



PROCEEDINGS



of

BOGOR SYMPOSIUM & WORKSHOP ON TROPICAL PEATLAND MANAGEMENT

BOGOR - INDONESIA, JULY 14th -15th 2009



“ WISE USE OF TROPICAL PEATLAND ”



Edited by :

Sudarsono, Ryusuke Hatano, Takashi Inoue,
Suwido Limin, Gunawan Djajakirana, Suwardi



**INTEGRATED FIELD ENVIRONMENTAL SCIENCE -
GLOBAL CENTER OF EXCELLENT (IFES-GCOE)
INDONESIAN LIAISON OFFICE**

W 16, Lv 6 Department of Soil Science and Land Resources Building,
Fac.of Agriculture, IPB Jl. Meranti, Kampus IPB Darmaga, Bogor 16680-INDONESIA
Phone: +62 (251)-8624334; Fax: +62 (251)- 8624334
Email: ifesindonesia@yahoo.co.id; suwardi_bogor@yahoo.com

ISBN 978-602-96223-0-0

ISBN 978-602-96223-0-0

**Proceedings of
Bogor Symposium and Workshop on
Tropical Peatland Management
“ Wise Use of Tropical Peatland”**

Editors :

Prof. Dr. Sudarsono,
Prof. Dr. Ryusuke Hatano,
Prof. Dr. Takashi Inoue,
Prof. Dr. Suwido Limin
Dr. Gunawan Djajakirana,
Dr. Suwardi,

Managing Editor :

Septian Tri Putranto, SP



**Bogor Agricultural University
Integrated Field Environmental Science - Global Center of Excellent
(IFES-GCOE) Indonesian Liaison Office
Hokkaido University
2009**

Proceedings of Bogor Symposium and Workshop on Tropical Peatland Management,
Bogor, Indonesia, 14-15 July 2009 “Wise Use of Tropical Peatland”

COMMITTEE

Steering Committee (SC)

Chairperson: Prof. Dr. Hanny Wijaya

Members:

1. Prof. Dr. Ryosuke Hatano
2. Prof. Dr. Yasuyuki Hashidoko
3. Prof. Dr. Budi Mulyanto
4. Dr. Takashi Inoue
5. Dr. Anas M. Fauzi, M.Eng
6. Prof. Dr. Didy Sopandie
7. Dr. Kukuh Murtilaksono

Organizing Committee (OC)

1. Chairman : Dr. Suwardi
2. Secretary : 1. Dr. Dyah Tjahyandari S.
2. Septian Tri Putranto, SP
3. Finance Secretary : Dr. Darmawan
4. Program, Publication and Documentation : 1. Dr. Iskandar
2. Dr. Gunawan Djajakirana
3. Dr. Basuki Sumawinata
5. Accomodation, Transportation and Consumption : 1. Dr. D.P.Tejo Baskoro
2. Ir. Hermanu Wijaya, Msc

TABLE OF CONTENTS

Foreword	i
Table of Content	iii
Opening Remark Chairperson of The Steering Committee Speech from Representative of IFES-GCOE (Prof. Dr. Hanny Wijaya)	vii
Speech from Representative of IFES-GCOE Targets of The Indonesian IFES-GCOE Program (Prof. Dr. Ryusuke Hatano, Graduate School of Agriculture, Hokkaido University)	viii
Speech and Opening The Symposium and Workshop (Dr. Anas M. Fauzi, Vice Rector of Research and Collaboration, Bogor Agricultural University)	ix
PART 1	
Issues Concerning the Tropical Peatland	
Current Issues of Tropical Peatland in Indonesia (Basuki Sumawinata and Darmawan)	1
CO ₂ and N ₂ O Emission Associated with Tropical Peatland Degradation (Ryusuke Hatano, Takashi Inoue, Untung Darung and Suwido Limin)	11
Dynamics of Greenhouse Gases in Tropical Peatland Soils: Research Plan (Yohei Hamada and Ryusuke Hatano)	19
A preliminary assessment of peat degradation in West Kalimantan (Gusti Anshari)	33
Estimation of Carbon Stock in Riau Peat-swampy Production Forest, Indonesia (Ulfah J. Siregar)	46
Screening of N ₂ O emitting microorganisms from soils of reclaimed tropical peat swamp forest and their N ₂ O emitting conditions (Yasuyuki Hashidoko)	52
.....	
PART 2	
Tropical Peatland in Natural Conditions	
Plant Diversity and Biomass Content in Relation with Wise Use of Tropical Peatland (Istomo, Cahyo Wibowo)	57
Community Structure of Aquatic Biota in the Peatland (Sutrisno Sukimin)	67
Methanogenic microorganisms in peatlands (Abdul Hadi)	74
Biomass content and biodiversity of tropical peat swamp forest under various land cover conditions (Adi Jaya, Ulfah J. Siregar, and M.Y. Massijaya)	84

PART 3

Potential of Tropical Peatland and Their Use

The Environmentally Design of Water Management System for Sustainable Peatland Development in Indonesia (Dedi Kusnadi)	99
Integrated Water Zoning for Sustainable Forest Plantation in Tropical Peatlands Budi Indra Setiawan A.Harisman, S.Arfianto, E.Susandi, J.Ginting, Soewarso)	110
Utilization of Peatland for Oilpalm Plantation (Suroso Rahutomo, E.S Sutarta, and W Darmosarkoro)	124
Food Availability And Agricultural Product In Peatland (Tabat Area), Central Kalimantan, Indonesia (Clara Kusharto and M. Annis Catur Adi)	134
Utilization of Degraded Peatland for Producing Biomass as Source of Bioenergy and Compost (Apong Sandrawati and Suwardi)	144
Mapping of peat hydrological unit and peat dome of Indonesia in supporting sustainable peat management (Baba Barus, K. Gandasmita and Reni Kusumo)	148
The carbon stock baseline as wise use management of tropical peat land. Case study in the oil palm plantation (Bambang Hero Saharjo)	157
Characterization and Prediction of Tropical Peatland for The Wise Use (Darmawan, Basuki Sumawinata and Suwardi)	171
Development and Management of Wetland (Soedodo Hardjoamidjojo and Nora H. Panjaitan)	178
Utilization of Acid Sulfate Soil in Rantau Rasau-Jambi Province for Cultivation of Gaharu (<i>Aquilaria sp</i>) (Suwardi, Basuki Sumawinata, Darmawan, Gunawan Djajakirana, and Hermanu Wijaya)	185

PART 4

Amelioration and Policy for Concerning Tropical Peatland

Renovation of Acid Sulfate Soil for Integrated Farming at Delta Berbak, Jambi Province (Suwardi, Gunawan Djajakirana, Hermanu Wijaya, and Basuki Sumawinata)	191
Study on improvement of Indonesian acid sulphate soil : ameliorant for masking aluminium toxicity in rice plant (Basuki Sumawinata, Gunawan Djajakirana, and D.P. Tejo Baskoro)	200
Absorption of Ca, Mg, K, Na in corn on ombrogenous peat as affected by volcanic ash and fly ash application (Eko Hanudin)	201

Application of Fly Ash as Ameliorant in Peatland Environment: The Release of Micro Nutrients and Heavy Metals (Iskandar, Suwardi and E.F.R. Ramadina)	207
Restoration of hydrophobic peat by surfactants addition, its effect on water retention, cation, depository efficiency and FTIR Spectroscopy (Sri Nuryani Hidayah Utami)	214
Closing Remark	237
List of Participants	239

UTILIZATION OF DEGRADED PEATLAND FOR PRODUCING BIOMASS AS SOURCE OF BIOENERGY AND COMPOST

Apong Sandrawati and Suwardi

Study Program of Soil Agrotechnology,
Department of Soil Science and Land Resources, Faculty of Agriculture,
Bogor Agricultural University
Email: aponksandra@yahoo.com

ABSTRACT

Peatland in Indonesia is recognized as the most important reservoir of plants and animals biodiversity and its exhibit a range of important ecological and natural resource functions. Natural vegetations at the peatland ecosystem are dominated by plants adapted with prolonged water lodge. Reclamation of peatland by canalization for making land suitable for many crops bring the areas become degraded land that characterized by very low pH and low nutrients for plants. Consequently, many areas are abandoned by farmers then only natural adapted vegetations are grown. Eichhornia crassipes, Stenochlaena palustris, and Lepironia articulata are the most tolerance vegetations in degraded peatland ecosystem. These vegetations are produce biomass in a high growth rate, therefore, they proposed for producing biomass as source of bioenergy and compost as well.

Keywords : *compost, peatland ecosystem, vegetation*

INTRODUCTION

Natural peatland is recognized as the most important reservoirs of plants and animals biodiversity. Natural peatland is very importance environment that have a highly productive ecosystem with diverse flora and fauna. It also form a unique habitats for certain aquatic and hydrophyte plants. These plants in peatland system provide the basis for animal life, as well as conduct important hydrologic buffering and water purification functions (Stokes, 1939).

Reclamation of the peatland has become a priority of many authorities due to limitation of land for agricultural development. Peatland environments were regarded as wasteland that has possibility for conversion into agricultural or industrial lands. Peatland was reclaimed for industrial and agricultural development elsewhere in the world. Since 1980's, Indonesian government has done a great reclamation of large peatland in Sumatra and Kalimantan Islands. One of the biggest programs call "One Million Hectares Peatland Reclamation" in Central Kalimantan (Adhi, 1986). In the last mentioned program of peatland reclamation to agricultural land was failed and most of the lands become degraded lands.

The most important key for reclamation of peatland is water management. Water is the key to peatland maintenance, even though water levels fluctuate throughout the year. In order to make the peatland became suitable for many crops, the authorities built very long, wide, and deep

drainage canals. The reclamation without concerned to the forest conservation on the peat dome caused many ecosystem damage such as subsidence and very low pH until 2,5. In the lowest soil pH, the soil become very poor of nutrient and many toxic substances invaded in high concentrate. In those condition, peatland become degraded and only limited adapted plants can grow (Hoag, 1994). The adapted plants that producing high biomass can be proposed as source of bioenergy and compost.

POTENTIAL PLANTS FOR BIOENERGY AND COMPOST

Peatland is characterized by water saturation in the root zone at or above the soil surface, for a certain amount of time during the year. The inundated or saturated conditions occurring an unique environment. Peatland is an important habitat for more than thousands kinds of flora both fauna (Adhi, 1986). Unwise utilization of peatland by human activity destroy peatland ecology become degraded peatland. The lands then abandoned by farmers. Abandoned peatland has low biodiversity, due to many varieties of flora and fauna died due to fires and unsuitable environment, and only certain varieties could survive. It is preferable only local adapted species that could survive in the limited condition.

Some adapted vegetations have good growth at degraded land. These vegetations have a highly tolerant with very low pH, flooding and insect invasion. Some vegetations also have a good tolerant to toxic substances, such as aluminium. Most of them can identified as water weeds (Hoag, 1994). The plants are *Eichhornia crassipes*, *Stenochlaena palustris*, and *Lepironia articulata* Domin. Those plants have a good adaptation with degraded land and have potential to produce biomass in high number. The description of the plant are as follows.

1. *Eichhornia crassipes*

This plant has local name as Eceng Gondok, or water hyacinth. It is a kind of water weeds, and has many kinds of varieties. Eceng Gondok can grow in the range of pH 3.5 – 10.0 but the optimum at pH 4.5 – 7.0 This plant has growth and regeneration very rapid. In 8 mounths, it can be able to produce 600.000 new plants from only 10 main plants. Another observation told that this plant double in number and biomass every 6 to 15 days, and could yield 20 and 120 tons of dry biomass per year/ha. The rapid growth of this plant potential to produce biomass in high number. Eceng gondok known as accumulator plant. This plant could absorb toxic substances and heavy metals (Schrauf, *et. al*, 2005)

2. *Stenochlaena palustris*, in local name known as Kelakai. It is a rhizomatous and epiphytic perennial that commonly found growing in fresh water as well as in peat swamps area. The expanded leaves are used as a vegetable. This plant has a high growth rate and could covered large area.

3. *Lepironia articulata*, in local name known as Purun. It is a kind of herb water weeds that have high growth rate in soil that containing acid sulphate and high concentrate heavy metals. Life in asosiated, with close connected roots, this would produce a high biomass.

BIOMASS IN DEGRADED LAND AS SOURCE OF BIOENERGY AND COMPOST

In particular to reduce the needs of oils and gas as energy resource, any contributions are certainly needed to find the other potential energy resources. Biomass has great potential to provide renewable energy and going to be the largest domestic source of energy. Biomass has great potential to provide heat and power to industry and to provide feedstocks to make a wide range of chemicals and materials or bioproducts. In United States, the use of this kind of source of energy has provide over 3 percent of the total energy consumption (Perlack, *et. al.* 2004).

Bioenergy is made from materials derived from biological sources such as biomass. It is most narrow sense a synonym to biofuel, which is fuel derived from biological sources. There is a slight tendency for the word *bioenergy* to be favoured in Europe compared with *biofuel* in North America. Bioenergy produced from organic matter. It's could be used directly as a fuel, processed into liquids and gasses, or be a residual of processing and conversion. Looking at the number of abandoned peatland in Indonesia, it is going to be a largest potential biomass sources. If we estimate that abandoned peatland could produce biomass 10 tons per hectare per year, a big biomass resources for bioenergy are available from degraded peatland.

Eichhornia crassipes, *Stenochlaena palustris*, and *Lepironia articulata* Domin, clasified as weeds that have a rapid growth in the wetland. Biomass that produced from those plants can be used for compost after mixing with improving compost quality materials, such as cow dung, liming, urea, etc. The compost can be produce manually by conventional composting or by machinery. The most important of making compost is preparing machine for destroying biomass.

All materials will oxidized to "compost", include *Eichhornia crassipes*, *Stenochlaena palustris*, and *Lepironia articulata* Domin. The compost can be use for rehabilitation of degraded land for planting horticultural plants as well as food crops, and plantations. Compost is the most important materials for improving soil properties.

Kaple (2009), told that the N, P, K content in *Eichhornia crassipes* compost generally 1,0 %, 0,5 % and 1,0 %, respectively. Likewise the N, P, K values in the farmyard manure falls under 0,5-1,0%, 0,5% and 0,5-1,0% ranges, respectively. It is shown that water hyacinth compost has acceptable to be used in agricultural land for growing food crops and horticultural crops.

Relation to the use of accumulator plants, the chemical analysis of compost must be done. The results from the laboratory analyses help us to assess the compost likely benefits and potential risks for soil amendmets. The concentration of toxicity materials or the presence of toxic elements can be used as compost quality.

CONCLUSIONS

Vegetation of *Eichhornia crassipes*, *Stenochlaena palustris*, and *Lepironia articulata* are included adapted plants at degraded peatland. These plants have a rapid growth and produce high biomass. The biomass can be used as source of bioenergy and compost. More analysis of compost in relation to the presence of toxic elements or substances should be done to assess the risk of compost application in the fields.

REFERENCE

- Adhi, I.G.P. Widjadja 1986. Pengelolaan lahan rawa pasang surut dan lebak. Agriculture Research and Development Journal. V(1):1-9.
- Hoag, J.C. 1994. Wetland Plant Ecologist, Interagency Riparian/ Wetland Plant Development Project, USDA - Natural Resources Conservation Service, Plant Materials Center, Aberdeen, ID.
- Kafle, Mohan Raj, et al. 2009. Results of an Experiment of Preparing Compost from Invasive Water hyacinth (*Eichhornia crassipes*) in Rupa Lake Area, Nepal. Journal of Wetlands Ecology, (2009) vol. 2, pp 17-19.
- Perlack, R.D, *et. al.* 2004. Biomass as Feedstock for A Bioenergy and Bioproducts Industry: The Technical Feasibility Of A Billion-Ton Annual Supply. Environmental Sciences Division. USA.
- Schrauf, Todd, and Smith, Mark. 2005. Wetlands Treatment Of Mine Drainage. The mining record, October 2005.
- Stokes, A.P. Dachnowski. 1939. Improvement of unproductive and abandoned peatland for wildlife and related uses. *Ecology*, Vol. 20, No. 2 (Apr., 1939), pp. 187-197. Published by: Ecological Society of America. Stable URL: <http://www.jstor.org/stable/1930739>.