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Terms of Reference  
The 4<sup>th</sup> Indonesia-Japan Forest Talks (IJFT-4)

*“REHABILITATING AND RESTORING DEGRADED PEATLANDS TO SUPPORT THE  
ACHIEVEMENT OF INDONESIA FOLU NET SINK 2030”*

Hokkaido & Tokyo, 8 November 2023

## From Research to Policy:

Bringing scientific evidence to inform decision making process

Mitsuru OSAKI, Ph, D  
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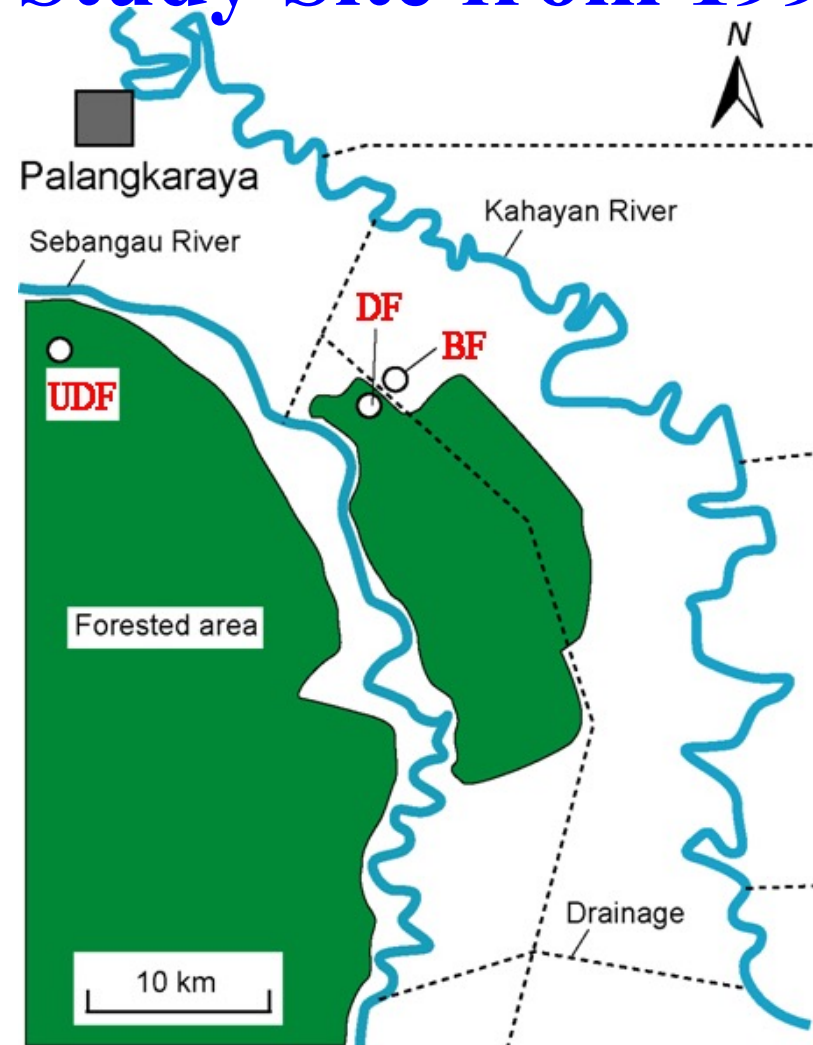
[Research.com](https://www.research.com) ranking in the field of Plant Science  
and Agronomy in 2023  
#11 in Japan  
#668 in the world

# Ex Mega-Rice Project Area @ Central Kalimantan, Indonesia

## Study Site from 1997



Palangkaraya



### Study Topics:

- Green House Gasses Flux ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ )
- Fire Detection and Protection
- Water Table Monitoring and Management
- Peatland Ecology
- Integrated Farming

# Research history on tropical peatlands in Indonesia by Hokkaido University

- 1993
- 1994
- 1995
- 1996
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018

**Joint project by**  
**Univs. Nottingham, Leicester,**  
**Palangka Raya & Hokkaido**

**JSPS Core University Program**  
**Japan: Univs, Hokkaido,**  
**Kagoshima, Tottori, Kyoto,**  
**Kanazawa, Tokyo Agr., etc.**

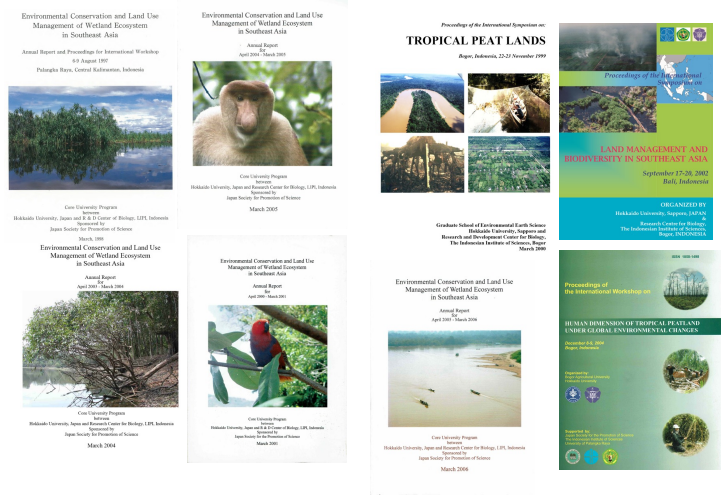
**Indonesia: LIPI, Biology,**  
**Geo-technology, Limnology,**  
**Bogor Agr. Univ.,**  
**Bandung Inst. Tech.,**  
**Univ. Palangka Raya**

**JICA-JST SATREPS**  
**Japan: Hokkaido Univ.**  
**Indonesia: BSN, BPPT,**  
**LIPI, FORDA, UPR, LAPAN**

**IJ-REDD+ Project**  
**Japan: JICA, Hokkaido Univ.**  
**Indonesia: KLHK**

**BRG-JICA-JPS Project**

**Indonesia: BRG, Japan: JICA, Hokkaido & Kyoto Univs.: JPS**

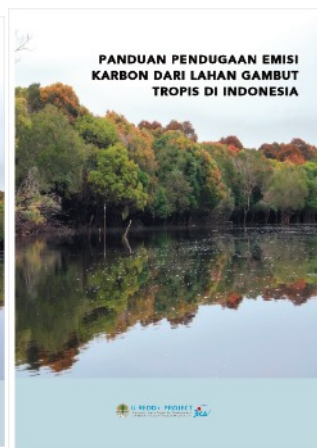
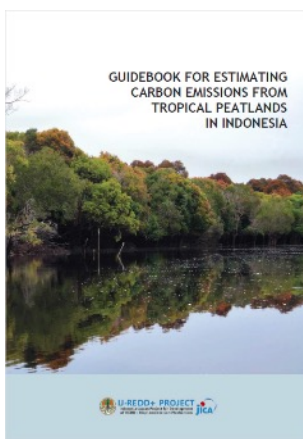


**ODA-JICA Program**  
**Japan: Midori Eng. Lab.**  
**Indonesia: BPPT**

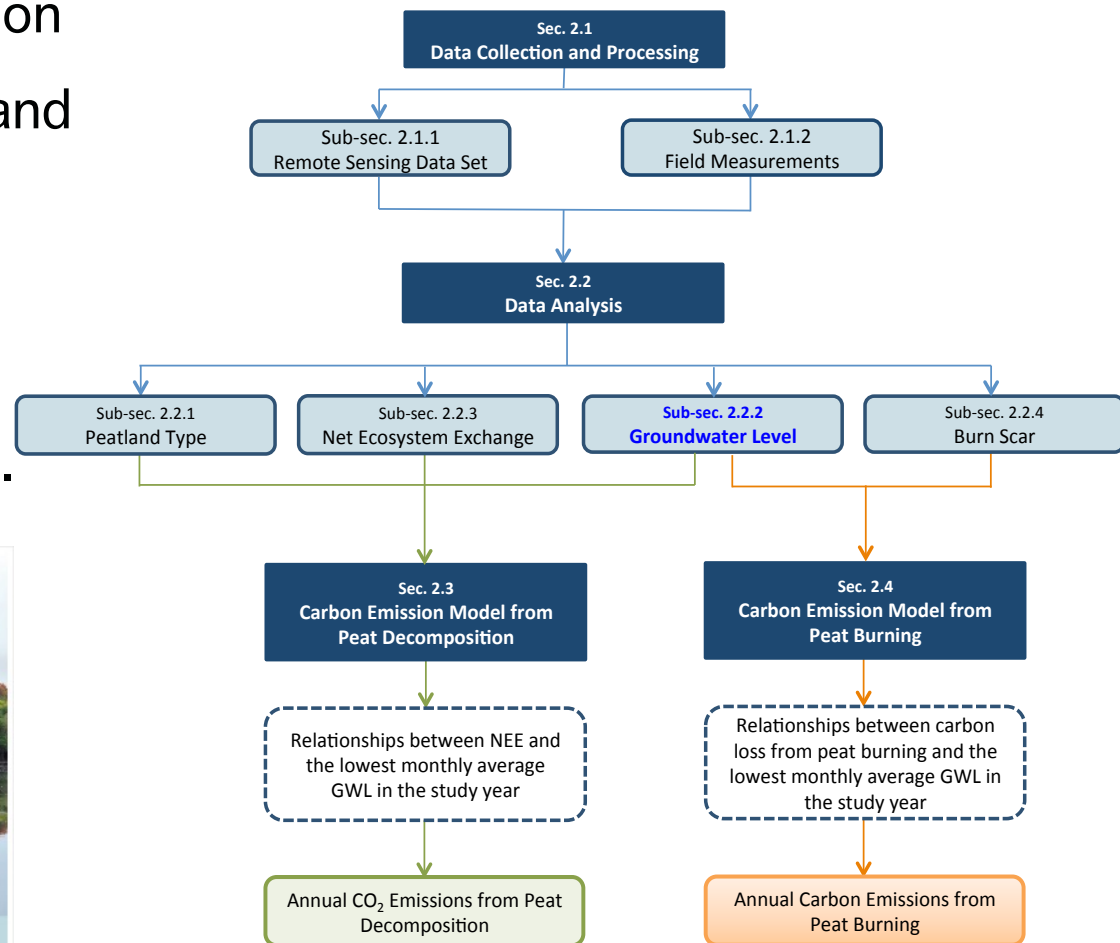
# Guidebook for Estimating C Emission

*Product of Hokkaido Univ. Task Force in IJ-REDD+ Project (2015-2016)*

- How to estimate C emission from:
  - 1) Peat decomposition, and
  - 2) Peat burningbased on GWL estimate.
- General descriptions applicable not only to Central Kalimantan, but also to another tropical peatland.



Guidebook in English & Bahasa



Flowchart of C emission estimation

# SATREPS Project



JST-JICA project on "Science and technology Research Partnership for Sustainable Development"

## Wild Fire and Carbon Management in Peat-Forest in Indonesia



**ICALRRD**  
(Indonesian Center for Agricultural Land Resources Research and Development)



**National Council for Climate Change (DNPI)**

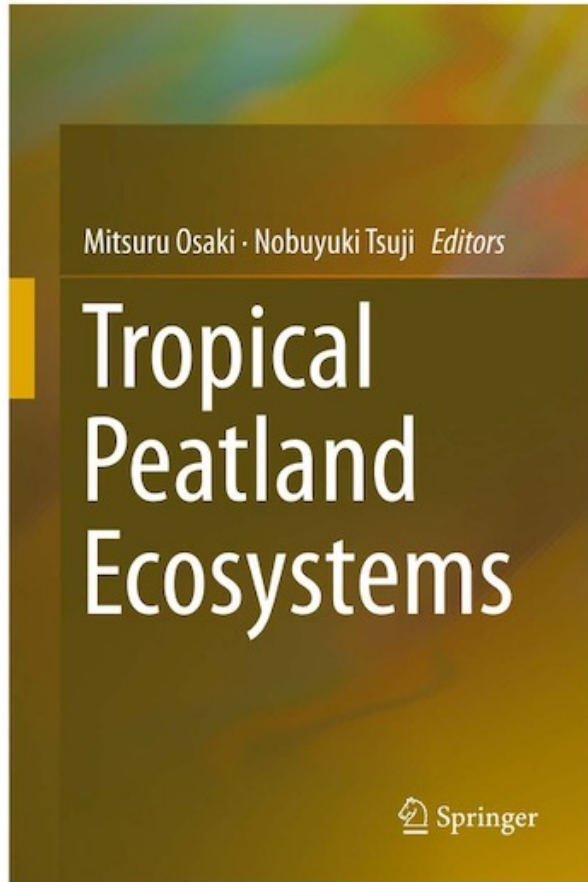
**UGM**



**UNPAR**

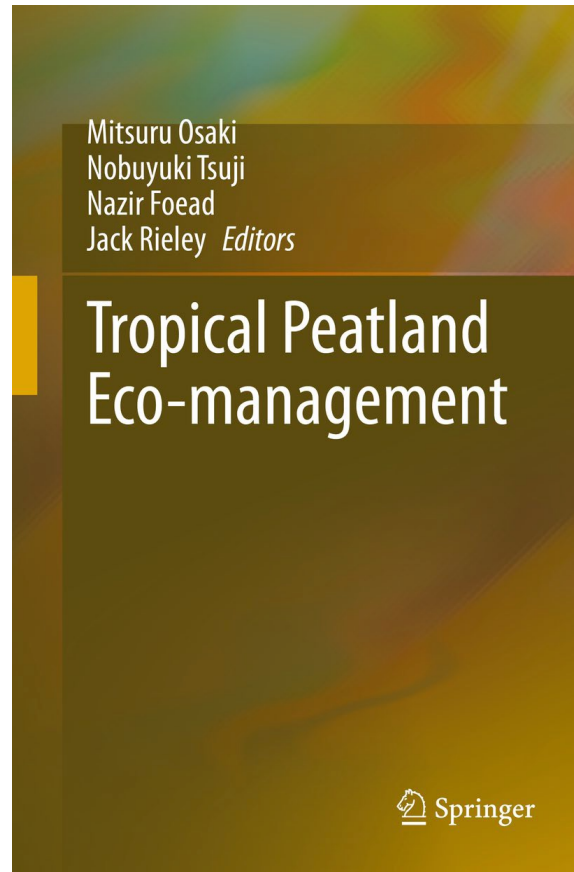


2016



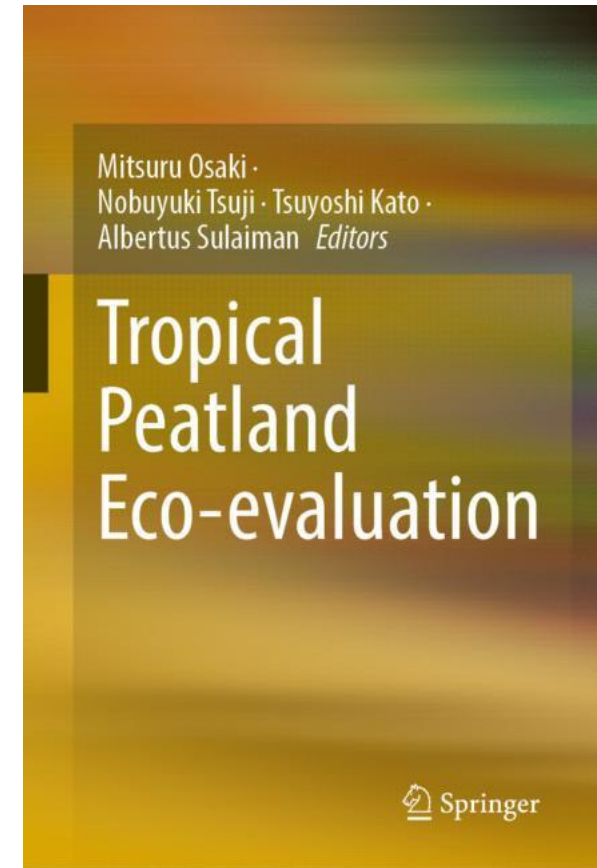
83k Accesses | 176 Citations | 4 Altmetric

2021



14k Accesses | 36 Citations | 7 Altmetric

November 2023

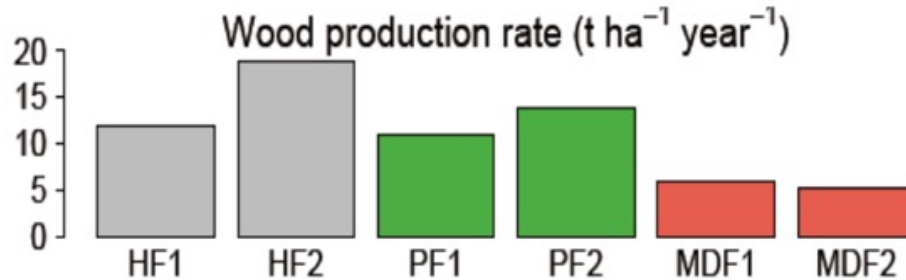
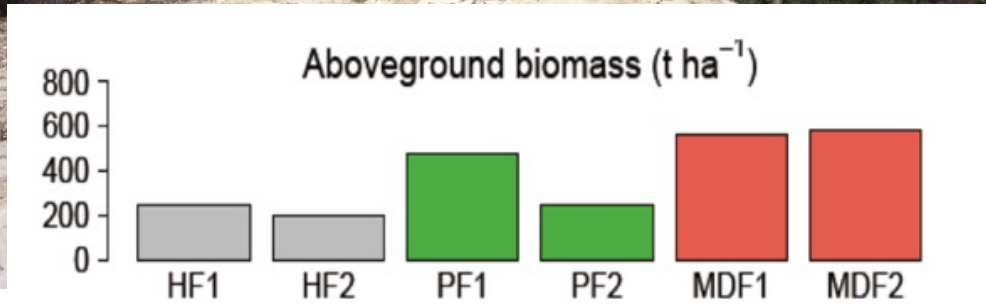


100,000 chapter download

# Ex Mega-Rice Project Area Destroyed



Central Kalimantan Highway  
@ Lahai





# Limiting Factors Study

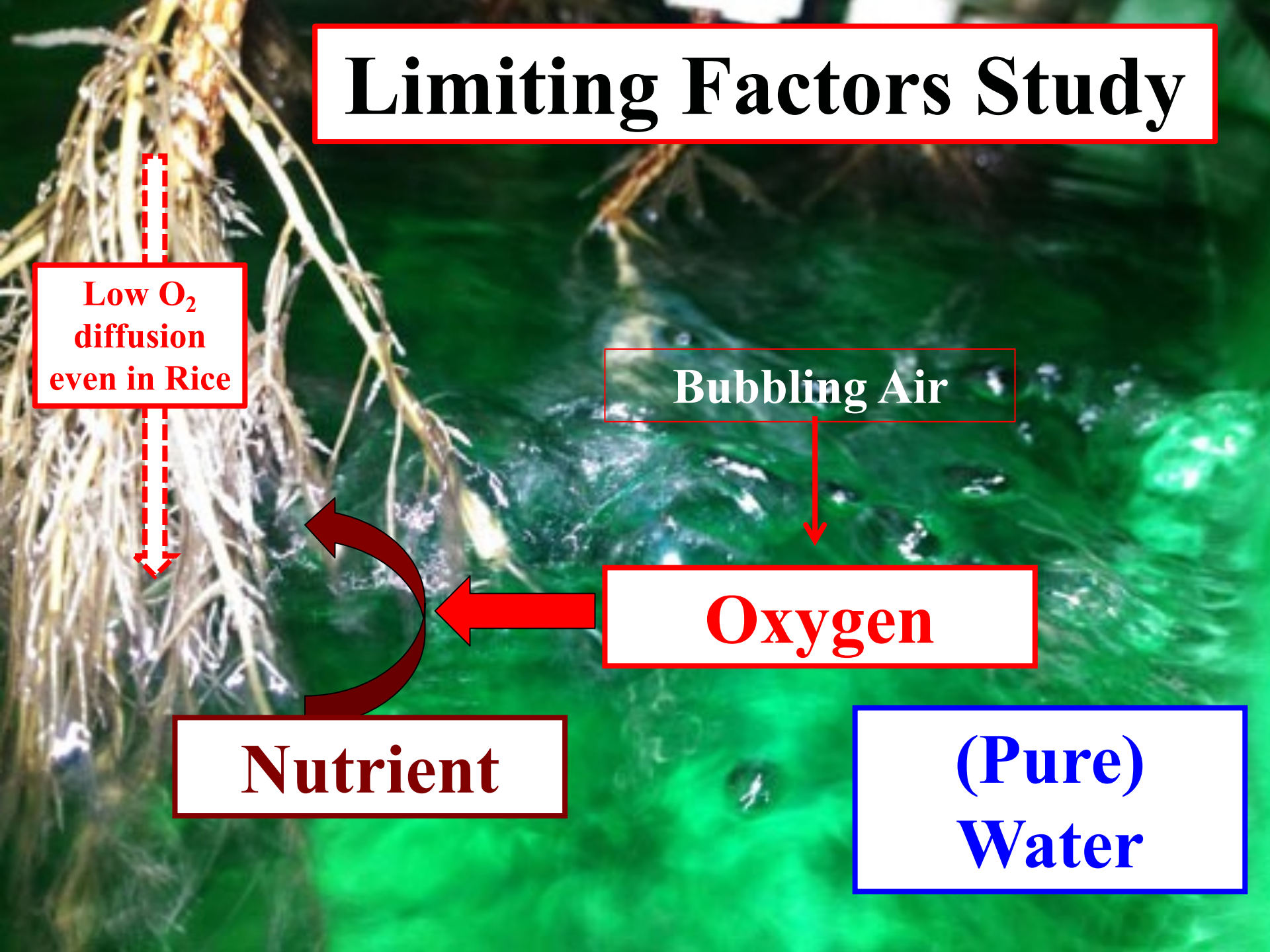
Low O<sub>2</sub>  
diffusion  
even in Rice

Bubbling Air

Oxygen

Nutrient

(Pure)  
Water

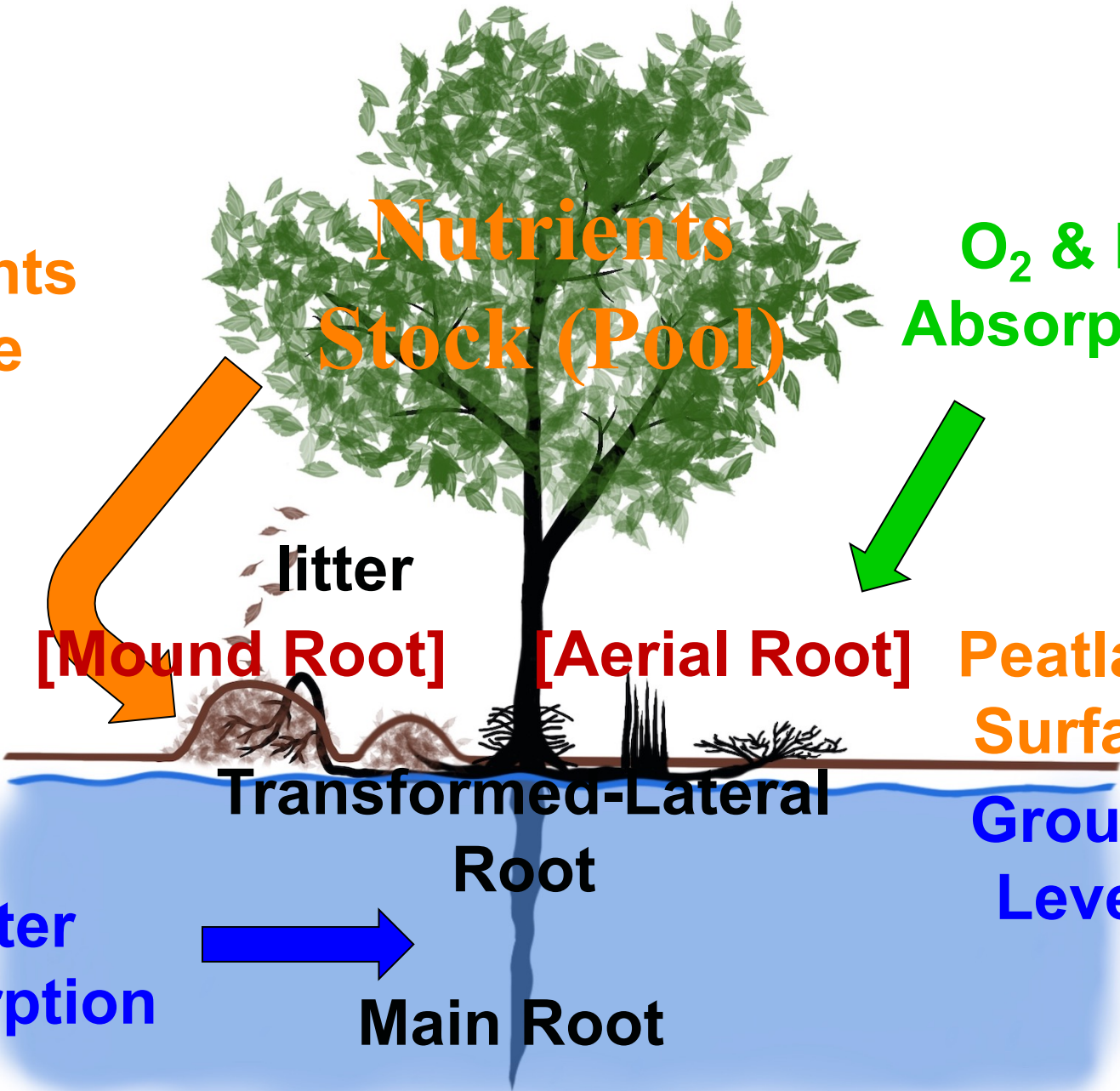


# **I. Nutrients Cycle**

**Nutrients  
Cycle**

**Nutrients  
Stock (Pool)**

**O<sub>2</sub> & N<sub>2</sub>  
Absorption**



**[Mound Root]**

**[Aerial Root]**

**Peatland  
Surface**

**Transformed-Lateral  
Root**

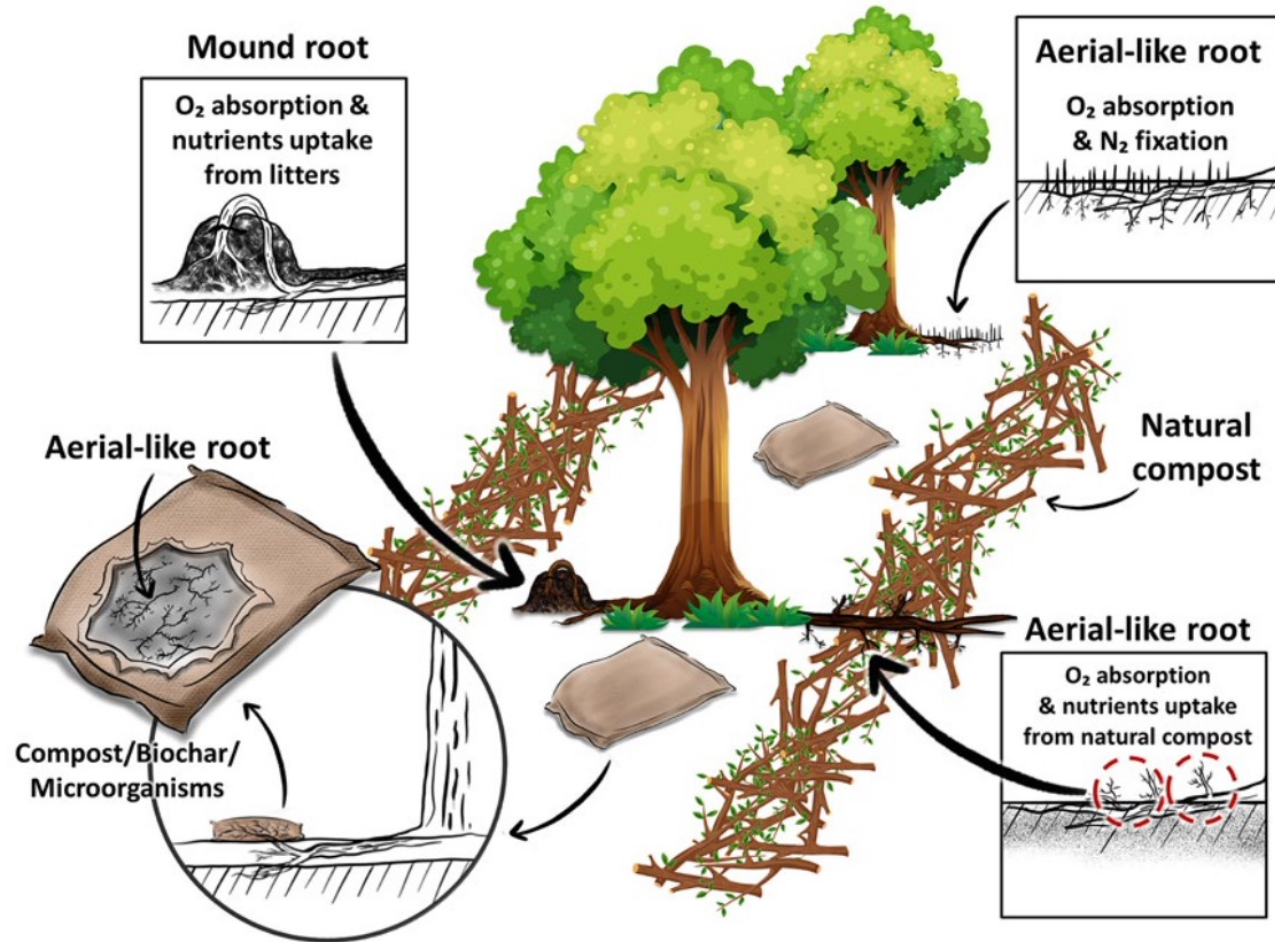
**Ground Water  
Level (GWL)**

**Water  
Absorption**



**Main Root**

# AeroHydro Culture



AeroHydro culture mimics the native peatland ecosystem under a high groundwater table.



**Fertilizer Bag**



**Lateral Roots  
inside Bag**



**Aerial Roots  
in Stem**

# Oil Palm

**Control**

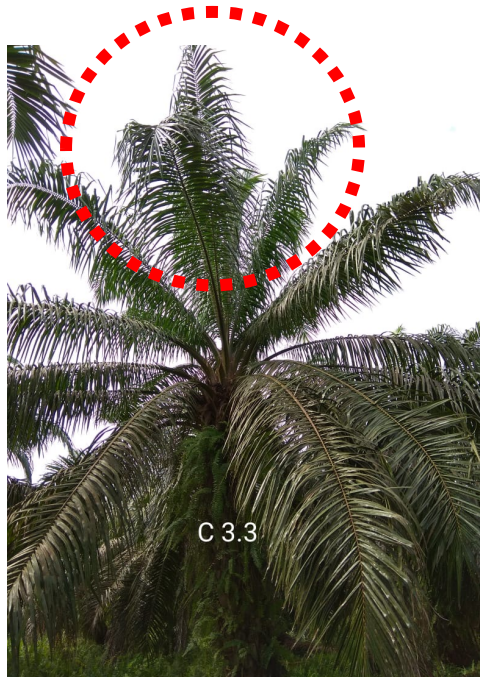
**Treatment**

**No**

**4-5**

**new leaves**

**new leaves**



# *Shorea balangeran*

**Control**

**Treatment**

**2-9**

**13-21**

**new leaves**

**new leaves**





**Treatment**

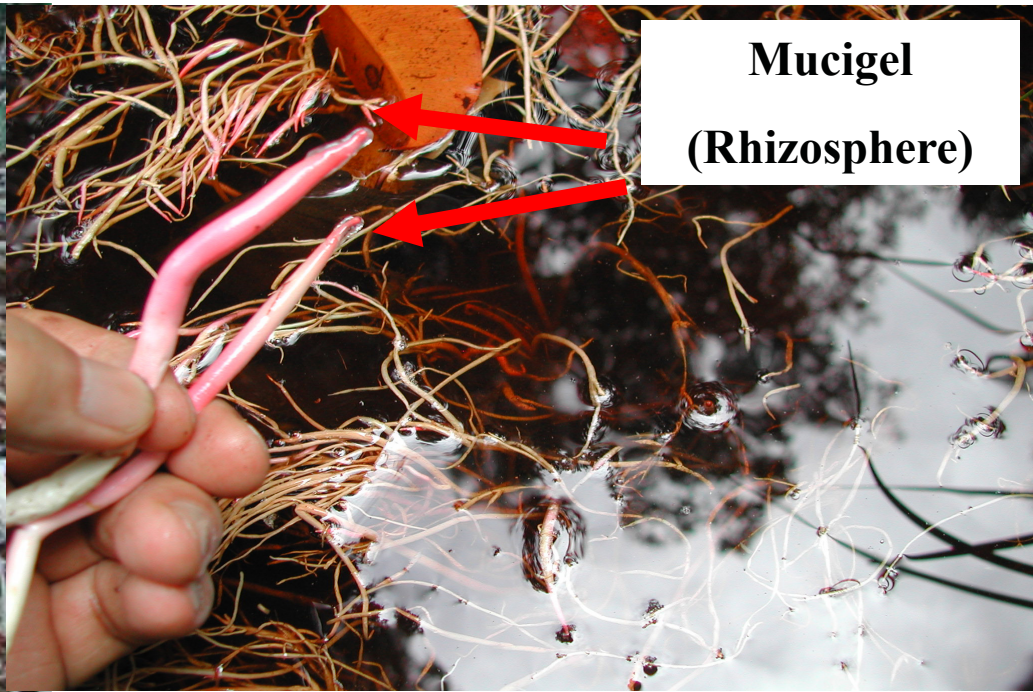


**Control**



Aerial Root of  
*Combretocarpus rotundatus*  
(Tumih or Perepat in local)

The image shows a dense thicket of aerial roots of Combretocarpus rotundatus. The roots are numerous, thin, and light brown, extending from the ground and surrounding vegetation. The background consists of green leaves and brown twigs, suggesting a natural, possibly coastal or mangrove, environment.



Mucigel  
(Rhizosphere)

The image shows a close-up of a hand holding a pinkish-red root of Combretocarpus rotundatus. The root is submerged in water, and a large amount of white, mucilaginous substance (mucigel) is visible around the root, particularly at the tip. Red arrows point to the mucigel. The background shows other roots and water, indicating a natural habitat.



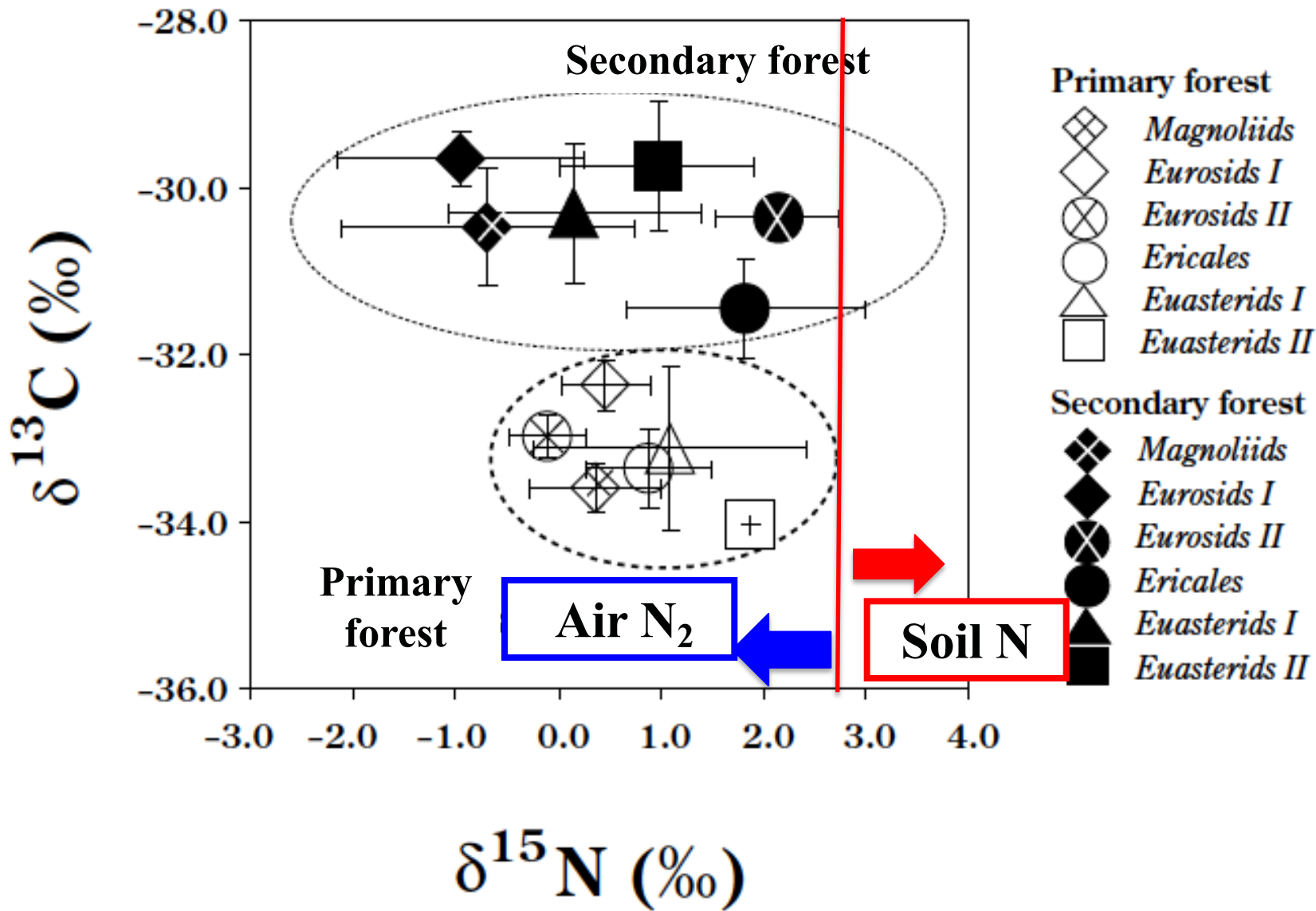
*Melastoma malabathricum* L.



**Mucilage:  
Rhizo- and free-living  
nitrogen-fixing bacteria**

**No endophytic  
nitrogen-fixing bacteria**





## **II. Carbon Cycle**

# What Factors Regulate Carbon in Tropical Peat?

## Deforestation

- Dryness of ground surface
- Decrease water holding capacity

## Ecosystem Change

- Farming/ Vegetation

## Drainage

- Decrease water table

**Water**

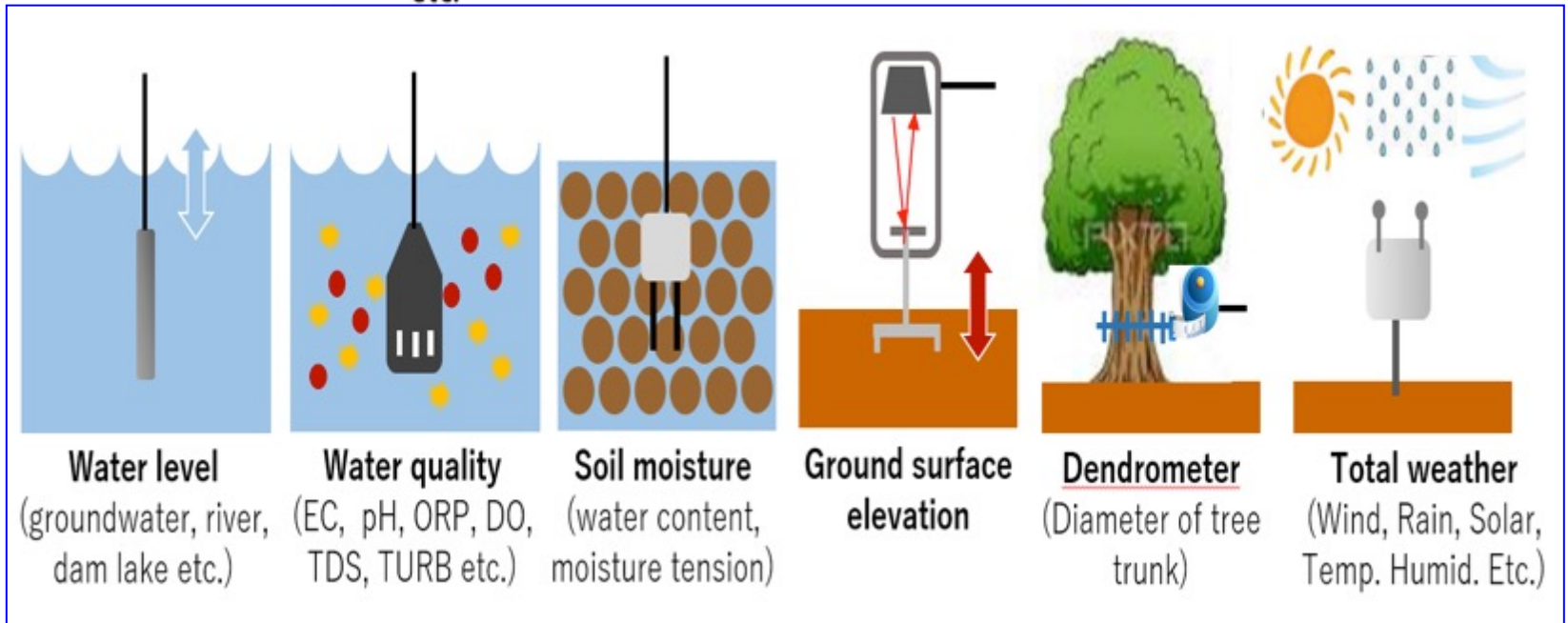
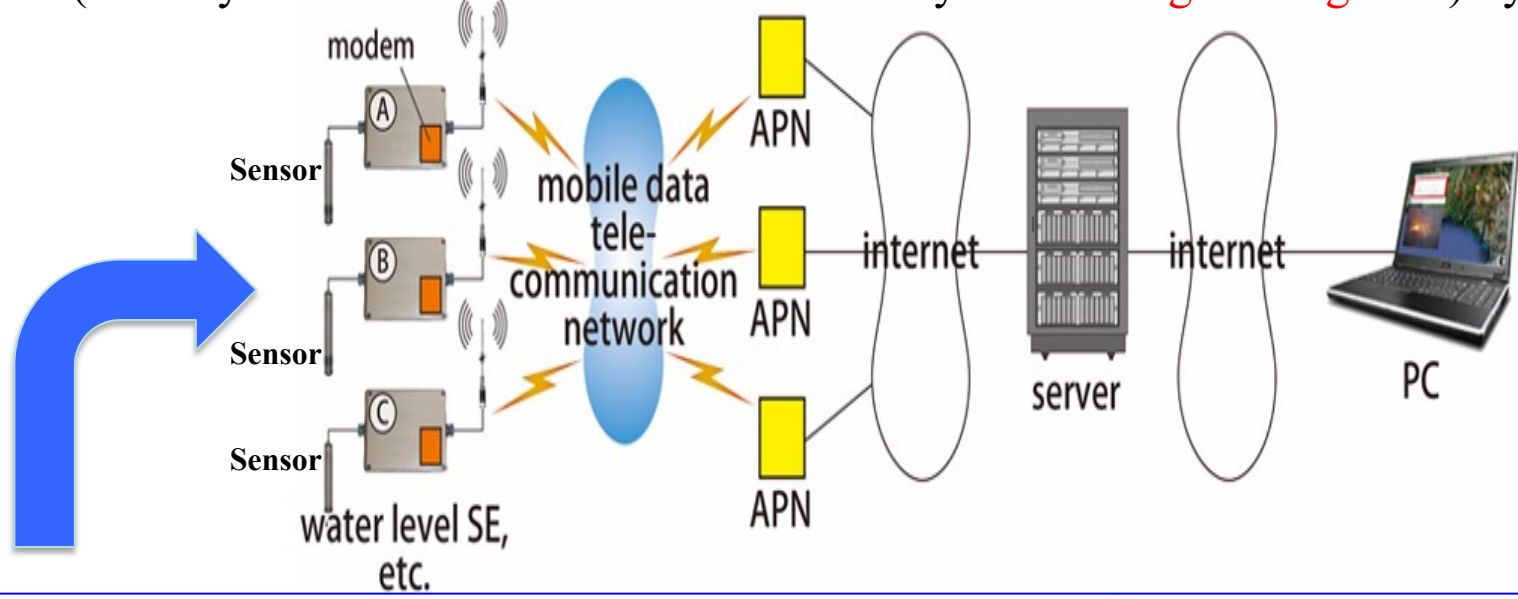
**Tree Growth/Mortality**

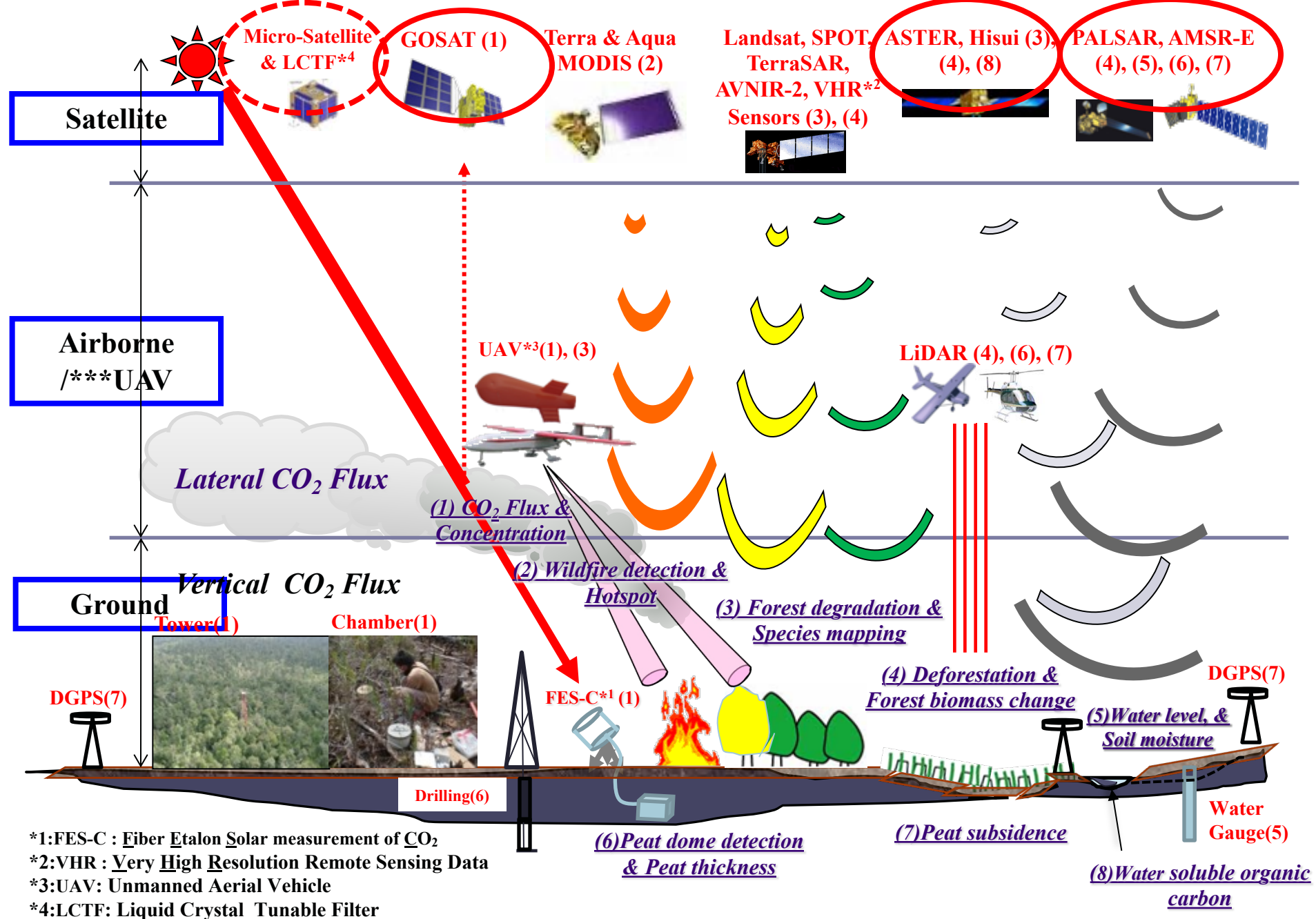
**Carbon Emission by Fire**

**Carbon Loss through Water**

**Carbon Emission by Microorganisms Degradation**

# SESAME (Sensory data transmission service assisted by Midori Engineering Lab.) System



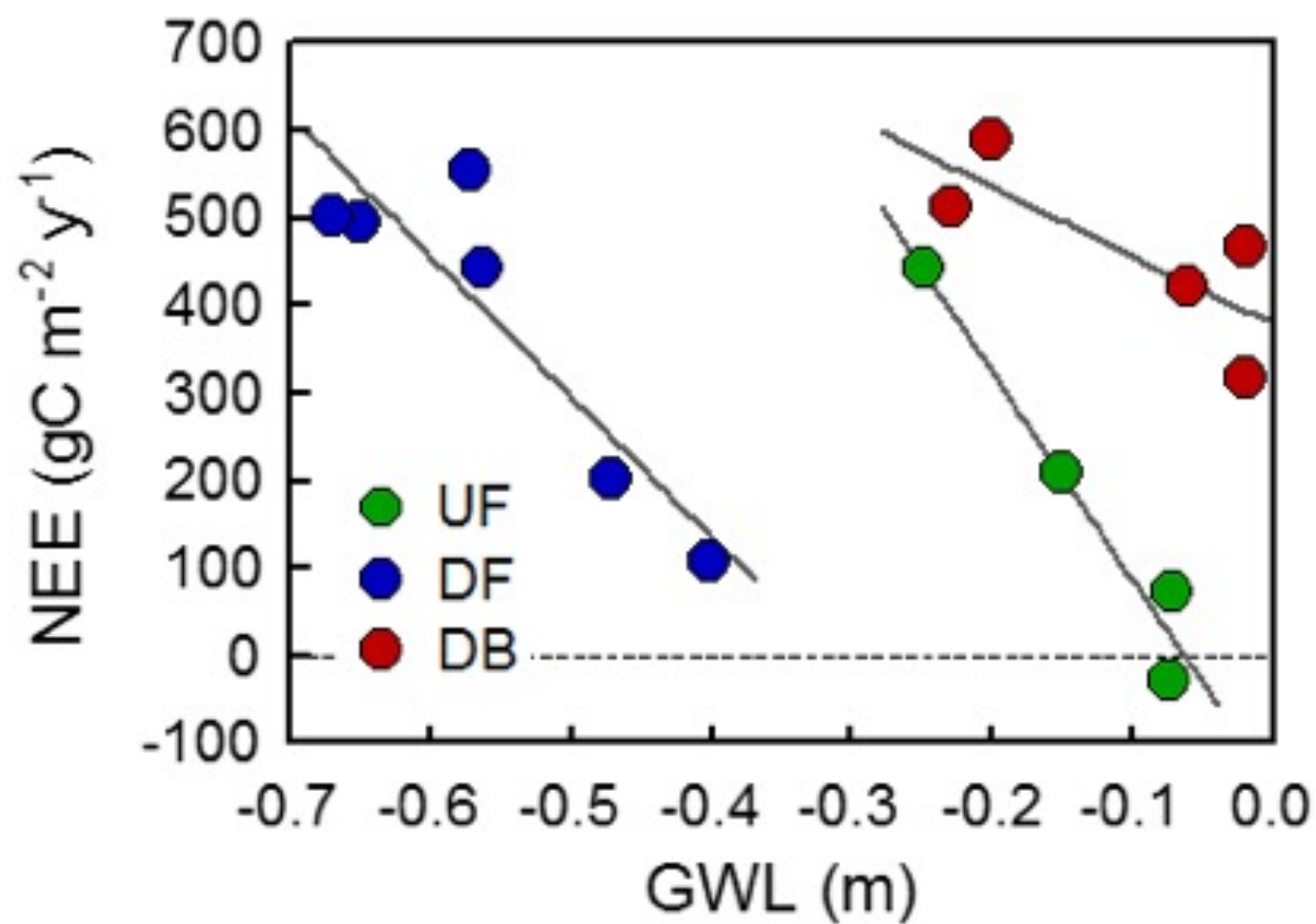


# SESAME

(sensory data transmission service assisted by Midori Engineering)

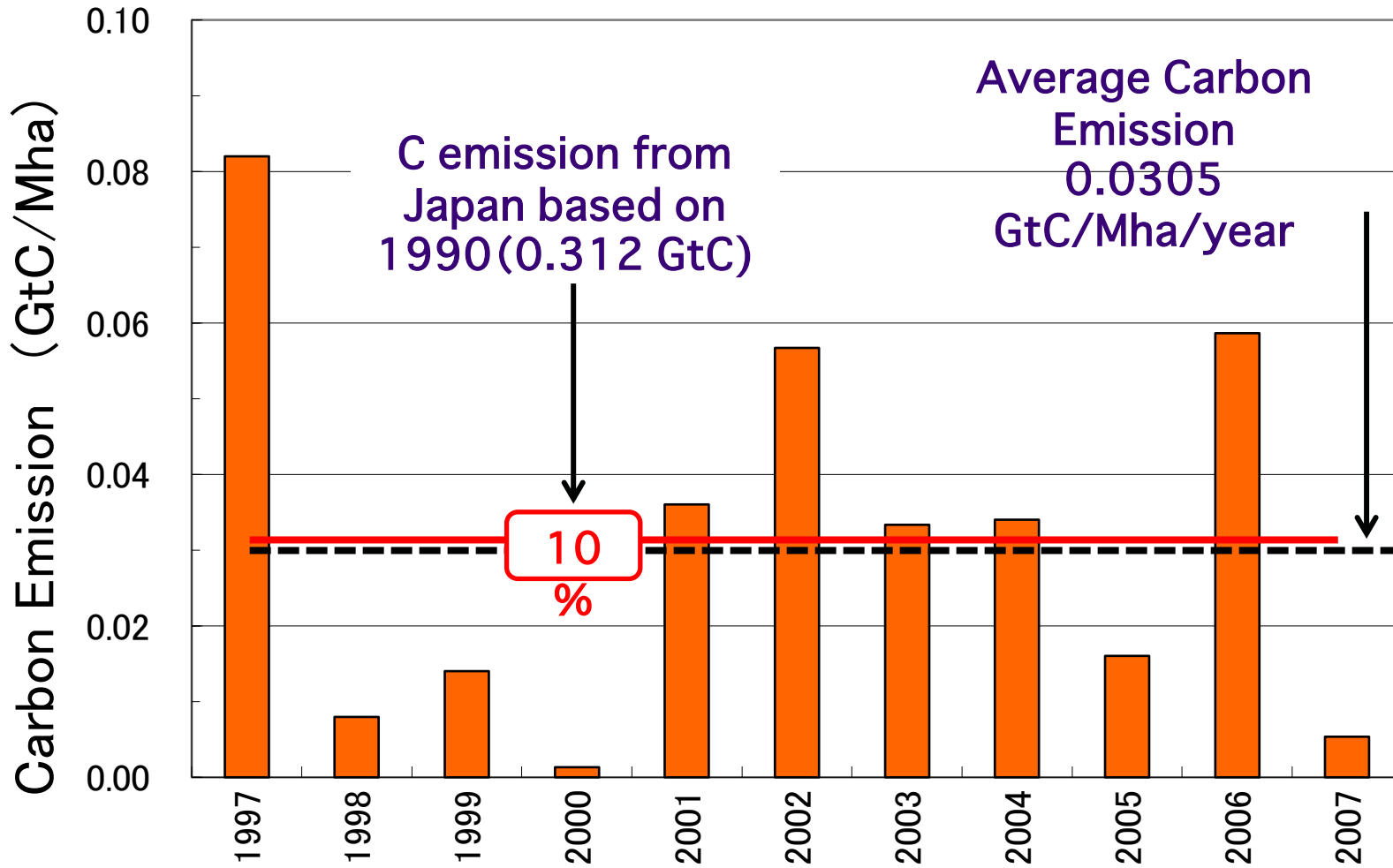


**Ground Water Level / Ground Surface Level**





# Carbon Emission (GtC/Mha) by Wild (mainly peat) Fire from Mega Rice Project area in Central Kalimantan



By Hidenori Takahashi,  
2013

# COP15 at Copenhagen in 2009

## COP15 Poster

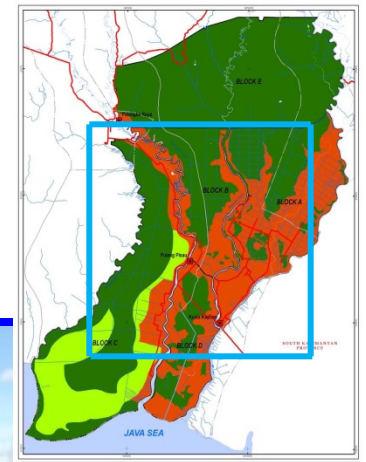
**Amount of carbon dioxide emitted annually from the tropical peatland per 1 million ha.**  
(Indonesia has 20 times the size of this tropical peatland.)

About 13% of the total emission from Japan in 1990.



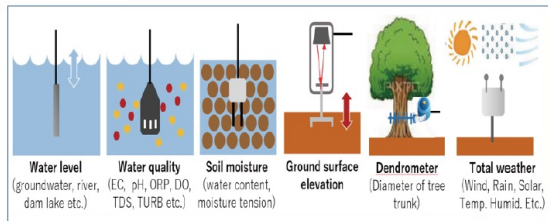
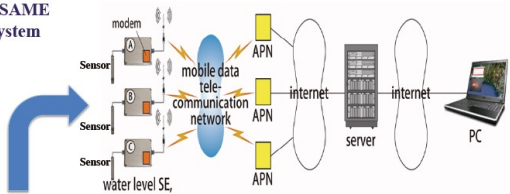
Amount of carbon dioxide emitted by microbial degradation (About 3 % of the total emission from Japan in 1990.)

Amount of carbon dioxide emitted by peat fire (About 10 % of the total emission from Japan in 1990.)



## Copenhagen Accord

- **REDD+**
- **MRV: Monitoring-Sensing**



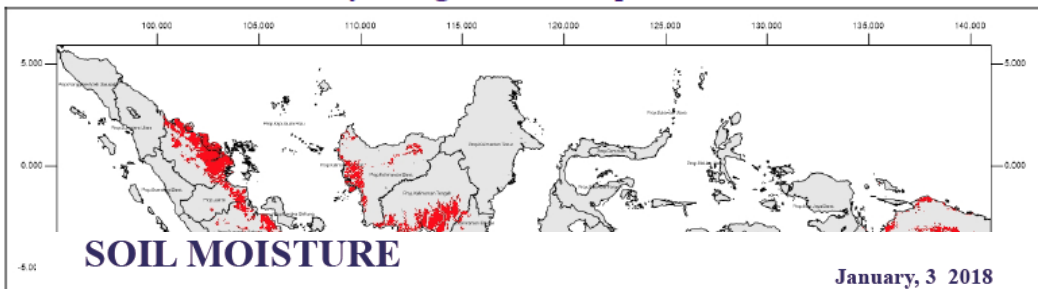
# PALSAR Application (1): GHGs Emission Mapping in Peat /Wetland

INPUT Data: Soil Moisture (every 6 hour before) 0.25 x 0.25 degree grid

Variable	Units
Air Temperature	Celsius
Cloud Liquid Water Ice	g kg <sup>-1</sup>
Convective	kg kg <sup>-1</sup>
Equivalent	kg kg <sup>-1</sup>
Geopotential Height	gpm
Humidity	g kg <sup>-1</sup>
Hydrostatic Pressure	hPa
Sea Level Pressure	hPa
Level (Sea Level) Geopotential	gpm
Planetary Boundary Layer	gpm
Potential Temperature	K
Height	gpm
Sea Surface Temperature	K
Sea Temperature	K
Slow Water Equivalent	kg kg <sup>-1</sup>
Soil Moisture/Water Content	kg kg <sup>-1</sup>
Soil Temperature	K
Surface Pressure	hPa
Surface Winds	m s <sup>-1</sup>
Terrain Elevation	m
Top Precipitable Water	mm
Transmittance	kg kg <sup>-1</sup>
Transmittance Diurnal	kg kg <sup>-1</sup>
Upper Air Temperature	K
Upper Level Winds	m s <sup>-1</sup>
Vertical Adiabatic Exponent	kg kg <sup>-1</sup>
Vertical Velocity	gpm
Wetness	kg kg <sup>-1</sup>
Upper Air Temperature	K

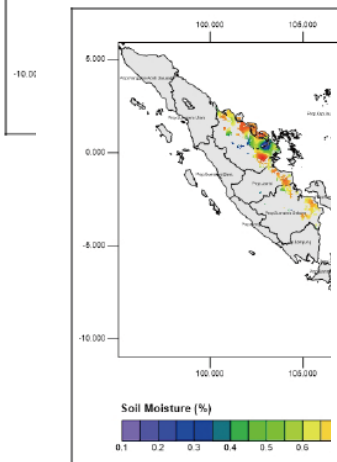
NCAR analysis WRF to get soil moisture 1km x 1km grid  
Soil moisture  
Peta Terbakjar dan tak terbakar  
Peta GWL  
Peta emisi

Peat Hydrological Unit Map

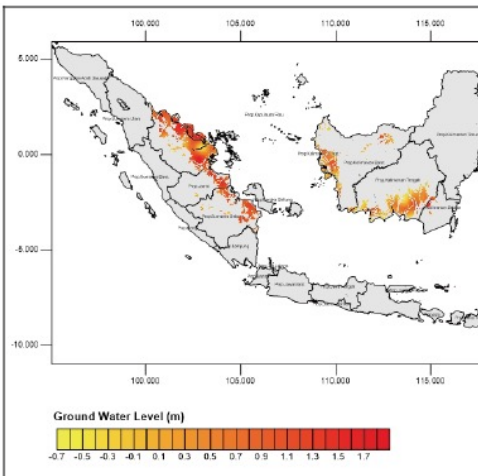


# NEE (Net Ecosystem Exchange)

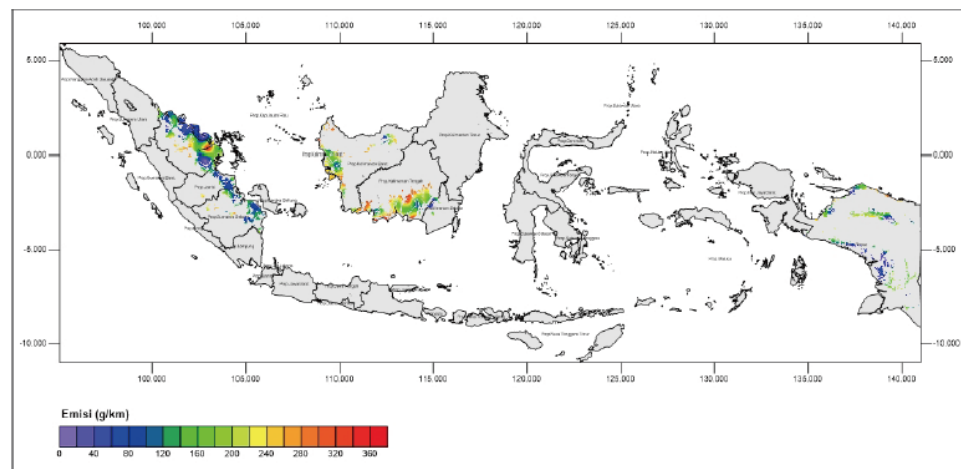
WATER TABLE by model



CARBON EMISSION by Model



KOMPOSIT MINGGU KE-1 2018



1 **2013 SUPPLEMENT TO THE 2006**  
2 **IPCC GUIDELINES FOR**  
3 **NATIONAL GREENHOUSE GAS**  
4 **INVENTORIES: WETLANDS**

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5 Methodological Guidance on Organic and Wet Soils  
6 across IPCC Land-use Categories

7

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14

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17

# CHAPTER 1

**Coordinating Lead Authors**

**Tom Wirth (USA) and Chengyi Zhang (China)**

**Lead Authors**

**Gusti Zakaria Anshari (Indonesia), Kenneth Byrne (Ireland), Elke Hodson (Switzerland), Hans Joosten (EC/WI/FAO), J. Boone Kauffman (IUCN/UNESCO), Leif Klemedtsson (Sweden), Tuija Elina Lapvetelainen (Finland), Christoph Mueller (Germany), Phillip O'Brien (Ireland) and Mitsuru Osaki (Japan)**

**UNFCCC-SBSTA 38 Research Dialogue**  
**-Developments in research activities relevant to the needs of the Convention-**  
**4 June 2012, 15:00 - 18:00, Maritim Hotel, Bonn, Germany**

**Plenary II: Emerging scientific findings: Ecosystems and GHG emissions and removals from sources, sinks and reservoirs, including from terrestrial ecosystems**



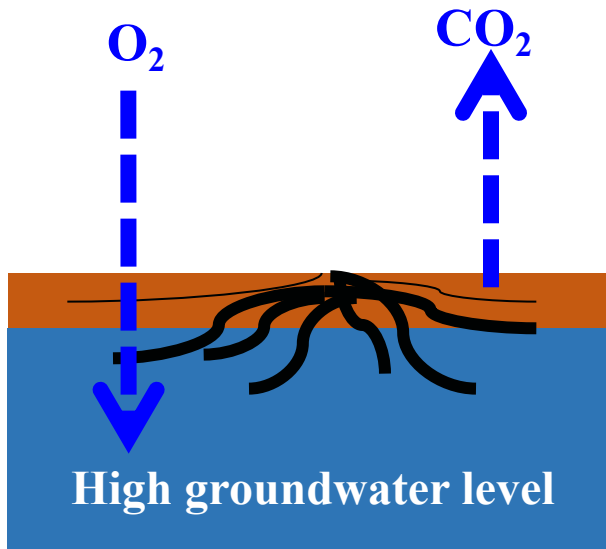
**Estimation of carbon and their fluxes in tropical peatlands:  
Results from a Japan-Indonesia joint project**



## Hydro Culture

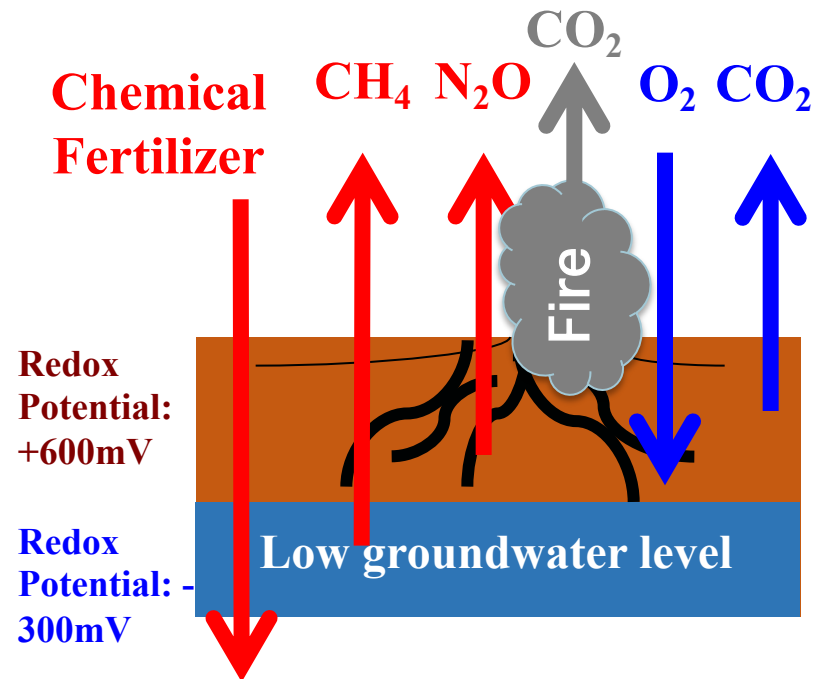
### Native Peatland

Redox Potential: +600mV  
Redox Potential: 0mV



## DeHydro Culture

### Peatland under Drainage & Chemical Fertilizer Application

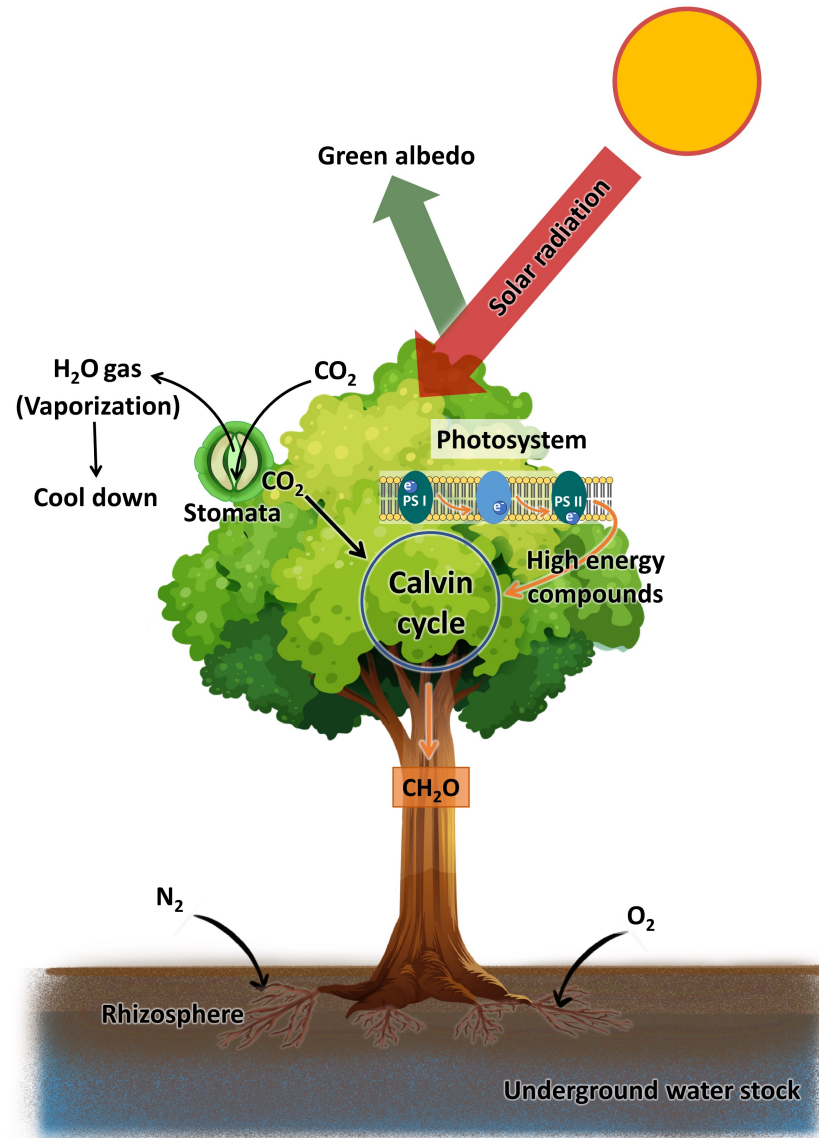


Leaching & Pollution



# **III. Water Cycle**

# Latent Heat Removable



a

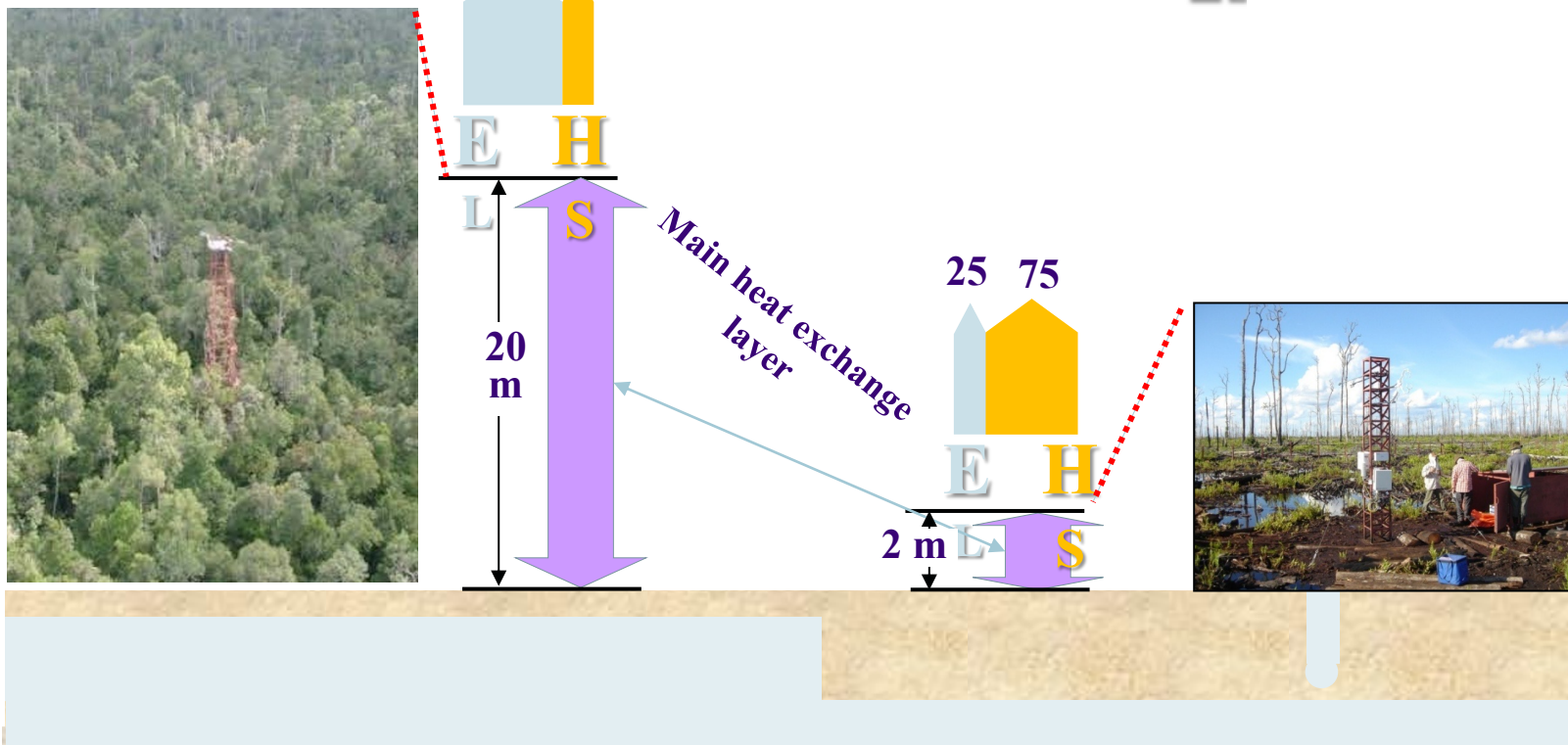
100

$R_N$

$R_N$  : Net radiation

$H_s$  : Sensible heat

$E_L$  : Latent heat



Undisturbed tropical peat swamp forest

Drained and disturbed peatland

**b**

