Proceeding of International Symposium on Wild Fire and Carbon Management in Peat-Forest in Indonesia
13-14 September 2012, Novotel Bogor, West Java INDONESIA

Editors:
Mitsuru Osaki
Hidenori Takahashi
Toshihisa Honma
Takashi Hirano
Hiroshi Hayasaka
Takashi Kohyama
Shunitz Tanaka
Kazuyo Hirose
Hendrik Segah
Satomi Shiodera
Eriko Momota

Bambang Setiadi
Kumpidy Widen
Aswin Usup
Suwido H. Limin
Sulmin Gumiri
Agus Hidayat
Nur Masripatin
Joeni Sri Rahajoe
Orbita Roswintiarti
Ardianor
Salampak Dohong
Muhammad Evri
Biama Dulbert
Febrian Isharyadi

Hokkaido University, Palangka Raya University, BSN, BPPT, LIPI, LAPAN, Minister of Forestry
July 2013
Novotel Bogor, West Java INDONESIA
13-14 September 2012
Preface

The importance of peat as a source of carbon emissions has gained greater recognition globally. The carbon release from tropical peatland represents a unique and predominantly Indonesian challenge, as Indonesia holds approximately 50 percent of the total tropical peat area. Currently emission from peatland represents 38 percent of Indonesia’s total emissions and will continue to remain a dominant portion in 2030 (at 30 percent) if there is no significant action undertaken. Under the business-as-usual scenario, emission from peatland is expected to increase by 20 percent, from 772 MtCO2e in 2005 to 972MtCO2e in 2030. Indonesia’s tropical peatland covers only 5% of the global peatland area, but it contributes more than 50% of the world emission, originated from tropical peatland. Peatlands all over the world are facing similar problems, threatened by drainage and uncontrolled fires. According to available data and information, in Indonesia more than 300,000 hectares of peatlands are degrading annually, resulting in degraded peat area of approximately 10 million hectares.

The "Wild Fire and Carbon Management in Peat-Forest in Indonesia" project has been conducted by JST-JICA in conjunction with Indonesian authorities to initiate a carbon management system in the peatlands of Central Kalimantan Province since 2008. Since remarkable progress has been made on the project, the International Symposium was held to share updated information and experiences on project activities. The goal of this workshop are: (1) synthesize knowledge on past, present and future trends relating to wildfires and the carbon management of peat-forest; (2) provide information on the possible impacts of climate change, as well as guidance for stakeholders in the area of planning, implementation and scenarios (REDD-plus, etc.); and (3) compile a roadmap that provides a short to long term vision on research needs. More than 200 participants from 8 countries (Indonesia, Japan, UK, Germany, Malaysia, Myanmar, Bhutan, and South Korea) attended the International Symposium on "Wild Fire and Carbon Management in Peat-Forest in Indonesia" in Bogor representing various research institutes, universities, private companies, bilateral projects, national and local government levels.

53 oral presentations and 41 posters have been shared in the following sessions:

The 1st day: Thursday, 13 September 2012
- Session 1 (FF): Remote Sensing, Carbon and Ecosystem Management of Tropical Peatland
- Session 2 (CA): Evaluation of Carbon Storage and Carbon Flux of Tropical Peatland
- Session 3 (CM): Sustainable Management of Carbon, Biodiversity and Ecosystem of Tropical Peatland
- Session 4 (PM): Integrated Tropical Peatland Management
- Posters Presentation

The 2nd day: Friday, 14 September 2012
- Special Talk: The role of peatlands in the fight against climate change
- Special Session 1: National Policy And Demonstration Activities on REDD+ Mechanism
• Special Session 2: Policy Assessment And Evaluation Modeling On Environment And Ecosystem
• Special Session 3: Challenging Of REDD+ and Forest Management Activities In Asian Countries
• Special Session 4: Capacity Building & Kalimantan University Consortium
• Posters Presentation

During the workshop, eight awards were given to the best posters on the specific poster presentation period and selected by all of participants of the International Symposium on "Wild Fire and Carbon Management in Peat-Forest in Indonesia" 2012:

- The 1st Best Poster: “The dynamic of carbon stocks in peatland forest” by Haruni Krisnawati (Indonesia-Australia Forest Partnership, INDONESIA)
- The 2nd Best Poster: “Tropical Peat Fire Characteristics in Kalimantan using MODIS hotspot and imagery data” by Nina Yulianti (UNPAR, INDONESIA)
- The 3rd Best Poster: Mohammad Fathi Royyani (Research Center for Biology-LIPI, INDONESIA)
- The 4th Best Poster: “Geologic fundamental of "Pasir Putih (PP) Formation(s)" Central Kalimantan, Indonesia (CKI)” by Hu Sung Gi (Raax. Co., Ltd, JAPAN)
- The 5th Best Poster: “Humic acid induces the endothelial NO syntheses activation via Hsp90 upregulation in human umbilical vein endothelial cells” by Masato Tanaka (Hokkaido Univ., JAPAN)
- The 6th Best Poster: “Biomass production on the Changes of Forest to Palm Oil Plantation in Hampangen, Central Kalimantan” by Laode Alhamd (Indonesian Institute of Sciences, INDONESIA)
- The 7th Best Poster: “Medicinal plant in Baun Bango Village-Central Kalimanntan: a local knowledge” by Vera Budi Lestari Sihotang (Indonesia Institute of Sciences, INDONESIA)
- The 8th Best Poster: “Moisture behavior of the surface peat layer in areas of different plant cover and ground conditions during the dry season in peatland in Central Kalimantan” by Adi Jaya (UNPAR, INDONESIA)

Finally, we would like to extend our sincere appreciation to the invited speakers (oral and poster presentations), session chairs and all participants. We are grateful to the Indonesian Institute of Sciences, JST-JICA, Workshop’s Steering Committee and Organizing Committee; for their kindness contributions and support to the success of this important workshop.

Sapporo, 1 August 2013

Prof. Dr. Mitsuru Osaki
Editor-in-Chief
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>i</td>
</tr>
<tr>
<td>Contents</td>
<td>ii</td>
</tr>
</tbody>
</table>

### Opening Remarks

- Japan International Cooperation Agency, Japan
  - Indonesian Institute of Sciences, Indonesia
  
1. Relating Ground Field Measurements in Indonesian Peat Swamp Forest With Multi-Temporal Airborne LiDAR Measurements

  Hans-Dieter Viktor Boehm, Veraldo Liesenberg, Alvand Miraliakbari, and Suwido Limin

2. Recent Forest Fire Trends in Indonesia

  Hiroshi Hayasaka, Nina Yulianti, and Aswin Usup

3. JICA Cooperation in Forestry Sector and A New Project on REDD+ (IJ-REDD+) in Indonesia

  Shigeru Takahara

4. Piloting A Village-Based Fire Prevention Program (PHKA/MOF-JICA) at Peat Land Area in West Kalimantan to Respond Decentralization

  Sahat Irawan Manik, Anna Sylviana Kartika, and Kuno Hiromitsu

5. Use of Peat Soils as A Sustainable Agricultural Land

  D. Nursyamsi and M. Alwi

6. Water Management and MRV Methodology for Coastal Rice Farming Peatland in Indonesia

  Akihiko Hirayama, Genichiro Sawamura, Akira Yashio, Hiroyuki Kurita, So Sato, Koji Mori, Asmadi Saad, Sugino, Momon Imanudin, and Aljosja Hooijer

7. International Movement Of Carbon Credit

  Noriyuki Kobayashi

8. REDD+ Readiness in Myanmar

  Win maw

9. Distribution of Vegetation Species Analysis in A Hyperspectral Image in Tropical...
Peat Swamp Forest, Central Kalimantan

10. The Dynamic of Aboveground Carbon Stock in Peat Swamp Forest

Haruni Krisnawati, Wahyu C. Adinugroho, and Rinaldi Imanuddin

11. Geotechnical Properties of Soft Soils in Kalampangan Canal

Hirochika Hayashi, Mitsuhiko Kamiya, Koichi Ikeda, Hiroshi Shimokura, Noriyoshi Ochi, and Hidenori Takahashi


Inggit Lolita Sari and Kustiyo

13. Distribution of Secondary Grasslands in Relation to Edaphic Conditions Established After Burning of Peat Forest in Central Kalimantan

Kazuo Yabe, Satomi Shiodera, dan Takashi Kohyama

14. Tree Biomass on The Changes of Forest to Oil Palm Plantation in Hampangen, Central Kalimantan

Laode Alhamd, Joeni S Rahajoe, and Bayu A Pratama

15. Humic Acid Induces The Endothelial No Synthase Activation Via HSP90 Upregulation in Human Umbilical Vein Endothelial Cells

Masato Tanaka, Miki Miyajima, Ryo Nishimura, Toshiyuki Hosokawa, Masaaki Kurasaki, Shunitz Tanaka, Takeshi Saito, and Sulmin Gumiri

16. Carbon Stock Estimation of Peatland Use ALOS PALSAR in Kampar Peninsula, Riau Province, Indonesia


17. Tropical Peat Fire Characteristics in Kalimantan Using Modis Hotspot and Imagery Data

Nina Yulianti, Hiroshi Hayasaka, and Aswin Usup

18. Mapping Forest in West Sumatera By Using Canonical Correlation Analysis for
Multitemporal Classification Purposes

Siti Hawariyyah, and Atriyon Julzarika

19. Status of MTSAT Wildfire Detection System in Lapan

Masami Tokuno

142

20. Mechanical-Quality Evaluation for Young Plantations of Shorea Balangeran

Koide Tomoya, Koizumi Akio, Gaman Sampang, Prawira Yuda, and Saito Hideyuki

149


Veraldo Liesenberg, Hans-Dieter Viktor Boehm, and Suwido Limin

155

22. Ground Penetrating Radar Mapping of Peat Depth

Salman Samson Rogers, Andrew Clague, and Hans-Dieter Viktor Boehm

161

23. Soil Chemical Properties at Heath Forest and Low Land Forest in Kalimantan

Wahyudi

168

24. The Specific Spectral Data of Dominant Trees in Peat-Forest in Central Kalimantan, Indonesia

Hendrik Segah, Hiroshi Tani, Muhammad Evri, Laju Gandharum, Aswin Usup and Mitsuru Osaki

177


184

Appendix

1. Translating MRV Ideas into Implementation on the Ground: SAPPORO Initiative’s Proposal

Mitsuru Osaki, Kazuyo Hirose, Noriyuki Kobayashi, and Muhammad Evri

197

2. Defining Uncertain Peatland Definition in Bridging Science to Policy

Mitsuru Osaki

225
OPENING REMARKS OF JICA SENIOR REPRESENTATIVE ON INTERNATIONAL SYMPOSIUM ON WILD FIRE AND CARBON MANAGEMENT IN PEAT-FOREST IN INDONESIA

Good morning,

On behalf of Japan International Cooperation Agency (JICA), I am pleased to deliver remarks on the occasion of “International Symposium on Wild Fire and Carbon Management in Peat-Forest in Indonesia”. This symposium is held under the project of JICA-JST “Wild Fire and Carbon Management in Peat-Forest in Indonesia” with cooperation of BSN (National Standardization Agency), Palangkaraya University, LIPI and other related agencies.

This symposium’s theme is “Wild Fire and Carbon Management in Peat-Forest in Indonesia” which is globally receiving remarkable attention in these days. We, JICA has dedicated climate change countermeasure with close cooperation with Government of Indonesia such as BAPPENAS, Ministry of Finance, DNPI, Ministry of Forestry, Ministry of Environment, REDD+ Task Force and other related agencies based on “Bilateral Cooperation on Climate Change Between the Government of Japan and the Government of Indonesia” issued by both governments on November 2011.

Our cooperation with Government of Indonesia on climate change is extensive and integrative to cover policy support, field activities and research collaboration both on mitigation and adaptation such as regional action plan formulation for mitigation, national action plan formulation for adaptation, vulnerability assessment in Bali, Greenhouse gas inventory, policy assessment on key issues and so forth.

We are also starting new cooperation with Ministry of Forestry on REDD+ in West Kalimantan and Central Kalimantan hopefully from January. In this project, we will attach special importance to forest fire and peat land conservation as these issues are directly connected to GHG emission especially in Kalimantan area. We realize importance of research cooperation especially on forest fire and peat land conservation in the context of climate change and REDD+ issues. In today’s symposium, we welcome a wide range of Indonesian and international experts from various organizations.

I hope that today’s symposium will be an opportunity to obtain further idea for promoting climate change countermeasure and enhancing the cooperation between respective organizations and projects. I wish a successful symposium today and I would like to express my special appreciation to LIPI for hosting today’s symposium.

Thank you.

Japan International Cooperation Agency, Japan
THE DYNAMIC OF ABOVEGROUND CARBON STOCK IN PEAT SWAMP FOREST

Haruni Krisnawati*, Wahyu C. Adinugroho and Rinaldi Imanuddin
Research and Development Center for Conservation and Rehabilitation, Forestry Research and Development Agency, Bogor, Indonesia

*) E-mail address: h.krisnawati@yahoo.co.id

Many studies on aboveground living biomass and carbon stock in tropical forests have been carried out, either measured directly based on destructive sampling in experimental plots or estimated based on forest inventory data. However, most of these studies focused on the estimation of forest biomass and carbon stock at one occasion. Forest biomass and carbon stock may be dynamic and changes occur continuously throughout time due to loss of biomass during deforestation and forest degradation as well as accumulation of biomass during re-growth of forests. This study aimed to estimate the dynamic of aboveground carbon stock in peat swamp forest using forest inventory data from permanent sample plots established in Jambi, Indonesia. Inventory data collected from sixteen Permanent Sample Plots (100 m x 100 m each) which have been selectively logged and measured annually for 5 years were used to estimate the dynamic of aboveground carbon stock of the peat swamp forest. All woody plants of at least 10 cm dbh were identified for species and measured for both dbh and total tree height. The dead and newly recruited trees were recorded at each measurement time. Overall, the aboveground carbon stock of all species in the plots increased although in several plots showed loss of biomass due to mortality. The increase of carbon stock may be attributed to the high rate of recruitment and growth of some species. The mean annual increment of carbon stock was 3.27 Mg C ha\(^{-1}\) yr\(^{-1}\). There was a significant logarithmic relationship between the aboveground carbon stock and its annual increment. This relationship could be applied to estimate the carbon stock change of the peat swamp forest in the study site.

**Keywords:** biomass, carbon stock, stand structure, dynamic, peatland.

Introduction

Knowledge of the aboveground biomass is useful in determining the amount of carbon stored through photosynthesis in the forest stands. Many studies on aboveground living biomass and carbon stock in tropical forests have been carried out, either measured directly based on destructive sampling in experimental plots (e.g. Ludang and Jaya 2007, Miyamoto *et al.* 2007) or estimated based on forest inventory data (e.g. Brown and Lugo 1984, Brown *et al.* 1989). However, most of these studies focused on the estimation of forest biomass and carbon stock at one occasion. Forest biomass and carbon stock may be dynamic and changes occur continuously throughout time due to loss of biomass during deforestation and forest degradation as well as accumulation of biomass during re-growth of forest.

Understanding the dynamics of tropical forest biomass and carbon stock is essential in order to know how the forest will grow and respond to natural conditions or occasional disturbances. The estimates of the forest biomass and carbon stock dynamics are also important in predicting the potential impacts of both climate change and land use change on forest ecosystem, as well as essential component for national carbon accounting (Eamus *et al.*, 2000; Comley and McGuinness, 2005; Soares and Schaeffer-Novelli, 2005). To monitor the dynamic of forest biomass and carbon stock, successive measurement of permanent sample plots at certain time intervals and over a long period of time are needed. This study aimed to estimate the dynamic of aboveground carbon stock in peat swamp forest using forest inventory data collected from permanent sample plots in Jambi, Indonesia.
Methods

Inventory data collected from sixteen Permanent Sample Plots (PSPs) (100 m x 100 m each) established at a forest concession area in Jambi, Indonesia (103°55’- 104°00’ E and 1°36’ - 1°35’ S, Figure 1) were used to estimate the dynamics of aboveground carbon stock of the peat swamp forest. All plots were established in 1994 and first measured in January 1995 and then re-measured annually in 1996, 1997, 1998, 1999, and 2000. The plots have been selectively logged with a minimum diameter cutting limit of 40 cm in 1992/1993.

![Map of the study site and the sixteen permanent sample plots](image)

**Figure 1.** Map of the study site

In each measurement plot, all woody plants of at least 10 cm dbh (diameter at breast height) were identified for species and measured for both dbh and total tree height. The dead and newly recruited (ingrowth) trees were recorded at each re-measurement time. Stand density (number of trees), basal area, and aboveground biomass were calculated at each measurement time. The aboveground biomass (AGB) of each tree in the plot was estimated using an allometric model (AGB = 0.206 dbh^{2.451}, R_{sq} = 0.96) developed for logged-over peat swamp forest in South Sumatra which was considered to have similar characteristics with this present study site in terms of forest type, topography, climate, soil type, and dominant species in the forests. Carbon stocks were then estimated by multiplying the aboveground biomass by a factor (carbon fraction) of 0.5 (IPCC 2003).

Results and Discussion

**Stand structure**

We found 80 tree species, 55 genera and 30 families in all plots with the range of wood density varied from 0.39 to 1.04 kg m^{-3}. The average basal area and the number of surviving trees at each measurement time over 5 year period are presented in Figure 2. In general, the average number of surviving trees in the study site increased by 11.6% from 610 trees per ha in 1995 to above 680 trees per ha in 2000 although there was a slight decrease in 1997 due to higher mortality rate. The average basal area also tended to increase over 5 year period; although its increase was not as high as the increase in the number of surviving trees per ha,
which was only 2.6% from 23 m$^2$ ha$^{-1}$ to 23.6 m$^2$ ha$^{-1}$. The average annual diameter increments of trees in the plots were 0.33-0.47 cm. These values were slightly higher than the diameter increments found in logged-over peat swamp forest in Riau, Sumatra (Krisnawati and Wahjono, 1997). Of these trees, only 2-3 trees were found to have diameter larger than 100 cm at the time of measurement.

![Figure 2](image.png)

**Figure 2.** The average basal area and the number of surviving trees over 5 year period

**Aboveground carbon stock estimates**

The estimates of aboveground carbon stocks of the sixteen PSPs at each measurement time over 5 year period are presented in Figure 3. The estimates of aboveground carbon stocks of the sixteen PSPs vary from 79.58 to 235.72 Mg C ha$^{-1}$ (average = 140.87 Mg C ha$^{-1}$) in 1995 and from 92.88 to 261.40 Mg C ha$^{-1}$ (average = 152.98 Mg C ha$^{-1}$) in 2000. Overall, the aboveground carbon stock of all species in the plots increased from the initial value.

These average aboveground carbon stock estimates were relatively lower with those measured directly for mature tropical forests in Asia (175 Mg C ha$^{-1}$; n = 4) and for all mature tropical forests of the world (150 Mg C ha$^{-1}$; n = 25) (Brown and Lugo, 1982). However, Clark et al. (2001) stated that direct measurement of biomass based on a few small plots could potentially result in overestimates due to plot biases (plots may not represent the population of interest or have a small sample size, and the influence of large trees).

The lower aboveground carbon stock recorded in the present study may be because the forests included in the inventory of this study have been previously logged 2–7 years ago, in which some bigger commercial trees (dbh ≥ 40 cm) were harvested. Brown et al. (1991) showed that tropical forests in Asia that appeared to have experienced little human disturbance had aboveground carbon stock of more than 175–200 Mg C ha$^{-1}$, compared with 92-135 Mg C ha$^{-1}$ for forests that were exposed to human disturbance.
**Figure 3.** Aboveground carbon stock estimates of the PSPs over 5 year period

**Carbon stock changes**

The changes of aboveground carbon stock for 5 years from the sixteen PSPs are presented in Table 1. The positive value means there was an addition in aboveground carbon stock which may be attributed to the high rate of recruitment and growth of some species. The negative value means there was a reduction in aboveground carbon stock due to loss of biomass as a result of mortality. Overall, the average aboveground carbon stock increment between two successive measurements was 3.27 Mg C ha\(^{-1}\) yr\(^{-1}\).

**Table 1.** The changes of aboveground carbon stock of the sixteen PSPs over 5 year period

<table>
<thead>
<tr>
<th>PSP</th>
<th>Carbon stock change (Mg C ha(^{-1}) yr(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.55</td>
</tr>
<tr>
<td>2</td>
<td>2.67</td>
</tr>
<tr>
<td>3</td>
<td>0.23</td>
</tr>
<tr>
<td>4</td>
<td>5.21</td>
</tr>
<tr>
<td>5</td>
<td>7.38</td>
</tr>
<tr>
<td>6</td>
<td>3.50</td>
</tr>
<tr>
<td>7</td>
<td>5.10</td>
</tr>
<tr>
<td>8</td>
<td>4.04</td>
</tr>
<tr>
<td>9</td>
<td>6.18</td>
</tr>
<tr>
<td>10</td>
<td>2.91</td>
</tr>
<tr>
<td>11</td>
<td>2.28</td>
</tr>
<tr>
<td>12</td>
<td>1.14</td>
</tr>
<tr>
<td>13</td>
<td>3.22</td>
</tr>
<tr>
<td>14</td>
<td>2.75</td>
</tr>
<tr>
<td>15</td>
<td>3.97</td>
</tr>
<tr>
<td>16</td>
<td>-16.88</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>2.52</strong></td>
</tr>
</tbody>
</table>
The estimates of aboveground carbon stock increment were considerably lower than those reported for undisturbed forest in East Kalimantan which found an average aboveground carbon stock increment of 3.85 Mg C ha\(^{-1}\) yr\(^{-1}\) (Krisnawati et al., 2011).

**Relationships between carbon stock and its increment**

The relationships between the aboveground carbon stocks and its annual aboveground carbon stock increment obtained from the sixteen PSPs are presented in Figure 4. There was a significant logarithmic relationship (\(P < 0.01\)) between the aboveground carbon stock and its annual increment. The determination coefficient of the logarithmic relationship was relatively high (\(R^2 = 0.805\)). Such a significant logarithmic relationship was also found by Clark et al. (2001) who analyzed published data from 17 old growth tropical forests (\(R^2 = 0.53\)).

![Figure 4. The relationship between annual aboveground carbon stock increment and aboveground carbon stock](image)

**Conclusions**

Aboveground carbon stock in peat swamp forest is dynamic. The mean annual increment is about 3.27 Mg C ha\(^{-1}\) yr\(^{-1}\). The relationship (model) between aboveground carbon stock and its increment could be used to estimate carbon stock change in the study site by calculating the product of the aboveground carbon stock increment per ha and forest area.

**Acknowledgement**

Data used in the study were collected from the forest concession area of PT Putraduta Indah Wood Industries. Funding from the Research and Development Center for Conservation and Rehabilitation (formerly Research and Development Center for Forest and Nature Conservation) during monitoring the plots is gratefully acknowledged.
References


