CARBON STOCK DETERMINATION IN PEAT SOIL: *Case study on Heho Valley Peatland, Southern Shan State, Myanmar*

January 2014

Outline of the Presentation

- Introduction
- Materials and Methods

    - sampling method,

    - analysis methods, etc.
- Results & Discussions
- Conclusions

Introduction

What is Peat?

- Peat belongs to a group of soils called Histosols
- **'it is a layer of partially decomposed vegetation with a high proportion of organic matter'**

a) Andriesse (1988) defines peat as organic soil that contain more than 50% organic matter in the upper 80 cm;

b) In the glossary of Rieley and Page (2005), the percentage of organic matter is required to be 65%, but thickness is reduced to 50 cm; and

c) Joosten and Clarke (2002), M. Zauft et al., (2010) specify a minimum thickness of 30 cm of material containing at least 30 % organic material

- **These definition can vary significantly "the minimum percentage OM required can range from 20% to 80% (Charman, 2002)"**

- One of the World's most important ecosystems
- Covering about 4×10^6 km^2 or 3% of the global land area (Lappalainen, 1996)
- The current estimates of the carbon storage in the global peatlands range from 120×10^9 to 541×10^9 t (Post *et al.*, 1982; Bolin, 1986; Gorham, 1991; Franzen, 1992; Lappalainen, 1996; Zoltai and Mattikainen, 1996; Rouse *et al.*, 2000),
- which is equavilent to 10% - 35% of the global soil carbon storage (Eswaran *et al.*, 1993)

Peatland areas in Myanmar

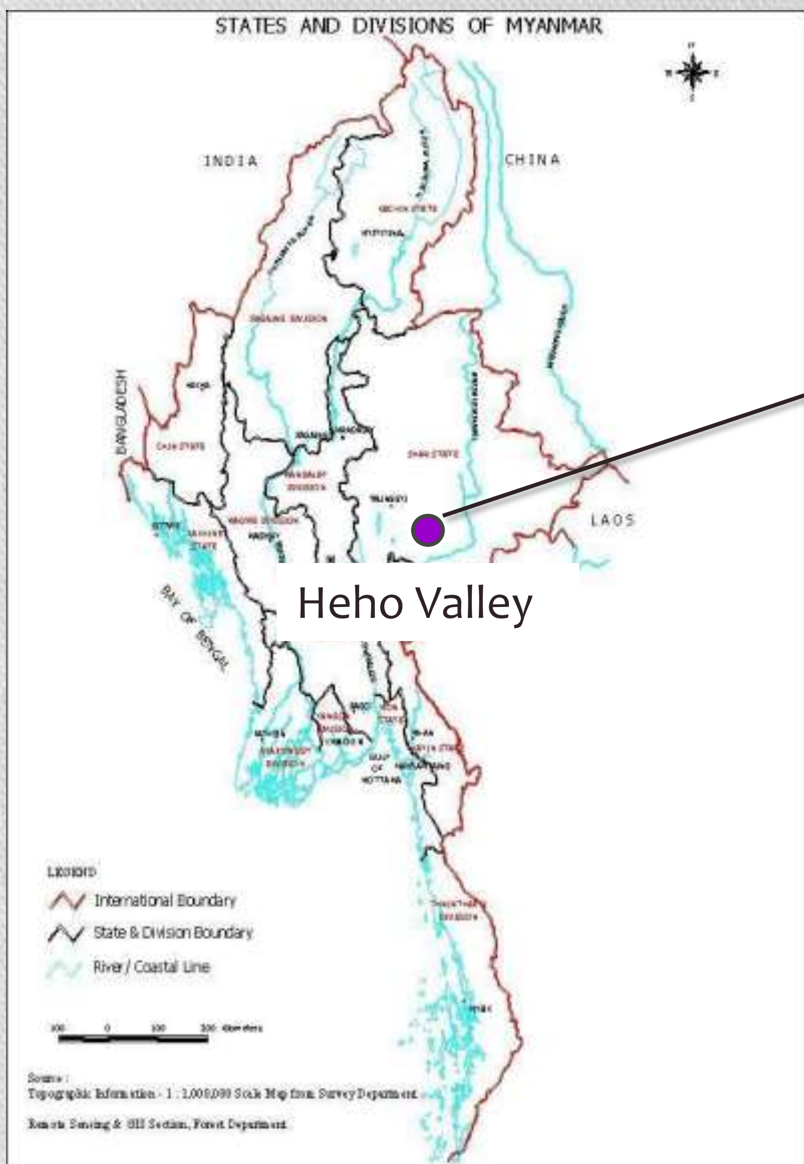
- **500 km² (>30 cm depth) by Kivinen& Pakarinen (1980) and Markov et al., (1988)**
- **3,410 km² by Van Engelen & Huting (2002)**
- **1228 km^2 by World Energy Council (2013); Verwer et. Al., (2010)**
- **122,800 ha (Peatland and Climate change in Southeast Asia) (cited by FREDA, 2014)**
- However, the peatland areas in Myanmar have not been adequately and exactly explored and identified yet.
- Therefore, information regarding the exact amount of carbon storage in peatlands in Myanmar is also limited.

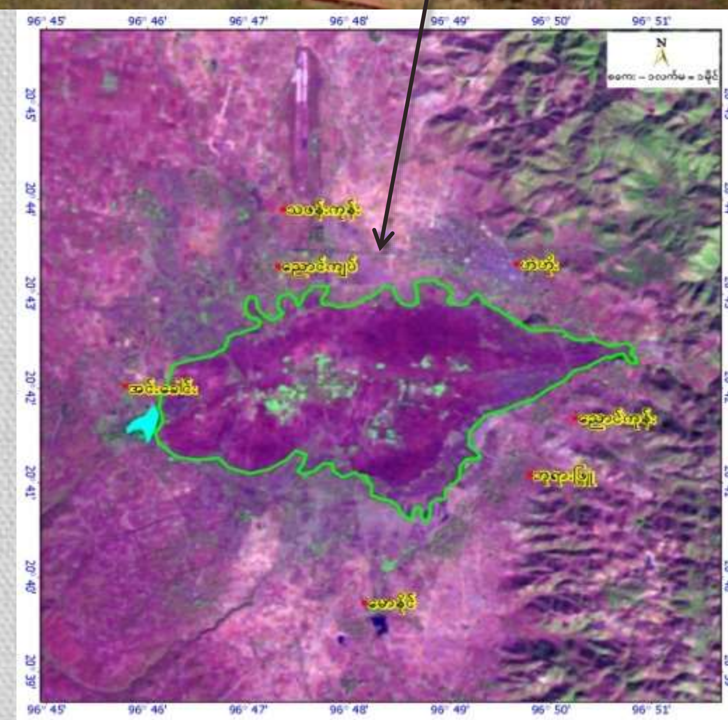
Objectives

- To assess the carbon storage and carbon density of peatland area

Materials and Methods

Study Area


STATES AND DIVISIONS OF MYANMAR
INDIA
CHINA
BANGLADESH
LAOS
BAY OF BENGAL
Heho Valley
LEGEND
International Boundary
State & Division Boundary
River / Coastal Line
Source :
Topographic Information - 1 : 1,000,000 Scale Map from Survey Department
Remote Sensing & GIS Section, Forest Department


96° 45'
96° 46'
96° 47'
96° 48'
96° 49'
96° 50'
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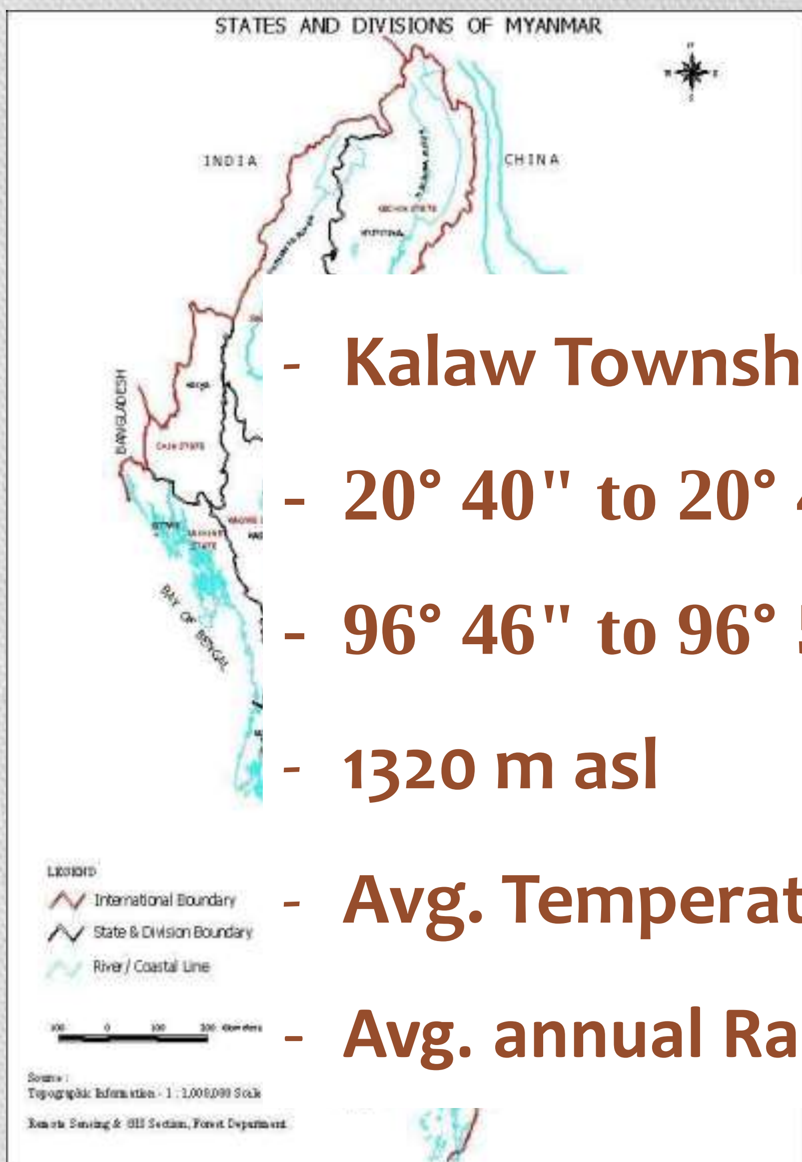
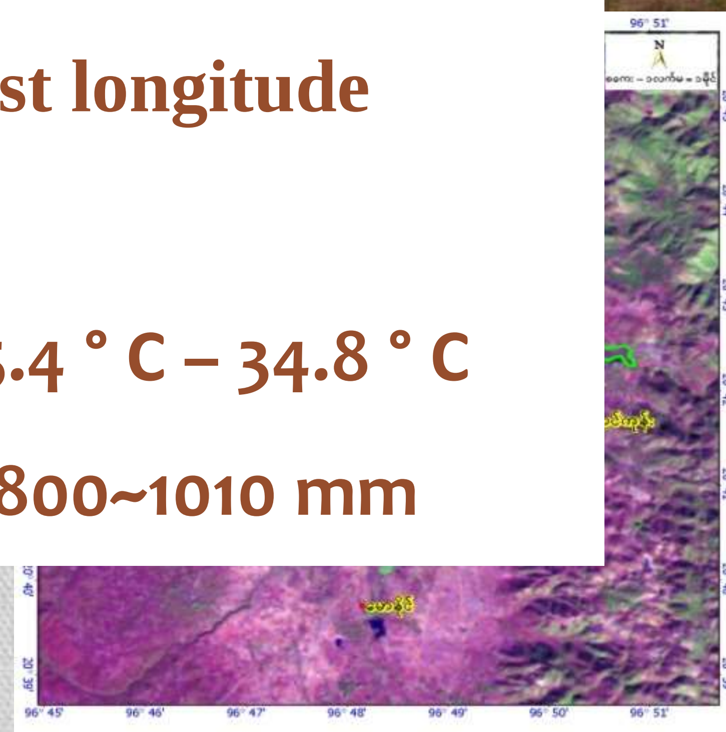
N
20° 45'
20° 44'
20° 43'
20° 42'
20° 41'
20° 40'
20° 39'

Study Area

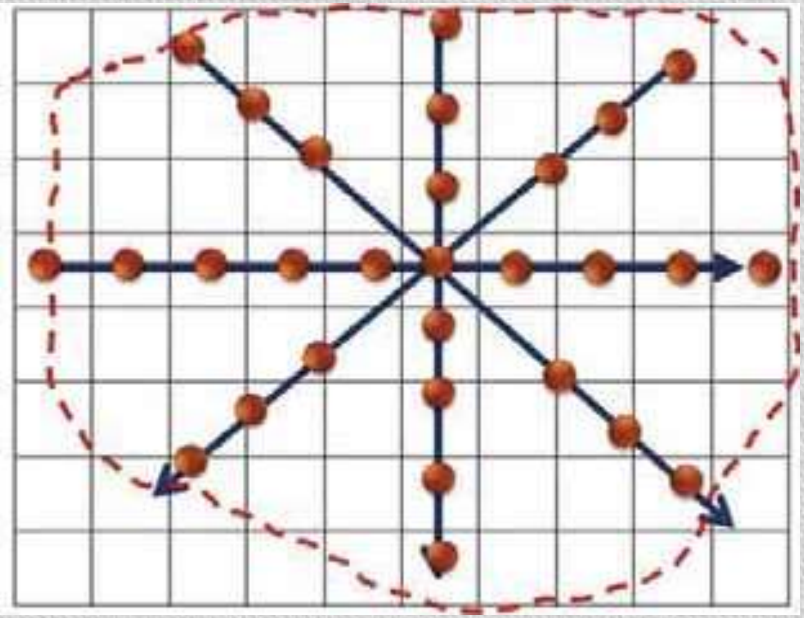


- Kalaw Township, Southern Shan State
- 20° 40" to 20° 43" North latitude
- 96° 46" to 96° 50" East longitude
- 1320 m asl
- Avg. Temperature : 15.4 ° C – 34.8 ° C
- Avg. annual Rainfall : 800~1010 mm



Data Collection

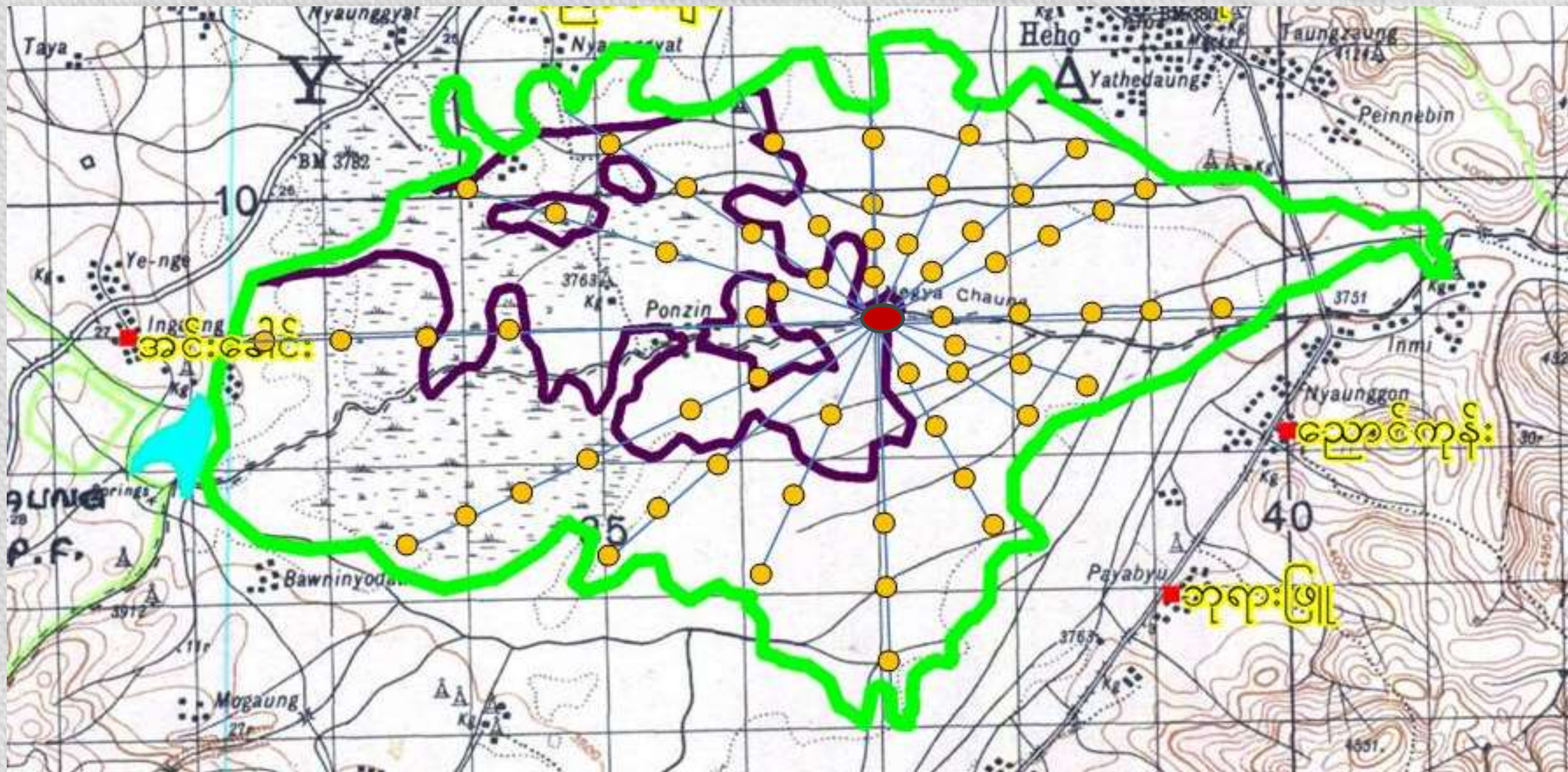
Sampling point determination



Source: Agus *et. al.* (2011)

- Sample collections occurred at points distributed on a grid system of transects across the area.
- A base-line transect was surveyed on the long axis of the Peatland, and side-line transects surveyed at right angle in order to properly distribute coverage across the Peatland.
- The coordinates of each point of measurement were recorded by using a global positioning system (GPS).

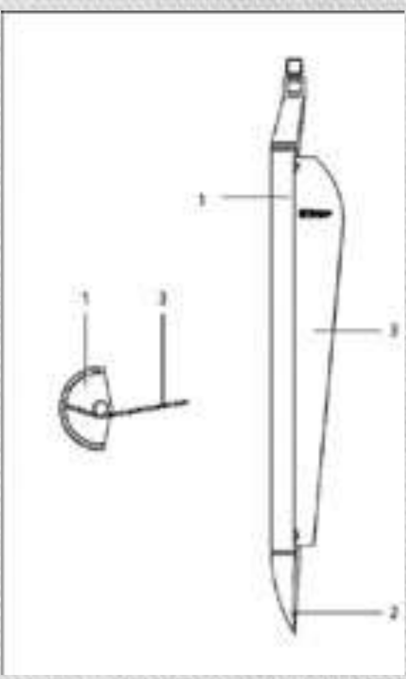
Schematic diagram of sampling points within a peat dome using transect methods for the study area



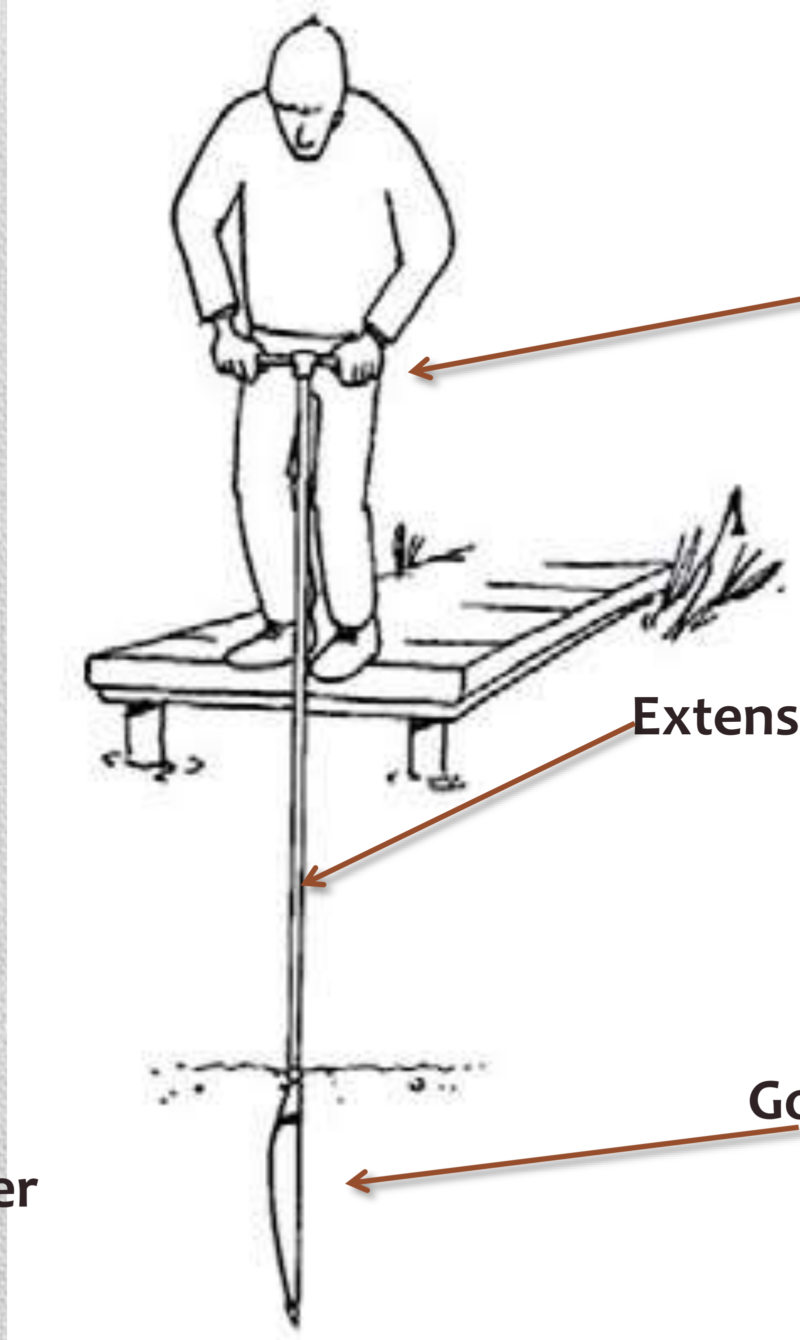
- Sample points were surveyed at 400± 5m interval
- Peatland information (peat depth, land use and drainage) was recorded.
- A total of (60) sampling points were collected by using Edelman auger.

Tools and materials

a) Peat auger, consisting of peat sampler, extension rods and one handle
b) Number 23 spanner or wrench (2 pcs) to install and disassemble the extension rods
c) Metre stick or tape (2 m long) for measuring the thickness of the peat layers, the depth of charcoal or clay layers (if any) and the water table
d) Fifty-metre-long metre tape for measuring the distance between observation points on a transect
e) Knife or plastic spatula
f) Brush and cloths for cleaning the auger
g) Bucket
h) Plastic Bags
i) Labeling cards
j) Markers
k) GPS device



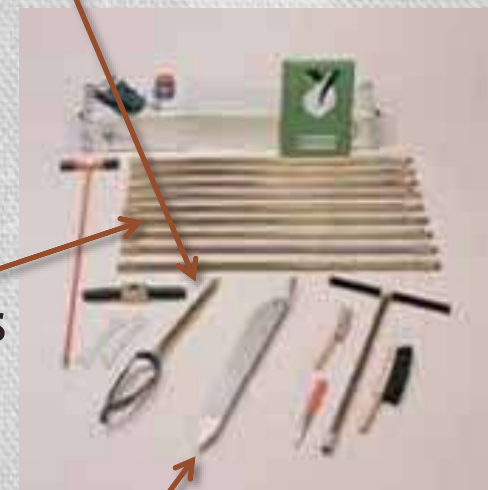
Edelman auger



Handle

Extension rods

Gouge and fin



Source: Agus *et al.* (2011)

Peat Depth

- Essential to estimate peat carbon store,
- Recorded by using a long metallic probe
- Carried out by gentle pushing a probe
- Measured the depth of the peat when the probe hit the mineral layer

- **Peat samples were collected at each point at each layer with 1 m increment.**
- **A total of (91) peat samples were collected by using Edelman auger.**
- **Samples were taken to the Lab (FRI) for analysis of variables (OC, BD, Peat maturity)**

Peat sample appearing from the gouge

Peat sample labeled and sealed in plastic bags, ready for transportation to the laboratory for analysis

Source: Agus *et al.* (2011)

Laboratory Methods

1. Determination of Peat Maturity

- Useful for assessing peat fertility and carbon content
- Peat maturity test was followed by Agus *et al.* (2011)
- $Fibre\ content\ = {}^{Vol\ 2}/_{Vol\ 1} \times 100\%$

Sapric peat: well decomposed peat with fibre content less than 15%

Hemi peat: half-decomposed peat with fibre content 15-75%

Fibric peat: immature peat with fibre content greater than 75%

2. Bulk Density determination


Source: Agus *et al.* (2011)

- A gravimetric method
- $BD = {M_{ds}}/{V_s}$
- M_{ds}- dry weight of sample (g)
- V_s - sample volume (cm^3)

3. Organic carbon determination

- as a proportion of organic matter content
- by using loss-on-ignition (LoI)
- $\boldsymbol{LOI\ (g/_{kg}) = {}^{(Weight_{dry} - Weight_{ignition})}/_{Weight_{dry}} \cdot 100}$
- Conversion factor of 1.724 (58%)

- **conversion factor can vary between 1.724 and 2.500 (Schumacher, 2002)**

- $\boldsymbol{Peatland\ Carbon\ Stock\ (kg\ C\ m^{-2}) = C_{g/kg} \times BD \times D_s \times A}$
- $C_{g/kg}$ = carbon concentration on gravimetric basis (g kg^{-1})
- BD = bulk density (g soil cm^{-3} or kg soil m^{-3})
- D_s = peat depth (m)
- A = area (m^2)
- $\mathbf{POCD} = \overline{\boldsymbol{BD}} \cdot \overline{\boldsymbol{TOC}} \cdot \boldsymbol{D_s}$

- **Tone of carbon dioxide equivalent per hectare (t CO_2-e/ha) is calculated by multiplying the carbon stock by 3.67 (*IPCC, 2006*)**

Results and Discussions

Characteristics of Peatland in Heho Valley

Peat Depth	: 110 (77) cm
Peat Bulk Density	: 0.23 (0.06) g/cm^3
Organic carbon concentration	: 25 (7) %
Moisture content	: 72 (9) %
Peat Maturity	: Hemic
Peatland type	: Buried peatland **Peat covered by a layer of mineral soil**
Land use	: Agriculture (cultivation of cabbage, garlic, anion, potato, etc.)

Total Carbon stored at the study area

	Range	Average
Peat thickness (cm)	15-295	110 (77)
Bulk Density (g/cm3)	0.11- 0.34	0.23 (0.06)
Carbon density (kg/m3)	11 –121	39 (21)
Total Carbon stock (t ha^{-1}) of thickness;		
< 200 cm	60 - 817	268 (168)
> 200 cm	217 - 476	285(97)
Total Carbon stock (t ha^{-1})		287 (214)
Total Carbon stock (M tons/area)		0.48 (0.35)
tCO_2e (t ha^{-1})		1053
tCO_2e (M tons/area)		1.8

(TOC, peat depth and BD are means ± SD, and total carbon stocks are shown with total uncertainties)

Country	Type of land use	Organic Carbon Density (kgm^{-3})	Remarks	Reference
China Jianxi Yunnen	n.a.	280 – 305 100 - 130	Buried peat land	Zigang *et. al.* (2012)
Indonesia Kalimentan	Agriculture land	40.22	Hemic	Wahyunto *et al.* (2010)
Myanmar Heho Valley	Agriculture land	39	Hemic	Present study

Conclusions

- Provides consistent estimates of C stocks for the peatland in Heho valley
- TOC contents were relatively lower than that of peatlands in other SE Asia countries, which may be due to the historical (peat extraction, drainage) and current land uses.
- The higher bulk density and lower organic carbon in this study area may be due to the lowering of the water table and the subsequent increased aeration of the peat due to drainage preparations for agriculture purpose.
- Although carbon stocks of the peatland on Haho valley are relatively low, they can be a significant source of vulnerable C which will be able to be transformed to carbon dioxide to release into the atmosphere if the peatland is drained or converted to agriculture for a long period.
- Therefore, planning the wise use of the peatland with low carbon emissions is urgently needed.

Acknowledgement

- MOECAF, FD
- ECD
- FREDA
- GEF

Thank You for your kind attention!