UNIVERSITI PUTRA MALAYSIA

QUANTIFICATION OF CARBON SEQUESTRATION IN UNLOGGED LOWLAND DIPTEROCARP FOREST, SEMENYIH, MALAYSIA USING CO2FIX V3.1 MODEL

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By

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Carbon dioxide (CO_2) is one of greenhouse gasses (GHG's) that cause of global warming and climate change. Carbon sequestration through forestry sector is one of mechanisms in removal of CO_2 from the atmosphere with the least cost. Therefore, 1 ha plot was established at Sungai Lalang Forest Reserve, Semenyih, Selangor to quantify carbon sequestration in an unlogged forest using inventory methods, allometric equations and modeling. CO2FIX V3.1 Model was used because it suitable for tropical forest, user friendly and required less data. Besides, litter fall study and litter bag experiment was conducted to determine litter fall for estimate carbon flow from plant to soil pool and determine decomposition rate of leaf litter. Results from simulation model CO2FIX showed carbon stocks in 1 ha study plot at Sungai Lalang

Forest Reserve were decreased from year 1 of simulation period (522.04 Mg C/ha) to year 100 (229.98 Mg C/ha). Meanwhile, results from calculation using allometric equation for year 2007 to 2008 showed carbon stocks were increased from 564.38 Mg C/ha to 592.25 Mg C/ha and decreased to 501.43 Mg C/ha for year 2009. This study concluded that carbon stock in Sungai Lalang Forest Reserve was in steady state of a mature forest because simulation results of CO2FIX showed after a few years total carbon increase, then it suddenly drops and maintain. This study also found that litter fall and decomposition process play an important role in carbon flow from plant to soil which representing one of the major pathways of nutrient cycling. Results of litter bag experiment showed leaves decomposed from fastest to slowest, in the following order: *Diospyros sumatrana* Miq > *Elateriospermum tapos* Blume > *Macaranga triloba* (Blume) Müll.Arg. All leaf types examined were decomposed significantly different each other depends on litter quality such as Carbon/Nitrogen ratio and Nitrogen. This study also discovered that carbon potential was influenced by species composition, tree density, and growth characteristics of tree. Therefore, strategies for carbon mitigation plan of forestry options can be planned through the knowledge gained from these findings. Species with high carbon stocks values are suggest to be selected for afforestation and reforestation activities to enhance the carbon potential of forest.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGUKURAN PEMENCILAN KARBON DALAM HUTAN PAMAH DIPTEROKARPA YANG BELUM DITEBANG, SEMENYIH, MALAYSIA MENGGUNAKAN MODEL CO2FIX V3.1

Oleh

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Karbon dioksida (CO_2) adalah satu daripada gas rumah hijau yang menyumbang kepada pemanasan global dan perubahan iklim. Pemencilan karbon melalui sektor perhutanan merupakan salah satu mekanisma untuk menyingkirkan CO_2 dari atmosfera dengan kos yang rendah. Oleh itu, 1 hektar plot telah dibina di Hutan Simpan Sungai Lalang, Semenyih untuk mengukur pemencilan karbon dalam hutan yang belum ditebang dengan menggunakan kaedah inventori, persamaan alometrik dan pemodelan. Model CO2FIX V3.1 digunakan kerana ia sesuai untuk hutan tropika, mudah diaplikasikan dan kurang data diperlukan. Selain itu, kajian luruhan sarap dan eksperimen beg sarap daun dijalankan untuk menentukan luruhan sarap bagi anggaran aliran karbon daripada tumbuhan ke takungan tanah

dan menentukan kadar penguraian sarap daun. Keputusan simulasi model CO2FIX menunjukkan simpanan karbon dalam 1 hektar plot kajian di Hutan Simpan Sungai Lalang menyusut dari tahun pertama simulasi (522.04 Mg C/ha) hingga tahun ke 100 (299.98 Mg C/ha). Sementara itu, keputusan pengiraan persamaan alometrik pada tahun 2007 hingga 2008 menunjukkan simpanan karbon meningkat dari 564.38 Mg C/ha kepada 592.25 Mg C/ha dan susut kepada 501.43 Mg C/ha pada tahun 2009. Kajian ini merumuskan bahawa simpanan karbon dalam Hutan Simpan Sungai Lalang berada dalam keadaan seimbang untuk hutan matang kerana hasil simulasi model CO2FIX menunjukkan selepas beberapa tahun jumlah simpanan karbon meningkat, ia menyusut secara mendadak dan kemudian stabil. Kajian ini juga mendapati bahawa luruhan sarap dan proses penguraian memainkan peranan penting dalam aliran karbon daripada tumbuhan ke takungan tanah dalam kitaran nutrien. Keputusan eksperimen sarap daun menunjukkan daun mengurai dari paling cepat ke perlahan, dalam susunan berikut: *Diospyros sumatrana* Miq > *Elateriospermum tapos* Blume > *Macaranga triloba* (Blume) Müll.Arg. Kesemua jenis daun berbeza penguraiannya bergantung kepada kualiti sarap seperti nisbah karbon/nitrogen dan nitrogen. Penemuan kajian ini juga mendapati bahawa potensi karbon dipengaruhi oleh komposisi spesies, ketumpatan pokok dan ciri-ciri pertumbuhan pokok. Oleh itu, strategi pengurangan karbon menggunakan sektor perhutanan boleh dirancang dengan mengunakan pengetahuan daripada hasil kajian ini. Spesies yang bernilai untuk menyimpan karbon yang tinggi dicadangkan

untuk aktiviti perhutanan dan penghutanan semula bagi meningkatkan potensi karbon dalam hutan.

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I certify that a Thesis Examination Committee has met on 4 April 2012 to conduct the final examination of Fazlyzan binti Abdullah on her thesis entitled "Quantification of Carbon Sequestration in Unlogged Lowland Dipterocarp Forest, Semenyih, Malaysia using CO2FIX V3.1 Model" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledge. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

FAZLYZAN BINTI ABDULLAH

Date: 4th April 2012

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