMENT

First of all, Alhamdulillah and thank to Allah S.W.T with all His Gracious and His Merciful for giving me strength and the ability to accomplish this project successfully. A lot of thanks and appreciation for my family members, especially my mom and dad, Siti Khalimah Jamil and Jamaluddin Abd Aziz who always support and provide financial assistance to prepare this thesis. Big thanks to my supervisor and co-supervisor for this final year project, Assoc. Prof. Dr Hazandy Abdul Hamid and Assoc. Prof. Dr. Arifin Abdu who has guided in generating ideas and providing useful advice throughout this study. Not forgetting, Ms. Aiza Shaliha, PhD student of Soil Science who helped a lot during the course of research and guidance in accomplishing this project. Thank you so much to fellow teammates ; Nadzira Huda, Dewi Kartini, Nursuria Mirza, Nurul Atikah, Nurul Aisyah, Mohammad Zawawi, Mohd Khairuldin, and my dear best friends Siti Nadzirah, Ros Shuhada and other colleagues for guiding and motivating me throughout the preparation of this thesis. And lastly, thank you very much for those who are directly or indirectly involved in this thesis making journey from the beginning until the end.

APPROVAL SHEET

I certify that this research project report entitled “Soil Charge Characteristics And Sesquioxide Properties In Different Land Use In Universiti Putra Malaysia Bintulu Campus, Sarawak” by Siti Zubaidah binti Jamaluddin 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, Universiti Putra Malaysia.

_____
Assoc. Prof. Dr. Hazandy Abdul Hamid
Faculty of Forestry
Universiti Putra Malaysia
(Supervisor)

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

Date: 5th January 2018

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 General Background

Malaysia's tropical rainforest is one of the most important ecosystem in controlling climate change globally (Arifin *et al*., 2008). This tropical rainforest in Malaysia consist of unique flora and fauna that contribute to most highly biodiversity and ranked Malaysia top 20 of country with highest biodiversity in the world. Currently, the forested area become smaller as the degradation of forest into plantation, shifting cultivation and agriculture activity are widely occurred. Research done by FAO states that Malaysian forest decreasing almost 50 percent each years in between 2005 to 2010, around 434,000 hectares while 1.92 million hectares decreased in between 1990 to 2010 from 17.1 million hectares in dryland area of forest, 5.48 million hectares are in Peninsular Malaysia, 7.83 million hectares are in Sarawak and 3.84 million hectares are in Sabah (ITTO, 2011). The activity of forest degradation causes the rising of temperature and climate change. Therefore, the lesser composition of trees making the accumulations of carbon dioxide gases increase thus encouraging to global warming. Forest degradation also lead to the soil fertility lacking, land slide and soil compaction.

Several study proven that, to overcome this degraded land problem into more productive land use is by plantation program or rehabilitation forest program. Rehabilitation forest program is an activity of making disturbed land or forest to generate its normal function again. This process involve recovery of ecosystem and function and services in the disturbed region. This kind of

activity are beneficial for forest ecosystem and ecological services as well. Besides, forest rehabilitation and agriculture cultivation can increase the fertility of the soil and stabilize the soil fertility status as it involve recovery of ecosystem functions and processes in the degraded habitat. Several rehabilitation efforts of land in Malaysia has been carried out with different degree of success. One of the successful method, dense planting method (Miyawaki, 1993) conducted in warm temperate zone are now implemented in Bintulu, Sarawak to rehabilitate the degraded cultivation area with indigenous species.

The soil charge characteristics and sesquioxide properties of secondary forest together with agriculture cultivated land area are yet to be studied. Therefore, the study were conducted to identify those character and make comparison among the two types of land use after deforestation activities takes place.

1.2 Problem Statement and Justification

Soil is a fundamental aspect that vital for plant growth. In Malaysia, the major soil order is Ultisol. As we know, Ultisol is infertile, acidic, highly weathered and lack of nutrient content. A proper management needs to be implemented on this type of soil, therefore the soil could provide enough nutrients to the plants for their growth. This is because, trees only absorb certain amount of nutrients at particular time. It is important to retain the nutrient and soil fertility for the sake of plant growth.

In past years, there were studies done on soil characteristics around the world but there are less studies conducted on comparing the agriculture land and the forested land. Hence, this study was conducted in order to provide information on soil status since agricultural activities are expanded to the existing forests. This study aims to identify the selected content of charge characteristic and the sesquioxide properties of soil in degraded area of secondary forest, oil palm plantation and rubber plantation at UPM Kampus Bintulu, Sarawak.

1.3 Objective

This study was conducted to compare the availability of charge characteristics and sesquioxide properties in the soil of secondary forest, oil palm plantation and rubber plantation in UPM Bntulu Campus, Sarawak.

REFERENCES

Abdu, A., Tanaka, S., Jusop, S., Majid, N. M., Ibrahim, Z., Sakurai, K., & Wasli, M. E. (2008). Assessment on soil fertility status and growth performance of planted dipterocarp species in Perak, Peninsular Malaysia. *Journal of Applied Sciences*, 8(21), 3795-3805.

Akbar,M.H., Ahmed, O. H., Jamaluddin, A. s., Nik, A. M, Abdul-Hamid, H., Jusop, S., et al., (2010). Differences in Soil Physical and Chemical Properties of Rehabilitated and Secondary Forests. *Am. J. Applied Sci.,* 7(9), 1200-1209.

Alias, M. A., Hamzah, M. Z., Fujiwara, K., and Meguro, S. (1998). Rehabilitation of Tropical Raiforests based on Potential Natural Vegetation Species for Degraded Area in Sarawak, Malaysia. *Tropics 7,* 223-229.

Anda, M., Shamshuddin, J., Fauziah, C. I., & Omar, S. R. S. (2008). Mineralogy and factors controlling charge development of three Oxisols developed from different parent materials. *Geoderma,* 3(14), 289-346.

Allen, B. L., and Fanning, D. S. (1983). Composition and soil genesis. Pedogenesis and soil taxonomy/edited by LP Wilding, NE Smeck, and GF Hall. *Soil Genesis and Classification*, 12: 250-176.

Cheng, c., Wang, R., and Jiang, J. (2007). Variation of soil fertility and carbon sequestration by planting *Hevea brasilliansis* in Hainan Isand, China. *Journal of Environmental Science* 19: 348-352.

Eswaran, H., Van Den Berg, E., and Reich, P. (1993). Organic carbon in soils of the world. *Soil Science Society of America journal*, 57(1), 192-194.

Jamaluddin, A. S. (2014). Assessing soil nutrient property and site quality of four land uses in Bintulu, Malaysia (Unpublished master's thesis). *Universiti Putra Malaysia, Kampus Bintulu*.

Jusop, S., and Ishak, C. F. (2010). Weathered tropical soils: the ultisols & oxisols. *Serdang, Universiti Putra Malaysia Press*.

Ishizuka, S., Sakurai, K., Sabang, J., Kendawang, J. J., & Lee, H. S. (2000). Soil characteristics of an abandoned shifting cultivation land in Sarawak, Malaysia. *Tropics*, 10(2), 251–263.

Mackeague, J.A., and Day, J.H. (1996). Dithionite and oxalate-extractable Fe and Al as aids in differentiating various classes of soils. *Soil Science* 46:13-22.

Micheis, T., Eschbsch, Lacote, R., Benneveau, A. and Papy, F. (2012). Tapping panel diagnosis, and innovative on-farm decision support system for rubber tree tapping. *Agronomy Sustainable Development*. 32: 791-801.

Mehra, O. P., and Jackson, M. L. (1958, October). Iron oxide removal from soils and clays by a dithionite-citrate system buffered with sodium bicarbonate.

In National conference on clays and clays minerals (Vol. 7, pp. 317-327).

Miyawaki, A. (1993). Restoration of Native Forest from Japan to Malaysia. In: Restoration of Tropical Forest Ecosystem, Leith H. and Lohmann M. (Eds.). Kluwer Academic Publishers, Neatherlands.

Pai, C. W., Wang, M. K., and Chiu, C. Y. (2007). Clay mineralogical characterization of a toposequence of perhumid subalpine forest soils in northeastern Taiwan. *Geoderma*, 138(1–2), 177–184.

Park, C. C. (1992). Tropical Rainforest Routledge, London and New York, 203 pp. ISBN: 0-203-72170-5 (Adobe eReader Format).

Lin, Q., Li, H., Luo, W., Lin, Z., & Li, B. (2013). Optimal soil-sampling design for rubber tree management based on fuzzy clustering. *Forest ecology and management*, 308, 214-222.

RAINFOREST, R. D. T. (2013). Assessing soil fertility status of rehabilitated degraded tropical rainforest. *American Journal of Environmental Science*, 9(3), 280-291.

Rao,P.S., Saraswathyamma, C. and Sethuraj, M. (1998). Studies on the relationship between yield and meteorological parameters of rubber tree (*Hevea brasilliensis*). *Agricultural Forestry Meteorology* 90: 235-245.

Saga, B. T., Ahmed, O. H., Jamaluddin, A. S., Abdul-Hamid, H., Jusop, S., Hassan, A and Abdu, A. (2010). Selected soil morphological, mineralogical and sesquioxide properties of rehabilitated and secondary forests. *American Journal of Environmental Sciences*, 6(4), 389-394.

Shamshuddin J, Fauziah CI (2010). Weathered Tropical Soils: The Ultisol and Oxisols. *UPM Press, Serdang*.

Universiti, A., Universiti, H. A., Universiti, S. A., Shamshuddin, J., Putra, U., and Assessment, M. (2016). Emphasizing the properties of soils occurring in different land use types of tropical rainforest in emphasizing the properties of soils occurring in different land use types of tropical rainforest in Sarawak, Malaysia, (February).

Zaidey, A. K., Arifin, A., Zahari, I., Hazandy, A. H., Zaki, M. H., Affendy, H., and Muhamad, M. N. (2010). Characterizing soil properties of lowland and hill dipterocarp forests at Peninsular Malaysia. *International Journal of Soil Science*, 5(3), 112-130.

Zhang, H., and Zhang, G.L. (2003). Microbial biomass carbon and total organic carbon of soils as affected by rubber cultivation. *Pedosphere* 13: 355-357.

Zhang, Y., Lal, R., and Resck, D.V.S. (2005). Texture and organic carbon relations described by a profile pedotransfer function function for Brazilian Cerrado soils.*Geoderma* 127: 168-173.