# Tropical peatlands of Southeast Asia – a vanishing jewel

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### Tropical peats in SE Asia before the Quaternary



Extensive Early Miocene coals (compressed peat) - from ~20 M years

> Present 3,000 – 20,000 years old up to 20 m deep



20 m thick Middle Miocene coal deposit in SE Kalimantan represents ~100 m peat accumulation!





#### Current Peatland Distribution in Southeast Asia





### Character of the Natural System

- Tropical peatlands are unique ecosystems
  - Acidic
  - Nutrient-poor
  - Waterlogged
  - Thick organic soil
- Support specialised peat swamp forest plant and animal communities.









 800 tree species recorded from the peat swamp forest of SE Asia

71 families and 237 genera

 Many display characteristic adaptation to the habitat, eg, still roots, pneumatophores



*Platea excelsa* (Jejangkang) in Alan Bunga Forest



#### Tree of *Shorea albida* (Alan Bunga) with low and long buttresses

### Plant Diversity

#### **Regional Variation**

- High regional floral variation.
- Only five tree species (from total ~800 spp.) recorded from psf across the whole west Malesian region:
- Baccaurea bracteata
- Campnosperma coriaceum
- Ilex cymosa
- Madhuca motleyana
- Stemonurus secundiflorus





### Plant Diversity

Peat swamp forest	No. species
<ul> <li>Euphorbiaceae</li> </ul>	50
<ul> <li>Myrtaceae</li> </ul>	47
<ul> <li>Lauraceae</li> </ul>	42
<ul> <li>Clusiaceae</li> </ul>	36
<ul> <li>Rubiaceae</li> </ul>	35
<ul> <li>Dipterocarpaceae*</li> </ul>	32

\* most diverse family in lowland rain forest





### Plant Diversity

#### **Endemic species**

- Archidendron clypearia
- Dactylocladus stenostachys
- Gonystylus bancanus\*
- Horsfieldia crassifolia<sup>\*</sup>
- Shorea belangeran<sup>\*</sup>
- Shorea teysmanniana



Gonystylus bancanus

On the CITES (IUCN) red list of endangered plant species.





### Faunal Diversity

 Endemic species – include some birds (e.g. Storm's stork) and blackwater fish (e.g. Baetidae).

 Refuge for species also associated with dipterocarp forest on mineral soils, e.g. orang utan, agile gibbon.

 Forest pools provide important fish spawning areas during the rainy season.

 Little known about the invertebrate communities of peat swamp forest.

















Storm's Stock

## Section of the sectio

Paedocypris progenetica - female Sumatra (c)HHTan 2005 The World's smallest freshwater fish

- the size of a large mosquito

- Maintenance of biological diversity
- Carbon storage and sequestration
- Sustainable forestry, non-timber forest products
- Flood control and water supply
- Livelihood support for local communities
- Tourism and recreation





Socio-economic and institutional drivers of change

Indonesia

- 1. Overpopulation in the island of Java Transmigrasi program
- 2. Loss of self-sufficiency in rice production in Indonesia Mega Rice Project (1995)
- 3. The forestry monopoly of under Suharto's family with no accountability Unsustainable logging
- 4. Collapse of Suharto government (1998) and associated socioeconomic problems Rapid escalation of illegal logging activities Unclear tenure systems
- 5. Lack of institutions and rules supporting the new autonomies Growing oil-palm and pulpwood industries







#### Tropical Deforestation Area (2000-2005)



#### Worldwide: 13 Million hectares each year



Mongabay using FAO Forest Resources 2006



#### Carbon Emissions from Land Use Change





Houghton, unpublished; Gullison et al. 2007, Science; Canadell et al. 2007, PNAS, in review

Earth System





## The Mega Rice Project – Central Kalimantan



- 1 Million ha deforested to be replaced by rice paddies – the rice bowl of Indonesian.
- 4,600 km of canals to drain the region.
- Tens of thousands of landless Javanese were brought in to tend the Mega Rice

Carbon Project.



Aldhous 2004



## The Mega Rice Project – Central Kalimantan



- Excessive drainage made the soil too dry and the peat turned out to be too acid for rice to grow.
- The project was abandoned and many immigrants fled Borneo.













### Palm Oil Production and Exports in Indonesia







Fire has become the biggest threat to Indonesia's forests and peatlands in the past 15 years







MODIS hotspots: courtesy of Modis fire team NOAA AVHRR: courtesy of IFFM, JAICA ATSR: courtesy of ESA



### Where fires originate?



- Fire is the cheapest method for land clearing
- Fire adds ash that temporarily improve soil conditions

- Pests and weeds control
- The economic value of the biomass 'waste' is too low
- Smallholders' wood pricing discourages producers
- Emerging large scale land based industries: agriculture (palm oil) and forestry (pulp wood)







### Spatial Distribution of the CO<sub>2</sub> Growth Perturbations





Carbon Quantities El Niño 1997-98

### SE Asia C Fire Emissions 1.8 Pg C

Compare to: Global fossil fuel emissions 6.4 Pg C yr<sup>-1</sup> (25% - equivalent) Global net terrestrial sink 1.4 Pg C yr<sup>-1</sup>

## Transboundary Haze

#### US\$4.5 billion in lost tourism and business



17% increase of children mortality under 2-y
= 16,400 deaths

- 1. To help find alternative forest uses that are economically attractive and sustainable (resulting with lower rates of deforestation and drainage)
  - Carbon markets for deforestation avoidance
- 2. To restore some of the drained regions and help to develop a more suitable and sustainable agriculture on peatlans.





### Avoided Emissions by Reducing Deforestation



1.5 Pg C yr<sup>-1</sup>; 18% of total emissions from human activities





Gullison et al. 2007, Science



### Restoration of hydrology of drained areas







### Vegetable and horticultural crops on peatland



![](_page_55_Picture_0.jpeg)

![](_page_56_Picture_0.jpeg)

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