BUSITEMA UNIVERSITY

FACULTY OF NATURAL RESOURCES AND ENVIRONMENTAL SCIENCES

ASSESSING THE CARBON SEQUSTRATION POTENTIAL OF OIL PALM PLANTATIONS IN KALANGALA DISTRICT

CASE STUDY OF BUGALA ISLAND

BY

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A RESEARCH REPORT SUBMITTED IN TO THE FACULTY OF NATURAL RESOURCE ECONOMICS IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE IN BACHELOR OF SCIENCE IN NATURAL RESOURCE ECONOMICS OF BUSITEMA UNIVERSITY

JUNE, 2017

DECLARATION

I, Bisangabasaija Sufyan do hereby declare that this research work has been through my own efforts and never has it been submitted to Busitema University or any other Institution of higher learning for the award of a degree or any other qualification.

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APPROVAL

This is to confirm that this research report is original and has only been through the efforts of Bisangabasaija Sufyan after pursuing a three year Bachelor of Science in Natural Resource Economics of Busitema University. He has therefore fulfilled part of his requirements for the Award of the Degree in Natural Resource Economics of Busitema University.

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DEDICATION

I dedicate this report to my family Members especially my dear Mother Mrs. Bisangabasaija safiina, My beloved sister Ampaire Kurusumu, Kabahuma Nashiibah, my brothers Hajji Latif Amanya, Mugisha Murushid, Mugisha Ahmed, Alimpa Murusali, My Step mother Hajati Bisangabasaija Mariam and Many not forgetting my dearly heart felt friends Nakabiri Ziadah, Muwaya Brian, Muduwa Agnes, Mayanja, Walliyah, Kyaligonza, Ojok, Nakhombi, Joan etc. and whoever put in a hand towards accomplishment of this report. May the good Lord reward you abundantly.

In addition, I dedicate this work to whoever is ready to address the Natural Resource and Environmental challenges using sustainable and economic ways for caring for the present and future generations. Thank you, change begins with you.

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LIST OF ACRONYMS

AGC	Aboveground Carbon
AGB	Aboveground Biomass
CO_2	Carbon dioxide
^0C	Degrees centigrade
C	Carbon
CDM	Clean Development Mechanism
CPO	Crude Palm Oil
DBH	Diameter at Breast Height (1.3M)
DNA	Designated National Authority
Exp	Exponential
EPA	Environmental Protection Agency
FACE	Forests Absorbing Carbon Emissions
FAO	Food and Agricultural Organization
FFB	Fresh Fruit Bunches
g	gram
GHG's	Green House Gases
GIS	Geographical Information System
GPP	Gross Primary Production
GPS	Global Positioning System
GtC	Gigatons of carbon
H	Height
Ha	Hectare (10000m^2)
IFAD	International Fund for Agricultural Development
IPCC	International Panel for Climate Change
KOPGT	Kalangala Oil Palm Growers Trust
Km	kilometer
MAAIF	Ministry of Agriculture, Animal Industry, and Fisheries
M	metre
Mg	Megagrams
MW	Mega Watts
NFA	National Forestry Authority

NGO	Non-Governmental Organisation
NTFP	Non Timber Forest Products
PEMA	Participatory Environmental Management Programme
PHRD	Policy and Human Resources Development Fund
KPO	Palm Kernel Oil
RED	Renewable Energy Directive
SOC	Soil Organic carbon
t/Ha	tones per Hectare
TEV	Total Economic Value
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WD	Wood Density
WMO	World Meteorological Organization
USA	United States of America

ABSTRACT

This study on assessment of aboveground carbon stock in oil palm plantations was carried out in the 4 selected different plots which were at the corners of the plantation. Also 4 plots were selected from the natural forest to enable comparison of the aboveground biomass in oil palm plantation and natural forests. The main objective was to estimate the aboveground carbon stock in oil plantations. The specific objectives included; finding the overall tree biomass production in oil palm plantations from the three allometric equations, and in the natural forests, to compare the above ground carbon stocks per hectare in oil palm plantations and natural/ tropical forests and finally to estimate the economic value of carbon sequestered by both natural forests and oil palm plantations. In data processing and analysis, all data collected from sampling plots were used for statistical evaluation. The data was summarized into tables and analyzed using Excel and SPSS. The results were illustrated using graphs for easy interpretation and discussions to draw conclusions. The results indicated that the aboveground biomass estimated from the four allometric equations is far different from each other. Allometric equation by Khalid gave a higher estimate of aboveground biomass in tonnes per hectare for both natural forests and oil palm plantations i.e. 242.08 and 106.24 respectively compared to equations by Henson, Chave and Syahrinudin. The results also indicated that the aboveground biomass in natural/tropical forests i.e. 124.56 and 242.08 is greater than the aboveground biomass in oil palm plantations compared by all the allometric equations. In addition, the economic value of carbon sequestered from the natural forest was higher than that from the oil palm plantation as estimated by the two models. It was recommended that tropical forests should not be substituted for oil palm plantations according to the results.

Keywords: *above ground carbon stocks, forest, oil palm plantation.*

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CHAPTER ONE; INTRODUCTION

1.1 Background

Policy makers in Uganda and many countries are debating on the promotion of biofuels to support economic growth and ensuring sustainable economic development as well as reducing their Greenhouse gas emissions. Biofuels are defined as combustible fuels produced from biomass and they are generally in the form of alcohols, esters, ethers, and other chemicals. Governments around the world support bio-fuels production because of concerns about climate change and a possible reduction in availability of imported traditional oil.

It is believed that bio-fuels can be used as gasoline and in this way it can be a way of contributing towards carbon emissions reduction by some governments. Examples of countries that produce bio-fuels are the United States, France, United Kingdom, Brazil and Spain. Europe's bio-fuels are mostly made from sugar beets, wheat, and barley. Brazil is the largest producer of sugar cane and it is used to make ethanol for powering cars, Lorries and buses instead of petrol. Other countries are making fuel from soya bean, sugar beet, corn and palm oil. African countries in the forefront of promoting bio-fuels include several South African countries and Sudan. However, the promotion of biofuels is associated with clearing large areas of natural forests to provide agricultural land for the biofuels. Large-scale deforestation of mature trees (which help remove CO_2 through photosynthesis— much better than does sugarcane or most other bio-fuel feedstock crops do) contributes to un-sustainable global warming atmospheric greenhouse gas levels, loss of habitat, and a reduction of valuable biodiversity (both on land and in oceans). Demand for Bio-fuel has led to clearing land for oil palm plantations. In Sumatra and Borneo, over 4 million hectares of forest have been converted to palm farms and tens of millions more hectares are scheduled for clearance in Malaysia and Indonesia.

REFERENCES

1. **Ahn, B.** (2014). Assessment of The Biomass Potential Recovered from Oil Palm Plantation, *42*(3), 231–243.
2. **Andalo, J. C. Æ. C., Cairns, Æ. S. B. Æ. M. A., Fromard, Æ. F., Fo, J. Q. C. Æ. D. E. Æ. H., & Yamakura, Æ. T.** (2005). Tree allometry and improved estimation of carbon stocks and balance in tropical forests, 87–99. https://doi.org/10.1007/s00442-005-0100-x
3. **Brown, E., and Jacobson, M. F.** (2005), Cruel Oil: How Palm Oil Harms Health, Rainforest & Wildlife, Center for Science in the Public Interest, Washington.
4. **Brown, S., and Lugo, A. E.** (1984), Biomass of Tropical Forests: A New Estimate Based on Forest Volumes, Science, 223(4642), 1290-1293.
5. **Brown, S., Gillespie, A. J. R., and Lugo, A. E.** (1991), Biomass of tropical forests of south and southeast Asia, Canadian journal of forest research, 21(1), 111-117.
6. **Brown, S.** (1997), Estimating biomass and biomass change of tropical forests: a primer, 55 pp., FAO, Rome.
7. **Buyinza, J., Tumwebaze, S. B., Namaalwa, J., & Byakagaba, P.** (2014). Above-ground biomass and carbon stocks of different land cover types in Mt . Elgon , Eastern Uganda, *1*(2), 51–61. https://doi.org/10.13140/2.1.4958.8003
8. **Casson, A.** (1999), The Hesitant Boom: Indonesian's oil palm sub-sector in an era of economic crisis and political change, Centre for International Forestry Research, Bogor, Indonesia
9. **Chave, J. et al., 2005.** Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Ecological, 145(1), pp.87-99.
10. **Chave et al., 2014.** Improved allometric models to estimate the aboveground biomass of tropical trees. Global Change Biology (2014)20, 3177–3190, doi: 10.1111/gcb.12629.
11. **Chave, J., Riera, B. & Dubois, M.A., 2001.** Estimation of biomass in a Neotropical forest of French Guiana: spatial and temporal variability. Journal of Tropical Ecology, 17, pp.79-96.
12. **District, K.**, Of, T. S., & Report, E. (2005). DISTRICT
13. **Eb, E. B., & Annex, R.** (2003). existing DOM ";
14. **FAO** (online). Palm oil and palm kernel production figures. FAOSTAT online database

15. **Henson, I. E. (1999).** Comparative Eco physiology of oil palm and tropical rain forest. In G. Singh, L. K. Huan, T. Leng, & D. L. Kow (Eds.), Oil palm and the environment—A Malaysian perspective(pp. 9–39). Kuala Lumpur: Malaysian Oil Palm Growers Council.

16. **Henson, I. E. (2003).** The Malaysian national average oil palm: Concept and evaluation. Oil Palm Bulletin, 14, 15–27.

17. **Henson, I. E. (2004).** Modelling carbon sequestration and emissions related to oil palm cultivation and associated land use change in Malaysia (MPOB Technology bulletin 27). Kuala Lumpur: Malaysian Palm Oil Board.

18. **International, W., & December, O.** (2013). Continuing to exploit and deforest Wilmar ' s ongoing abuses, 1–6.

19. **IPCC, 2001.** Climate Change 2001: Working Group I: The Scientific Basis. Cambridge University Press, New York.

20. **IPCC, 2003.** Good practice guidance for land use, land-use change and forestry. Institute for Global Environmental Strategies (IGES), Hayama.

21. **IPCC, 2006.** 2006 IPCC Guidelines for National Greenhouse Gas Inventories H. S. Eggleston et al., eds., Japan: the Institute for Global Environmental Strategies (IGES).

22. **IPCC, 2007.** Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

23. **IPCC, 2007.** Climate Change 2007: The Physical Science Basis. Summary for Policymakers, Paris.

24. **Khasanah, N., Noordwijk, M. Van, & Ningsih, H.** (2015). Aboveground carbon stocks in oil palm plantations and the threshold for carbon-neutral vegetation conversion on mineral soils. *Cogent Environmental Science*, *8*(1), 1–18. https://doi.org/10.1080/23311843.2015.1119964

25. **Khalid,** H., Zin, Z. Z., & Anderson, J. M. (1999). Quantification of oil palm biomass and nutrient value in a mature plantation. I Above-ground Biomass. Journal of Oil Palm Research, 1, 23–32

26. **Network,** P. (n.d.). Change in carbon stocks arising from land - use conversion to oil palm plantations Change in carbon stocks arising from land-use conversion to oil palm plantations.

27. **Noordwijk, M. Van, & Ningsih,** H. (2015). AbovegroError! **Reference source not ound.Error! Reference source not found.**und carbon stocks in oil palm plantations and the

threshold for carbon-neutral vegetation conversion on mineral soils, (June), 1–18. https://doi.org/10.1080/23311843.2015.1119964

28. **Segura, M.** (2005). Allometric Models for Tree Volume and Total Aboveground Biomass in a Tropical Humid Forest in Costa Rica 1, *37*(1), 2–8.
29. **Service, F., Woodall, C. W., Heath, L. S., Domke, G. M., & Nichols, M. C.** (2010). Methods and Equations for Estimating Aboveground Volume, Biomass , and Carbon for Trees in the U . S . Forest Inventory , 2010.
30. **Sharma, B.** (2009). Modelling carbon stock in oil palm using system â€™ s approach.
31. **Syahrinudin.** (2005). The potential of oil palm and forest plantations for carbon sequestration on degraded land in Indonesia. In M. Denich, C. Martius, & C. Rodgers, & N. van de Giesen (Eds.), Ecology and Development Series No. 28. Göttingen: Cuvillier Verlag
32. **Republic**, T. H. E. (n.d.). The Potential of Bio-fuel in Uganda January 2010.
33. **Velle, K., 1997.** Evaluation of components of the National Biomass Study, Uganda. Suggestions and recommendations for the biomass measurements, procedures for phase III of the project. Unpublished report for Forestry Deportment of Uganda and Norvegian Forestry Society, Kampala, 22 pp.

Appendix

Table a; Aboveground biomass estimates in oil palm plots from allometric equation by Khalid and Chave.