ウータン・パーム油学習会　第9弾
12月2日（土）14時~16時30分
大阪市　大阪聖パウロ教会1階会議室

「熱帯泥炭は地球の心臓と肺」

心臓：エネルギー・物質循環
肺：ガス交換

大崎満

Dr. Mitsuru OSAKI (Hokkaido University)

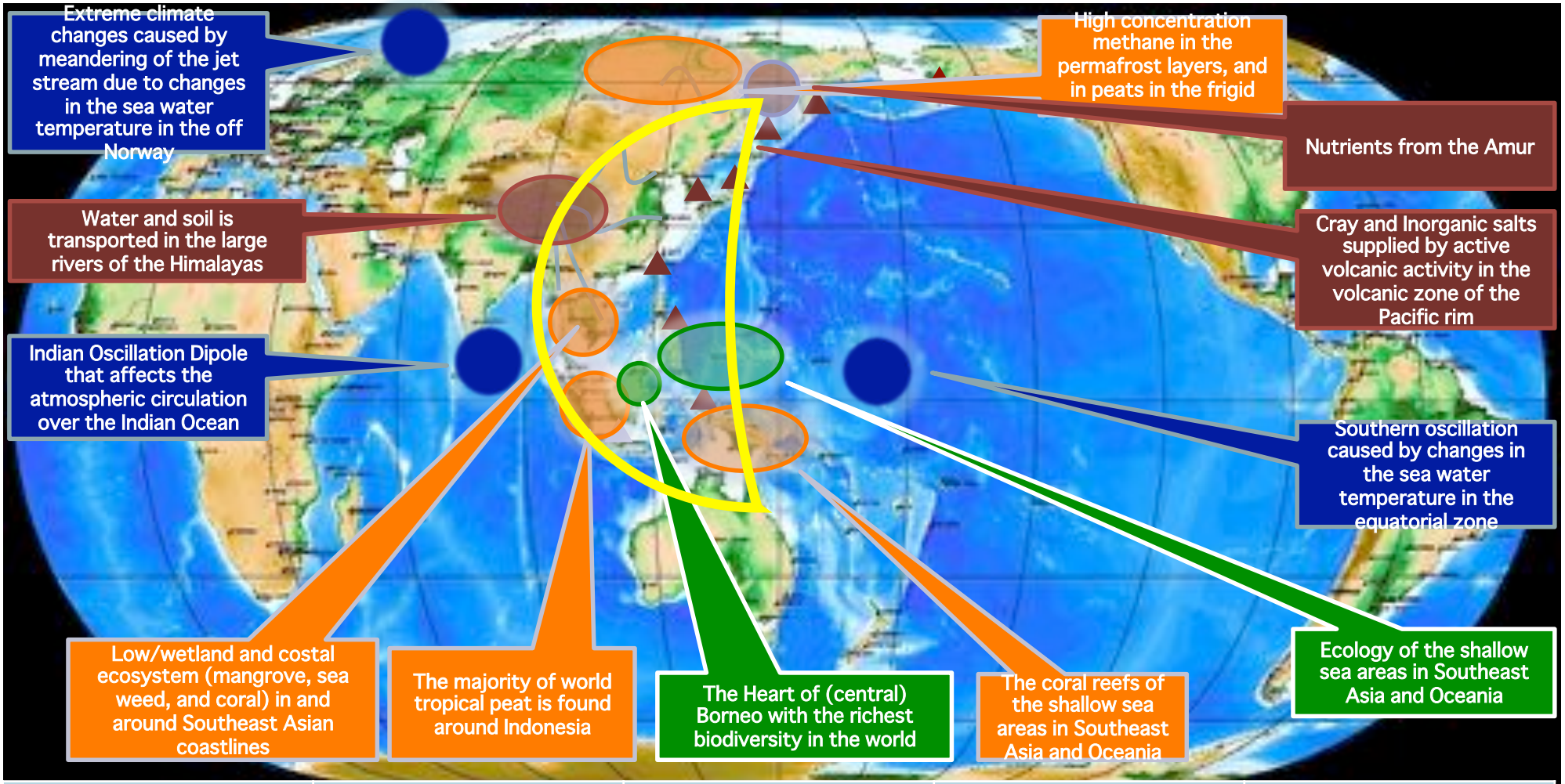
Asian Green Belt

Asian Fertile Crescent

The Navel
Mt.
Kinabalu

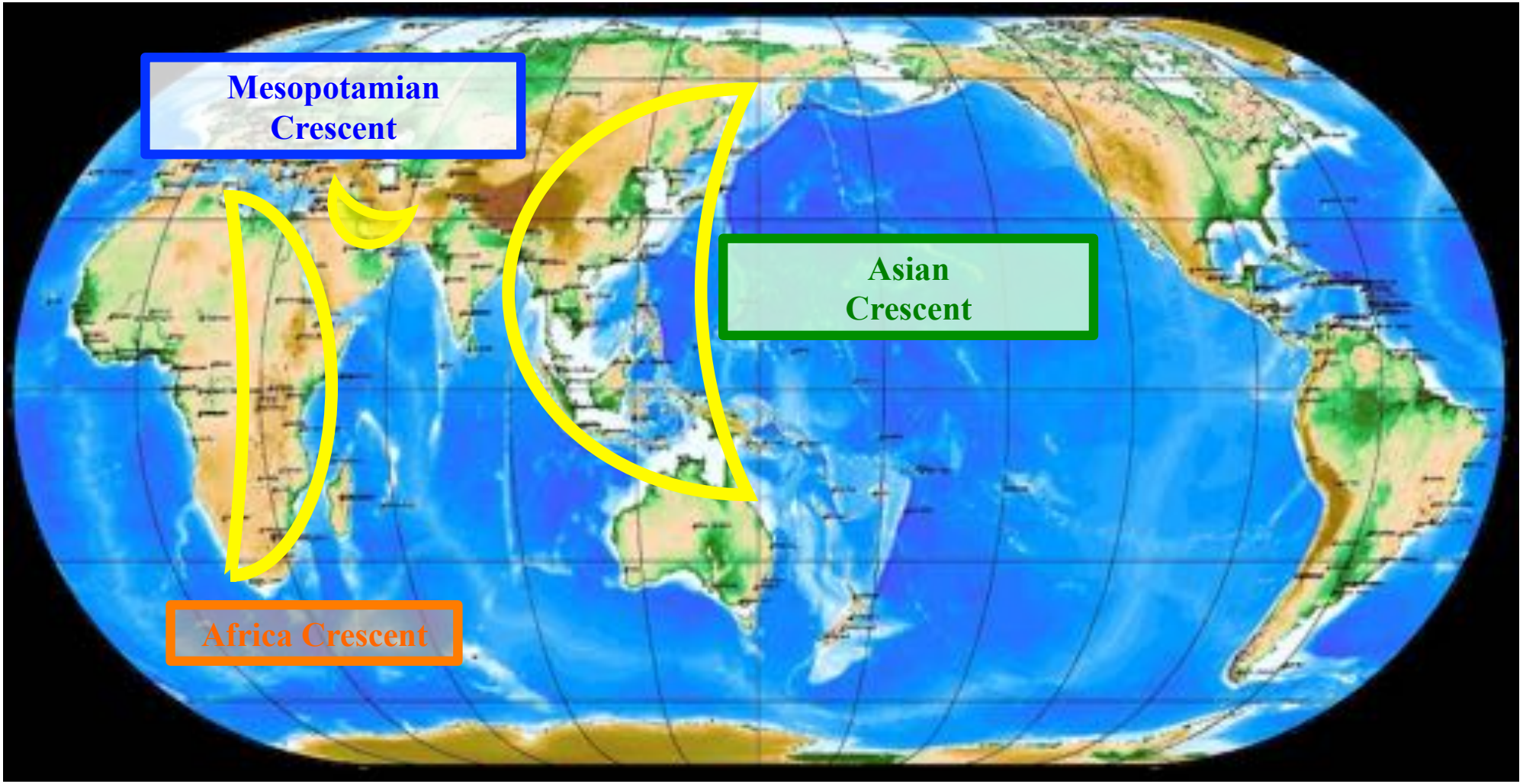
松本健一「泥の文明」(新潮選書)、2006

Asian Fertile Crescent -fragile-



Infections affecting wide areas	Areas that drive climate change	High carbon reservoir ecosystems	Biodiversity	Abundant water and fertile soil

Fertile Crescent



2. Africa Fertile Crescent -potential-

- Potential of 10% food production increase (soil improvement, efficient water usage, cropping system)
- Similar size of Africa Fertile Crescent to China and India size
- High potential of biomass production

The True Size of Africa

A small contribution in the fight against rampant immappancy by Kai Krause

Graphic layout for visualization only (some countries are cut and rotated)
But the conclusions are very accurate: refer to table below for exact data

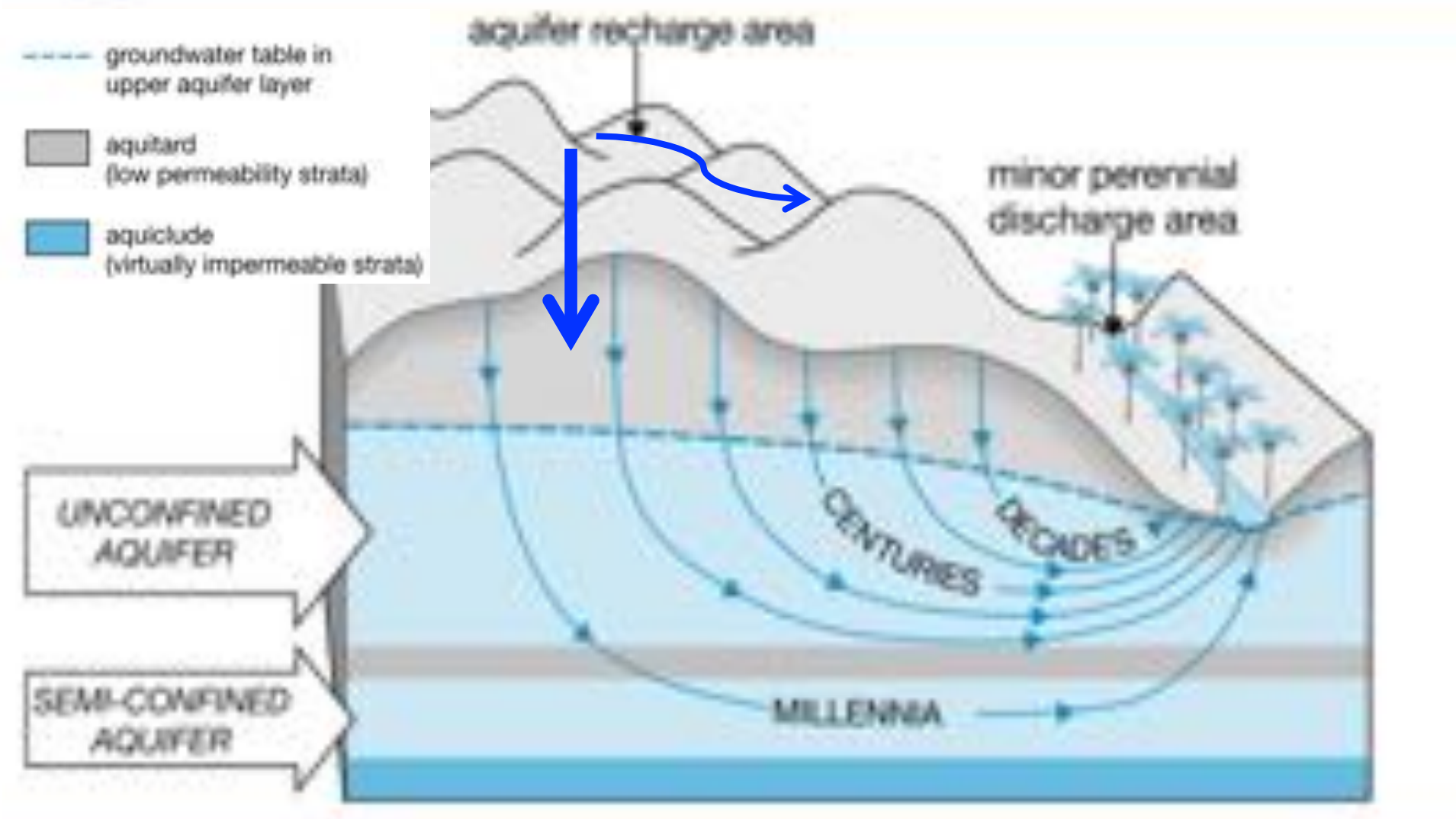
COUNTRY	AREA x 1000 km²
China	9.597
USA	9.629
India	3.287
Mexico	1.964
Peru	1.285
France	633
Spain	506
Papua New Guinea	462
Sweden	441
Japan	378
Germany	357
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
TOTAL	30.102

The True Size Of Africa (http://all-that-is-interesting.com/the-true-size-of-africa)

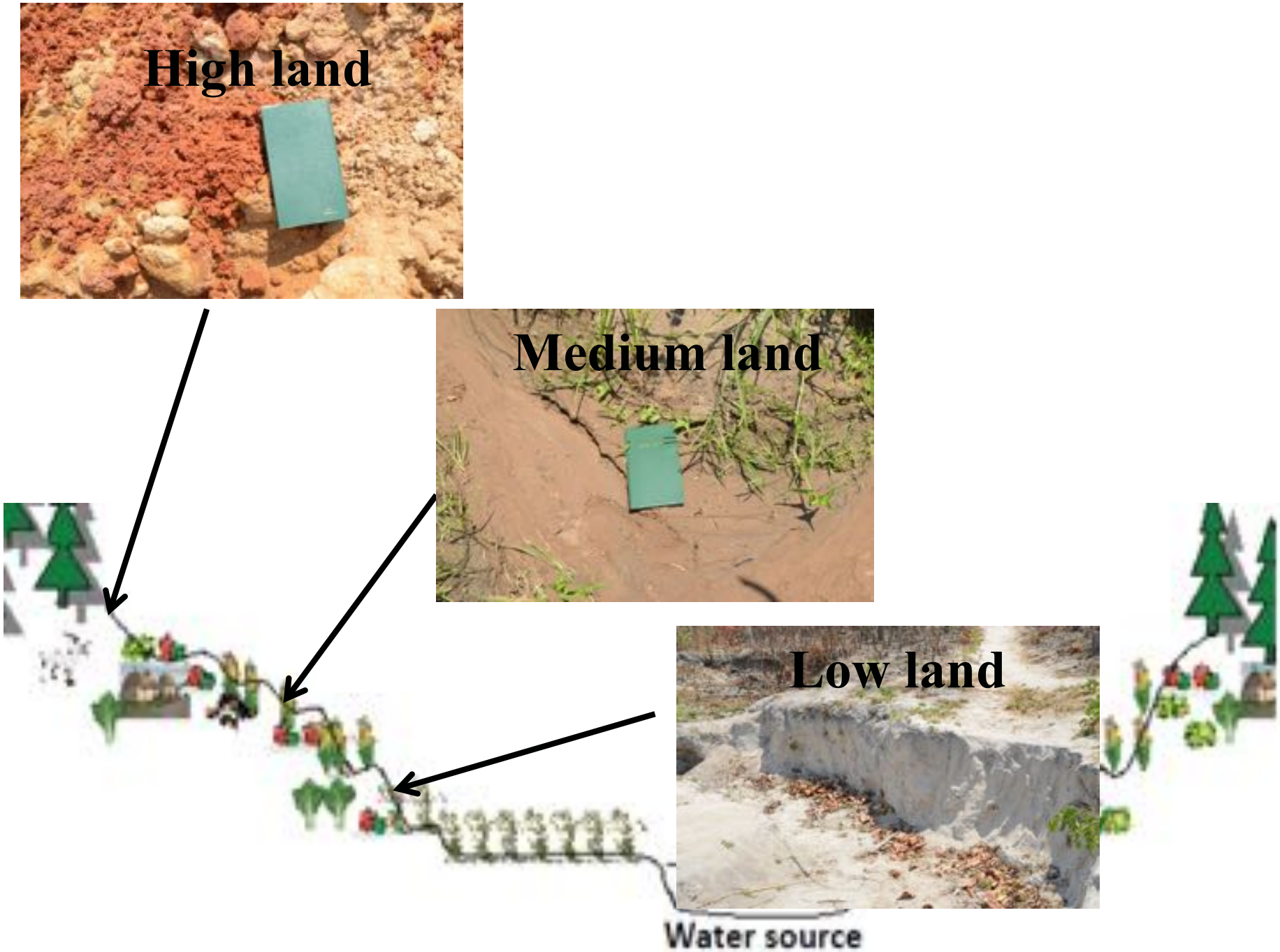
By Savannah Cox (Http://All-That-Is-Interesting.com/Author/Savannah/) on August 28, 2012 in Africa (Http://All-That-Is-Interesting.com/Tag/Africa/), Astounding (Http://All-That-Is-Interesting.com/Tag/Astounding/), Geography (Http://All-That-Is- Interesting.com/Tag/Geography/), and Maps (Http://All-That-Is-Interesting.com/Tag/Maps/)

An amazing map revealing the true size of Africa:

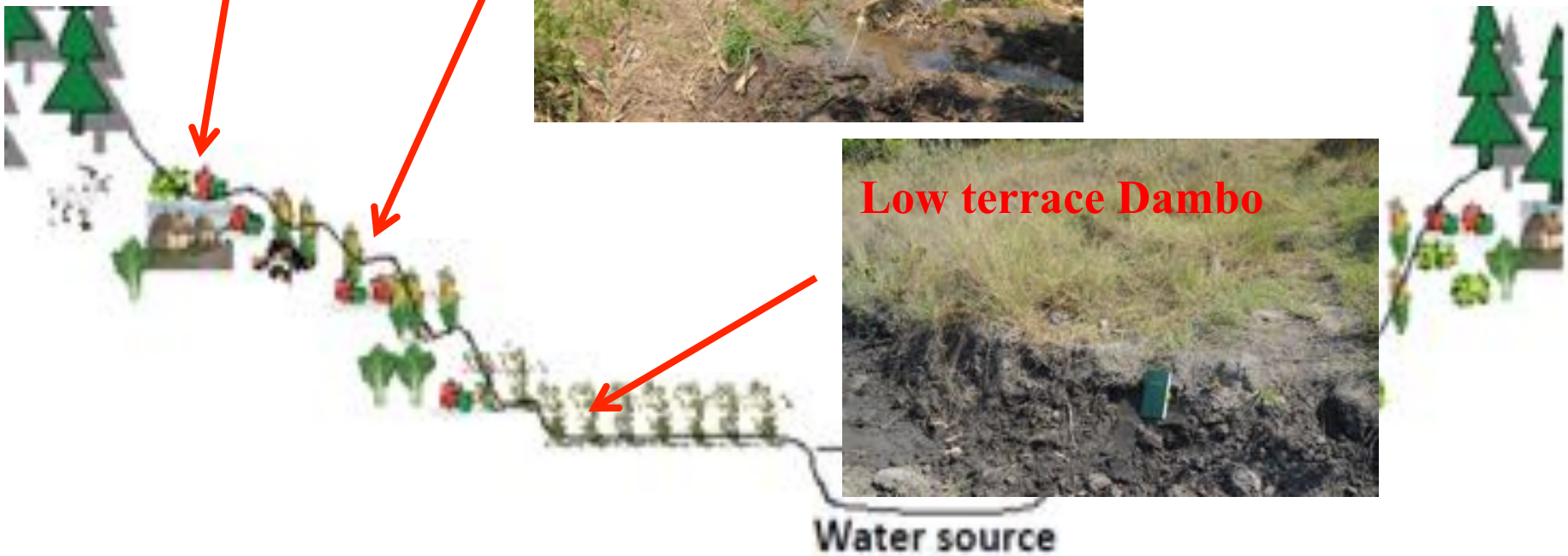
Mechanisms



From Prof. Imasiku Nyambe modified

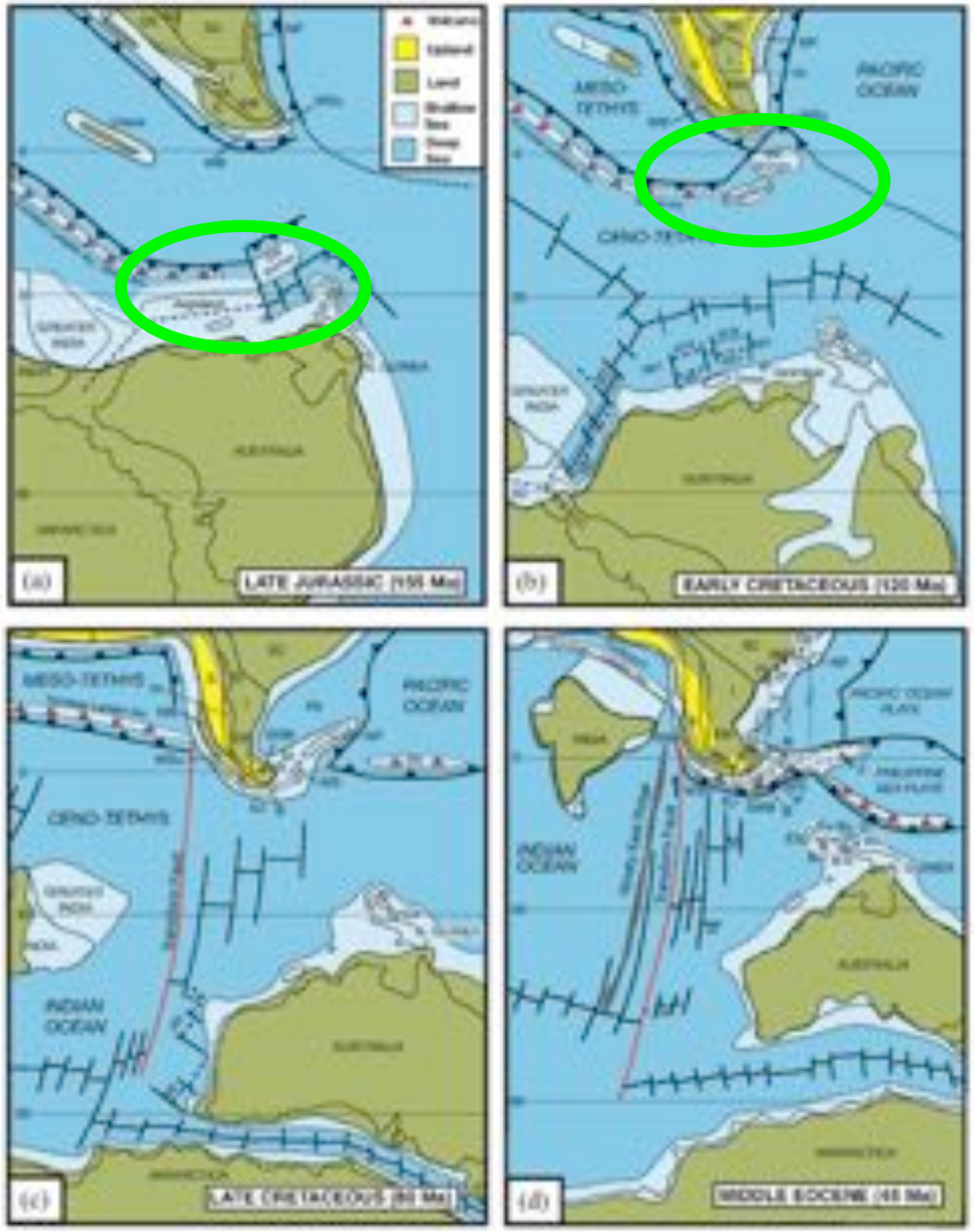


Geology schema from JICA expert Tokutaro Iino：Rice Cultivation in Zambia, 19/8/2014 PCV workshop



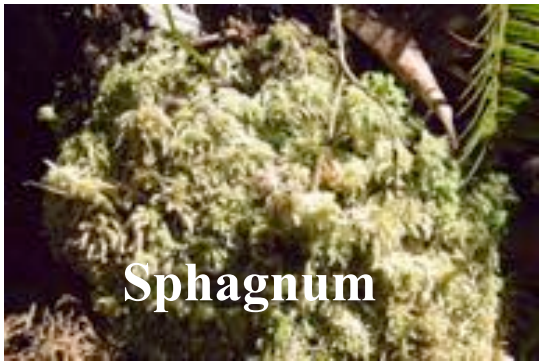
Geology schema from JICA expert Tokutaro Iino：Rice Cultivation in Zambia, 19/8/2014 PCV workshop

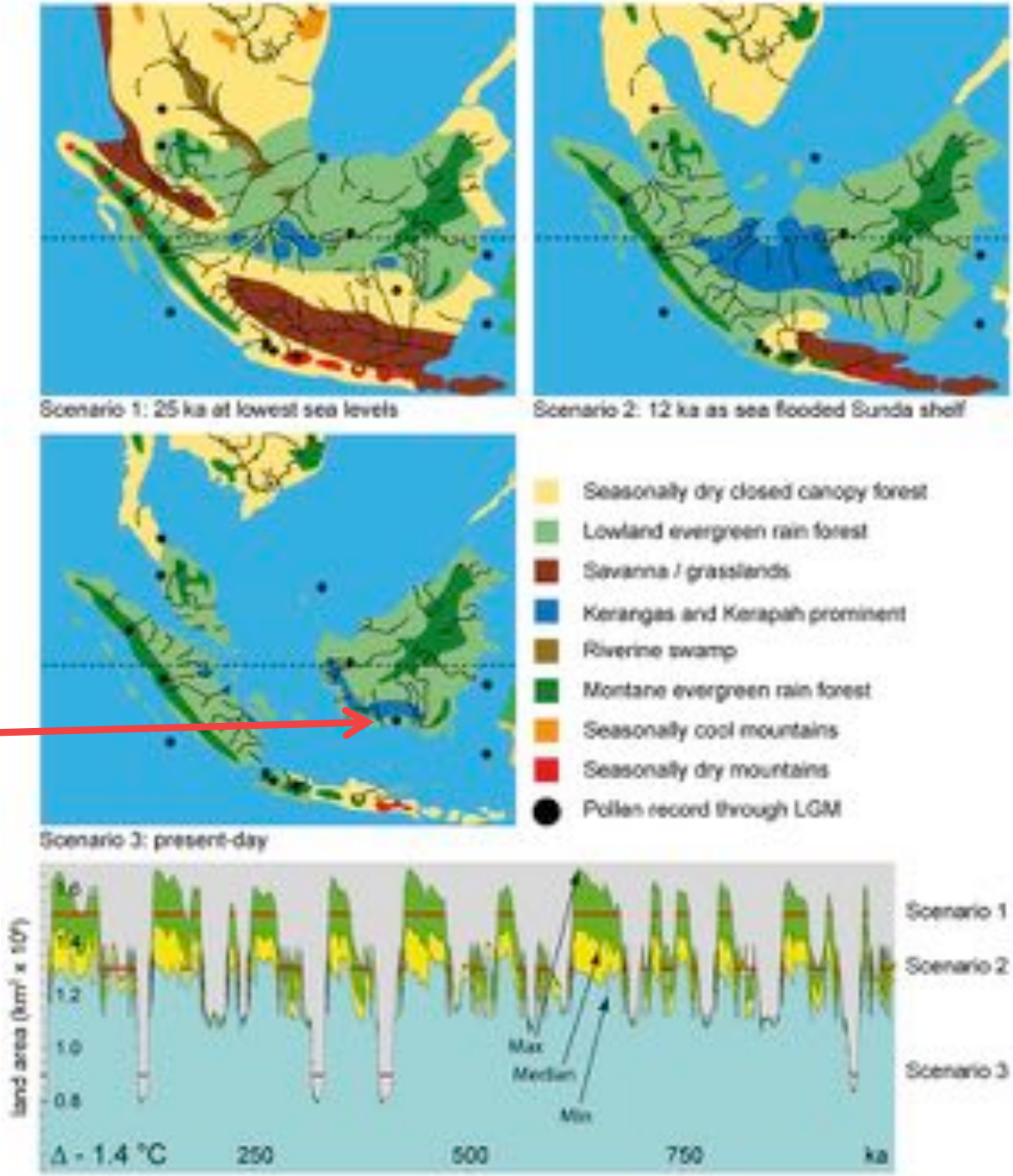
Borneo: Jurassic to Eocene



de Bruyn, M et al in review. Borneo is a major evolutionary hotspot for Southeast Asian biodiversity. Science.

The role of changing Pleistocene sea levels

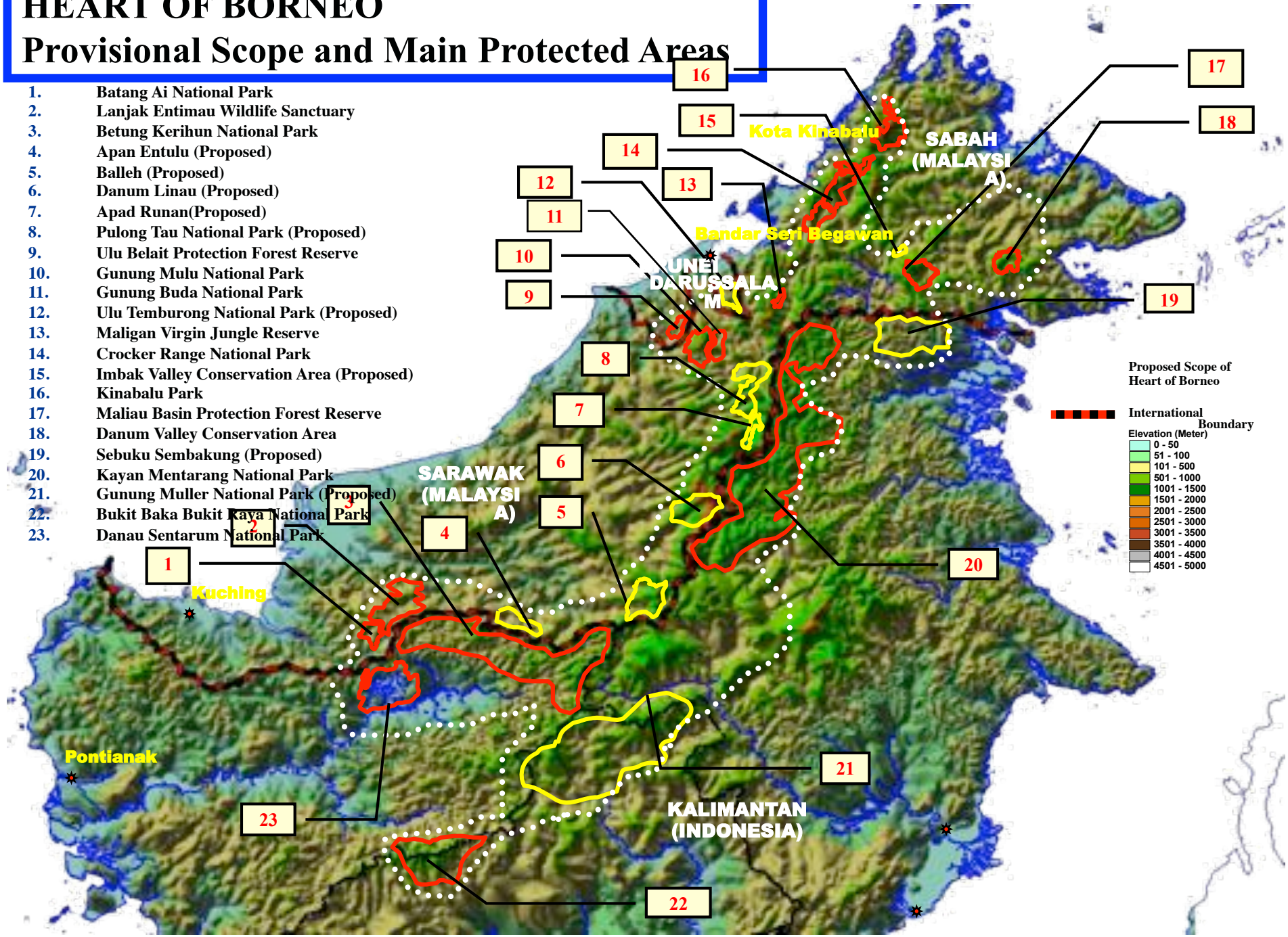


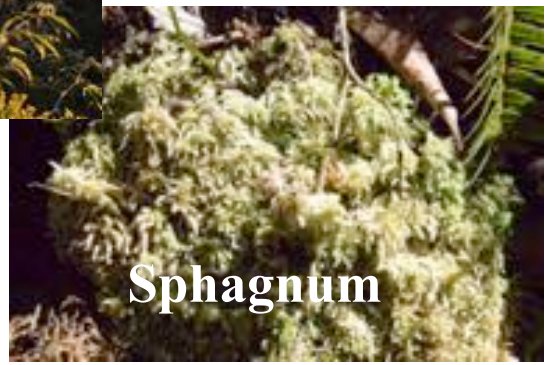


de Bruyn, M et al in review. Borneo is a major evolutionary hotspot for Southeast Asian biodiversity. Science.

HEART OF BORNEO
Provisional Scope and Main Protected Areas

1. Batang Ai National Park
2. Lanjak Entimau Wildlife Sanctuary
3. Betung Kerihun National Park
4. Apan Entulu (Proposed)
5. Balleh (Proposed)
6. Danum Linau (Proposed)
7. Apad Runan(Proposed)
8. Pulong Tau National Park (Proposed)
9. Ulu Belait Protection Forest Reserve
10. Gunung Mulu National Park
11. Gunung Buda National Park
12. Ulu Temburong National Park (Proposed)
13. Maligan Virgin Jungle Reserve
14. Crocker Range National Park
15. Imbak Valley Conservation Area (Proposed)
16. Kinabalu Park
17. Maliau Basin Protection Forest Reserve
18. Danum Valley Conservation Area
19. Sebuku Sembakung (Proposed)
20. Kayan Mentarang National Park
21. Gunung Muller National Park (Proposed)
22. Bukit Baka Bukit Kaya National Park
23. Danau Sentarum National Park

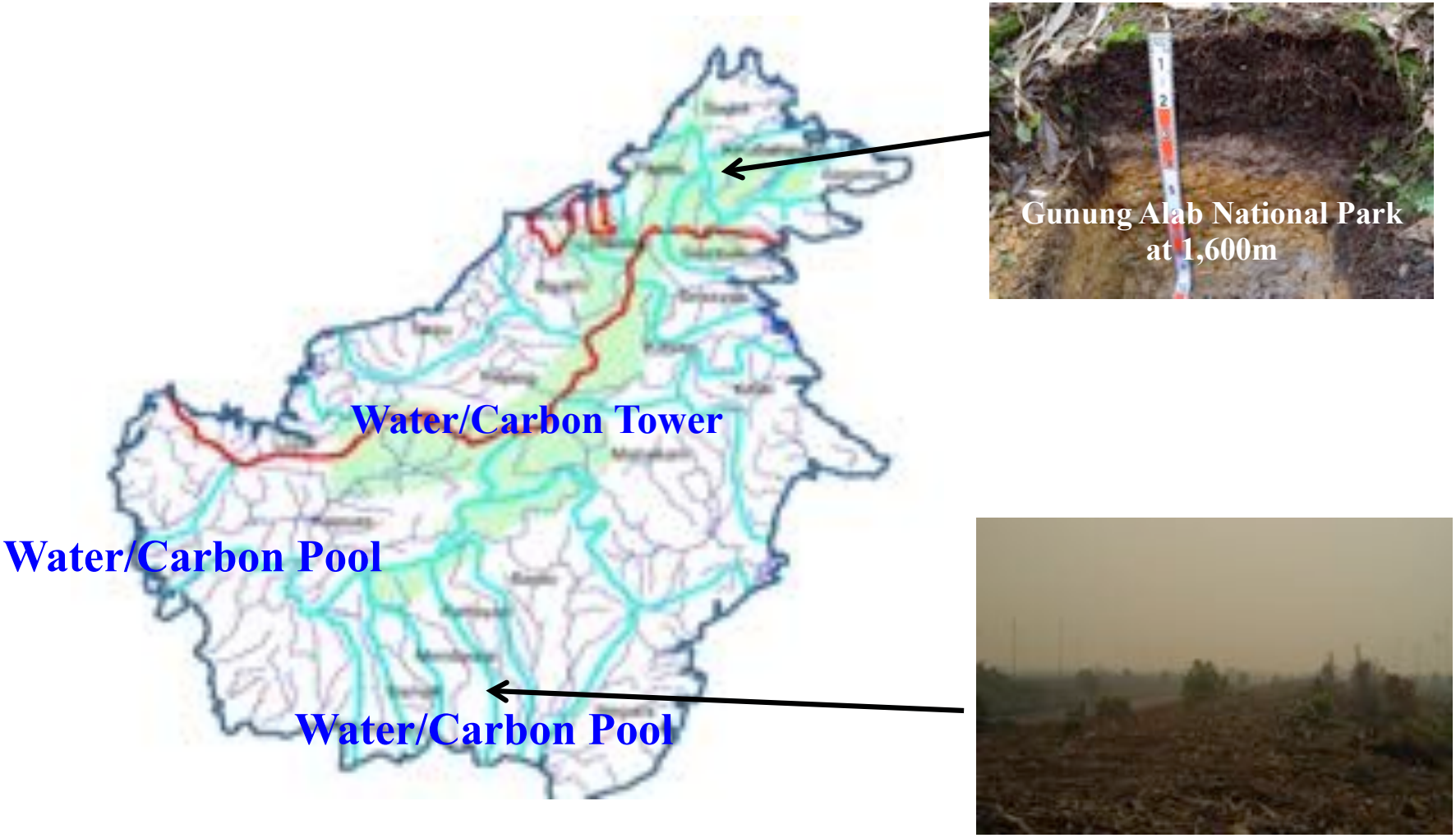




Organic or Peat

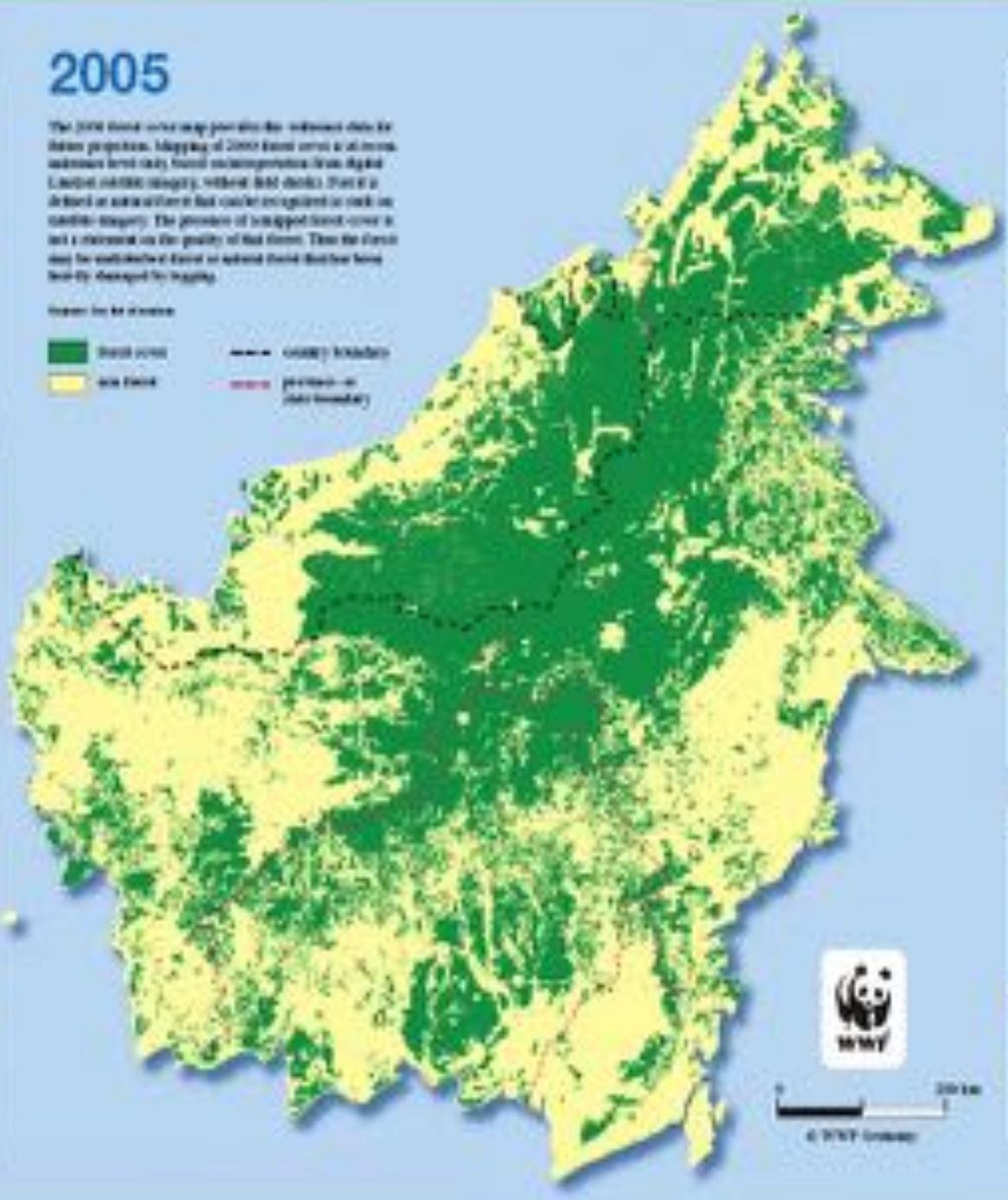
Carson's Waterfall

Water Tower and Water Pool in Borneo

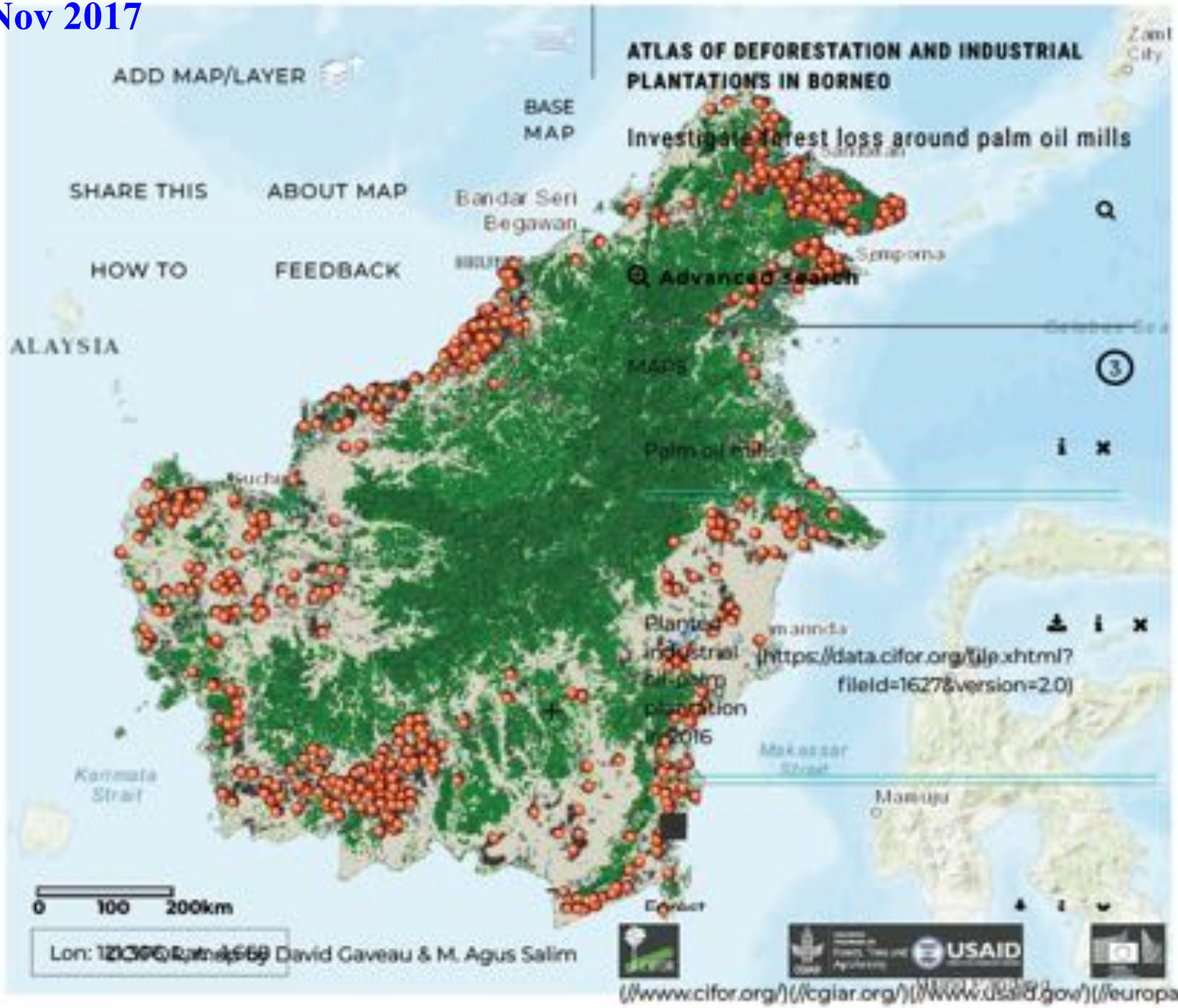


FOREST COVER

2005



23 Nov 2017


ADD MAP/LAYER
BASE MAP
SHARE THIS
ABOUT MAP
HOW TO
FEEDBACK
ATLAS OF DEFORESTATION AND INDUSTRIAL PLANTATIONS IN BORNEO
Investigate forest loss around palm oil mills
Advanced search
MAPS
Palm oil mill
Planted industrial oil palm plantation in 2016
(https://data.cifor.org/file.xhtml?fileId=16278&version=2.0)
Bandar Seri Begawan
Makassar Strait
Kalimata Strait
Mamuju
0 100 200km
Lon: 120.396 Lat: 4.569
David Gaveau & M. Agus Salim
USAID
(//www.cifor.org/)(//cgiar.org/)(//www.usaid.gov/)(//europa.eu/)

Crocker/Kinabalu (HoB)

Highland

High carbon/water reservoir (Carbon/ Water Tower)

Hill side

-Slash-and-burn

-Farming

-Plantation

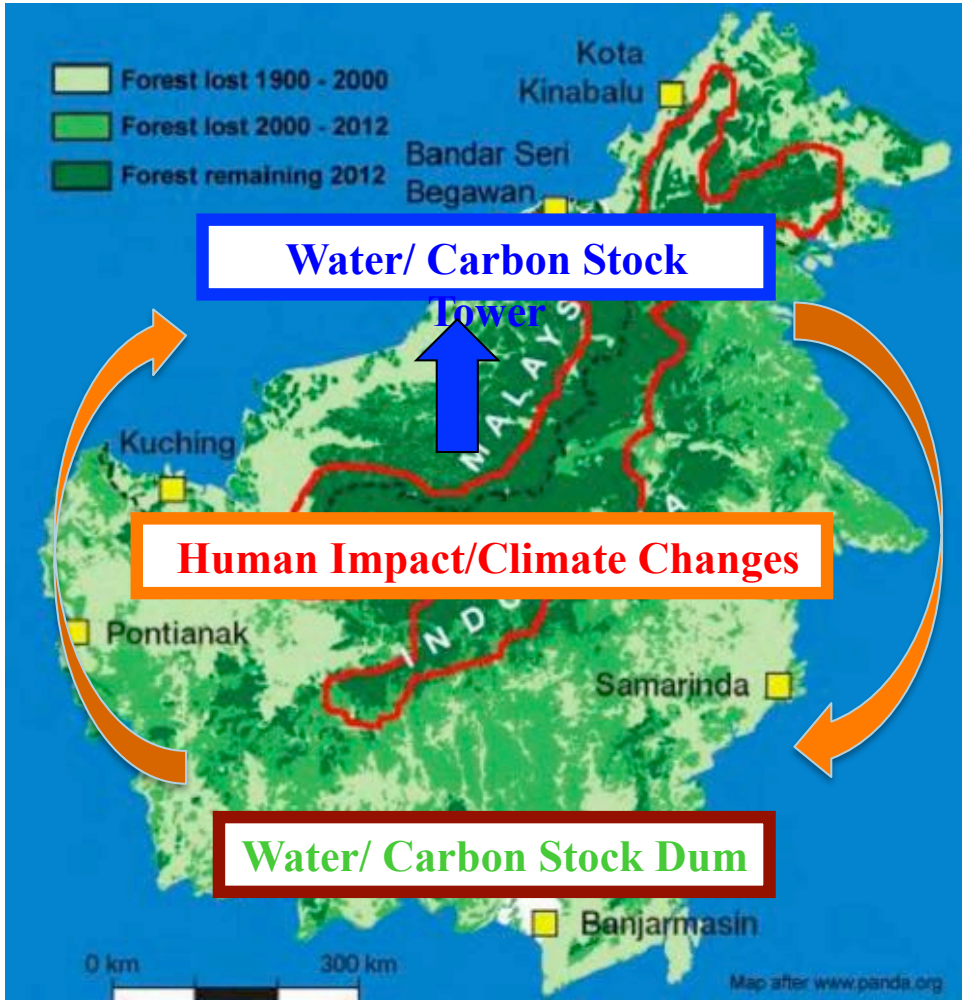
Basin

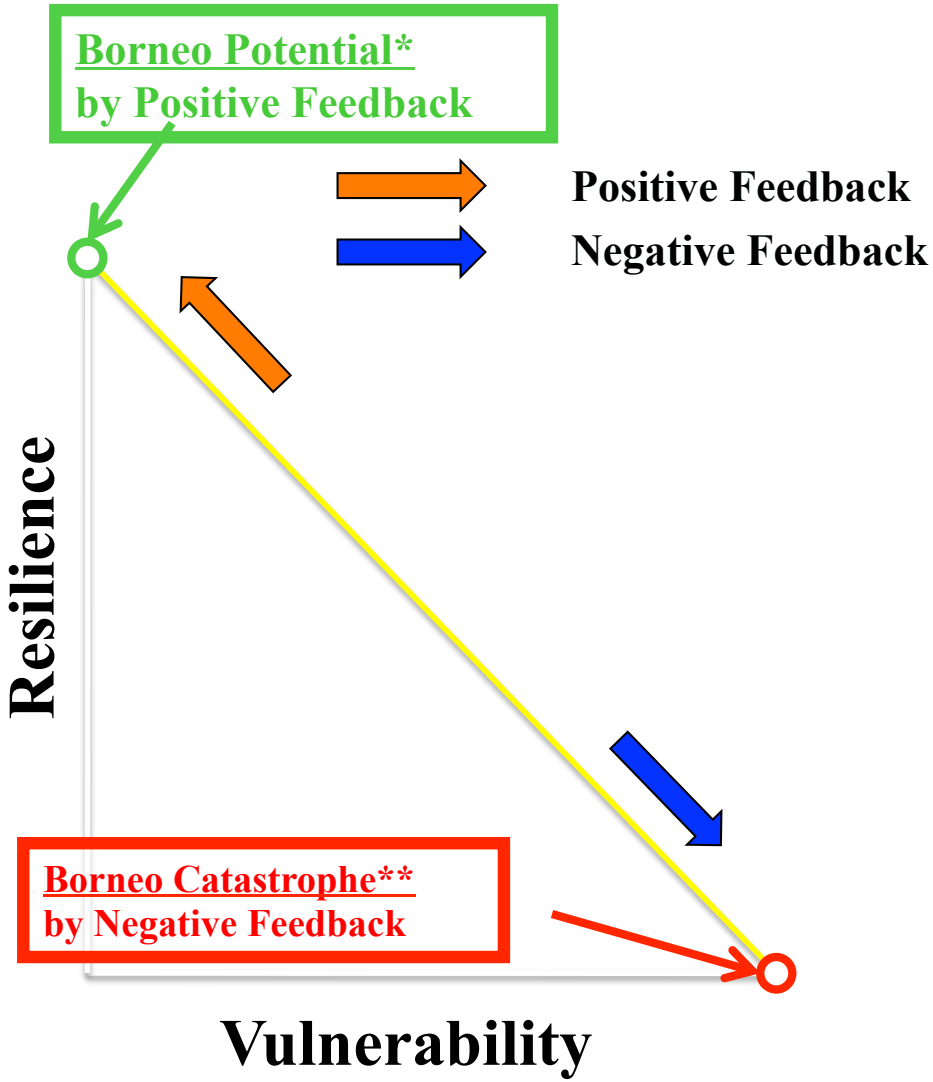
-High carbon/water reservoir

Lowland (Peatland, Mangrove)

High carbon/water reservoir (Carbon/ Water Pool)

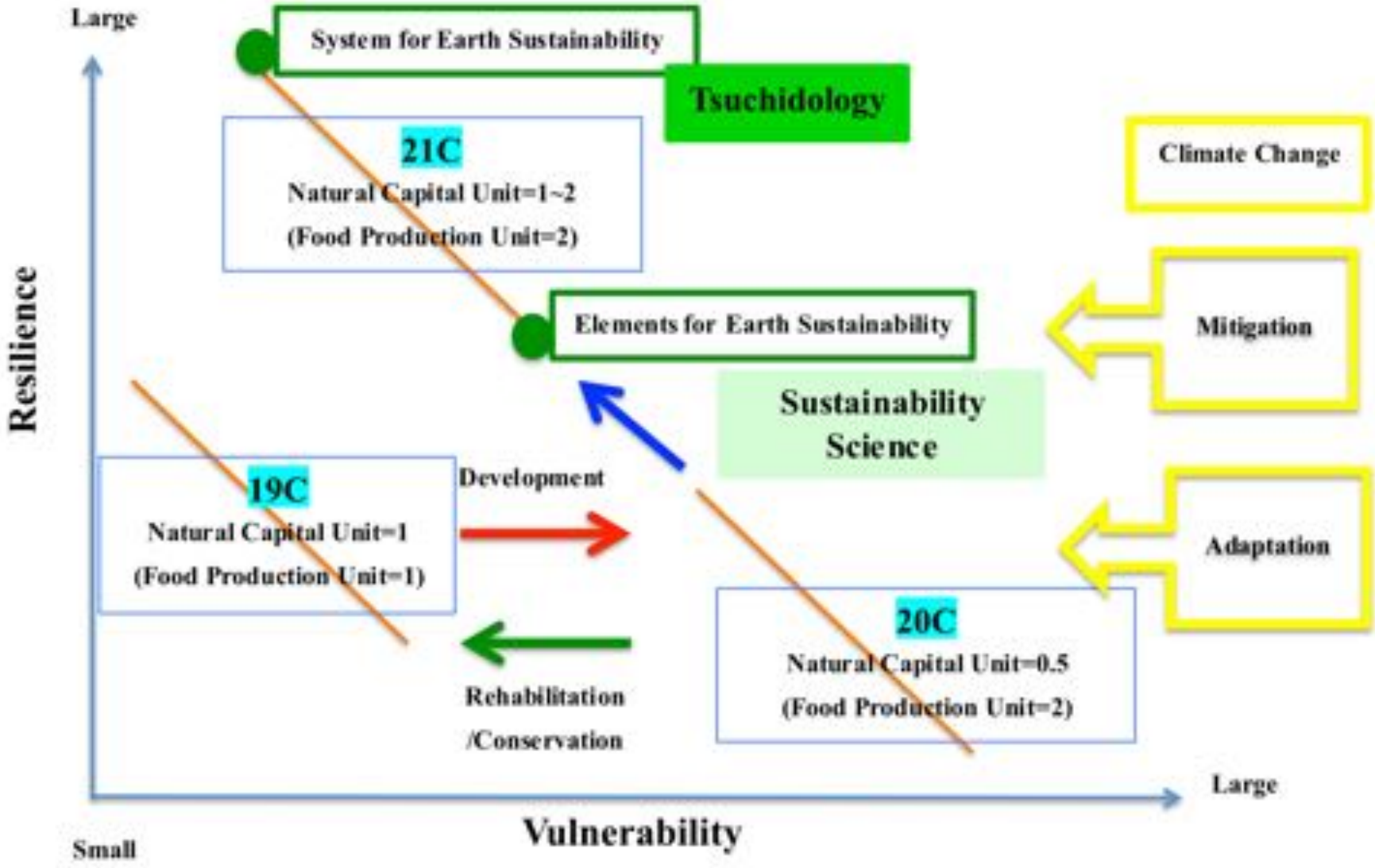
Mutual Interacted Ecosystem
- vulnerability and resilience-





* High Biodiversity & High Productivity/ Enrich of Water & Carbon Stock

** Low Biodiversity & Low Productivity/ Loss of Water & Carbon Stock


Large
System for Earth Sustainability
Tsuchidology
21C
Natural Capital Unit=1~2
(Food Production Unit=2)
Climate Change
Resilience
Elements for Earth Sustainability
Mitigation
Sustainability
Science
19C
Natural Capital Unit=1
(Food Production Unit=1)
Development
Adaptation
20C
Natural Capital Unit=0.5
(Food Production Unit=2)
Rehabilitation
/Conservation
Large
Vulnerability
Small

Meaning of Tsuchidology


常【生】5 2510
セイ ショウ(シャウ)
はえる うまれる うむ いきる
象形 草の生え出る形。〔説文〕六下に「進むなり。艸木の生じて土上に出づるに象る」と生・進の音を以て解するが、声義の関係はない。卜辞の多生は

常【土】3 4010
ド トつちくにところ
象形 土主の形。土を饅頭形にたて長にまるめて台上におき、社神とする。卜文にはこれに灌鬯祭する形のものがあり、社(社)の初文として用いる。〔説文〕十三下に「地の万物を吐生する者なり」(小

United Nations
Climate Change Secretariat

UNFCCC workshop on
"Technical and scientific aspects of ecosystems with high-carbon reservoirs not covered by other agenda items under the Convention"
24 to 25 October 2013, Bonn, Germany

High Carbon Reservoir Ecosystem

1) Peatlands/Wetlands: **Gold Carbon**

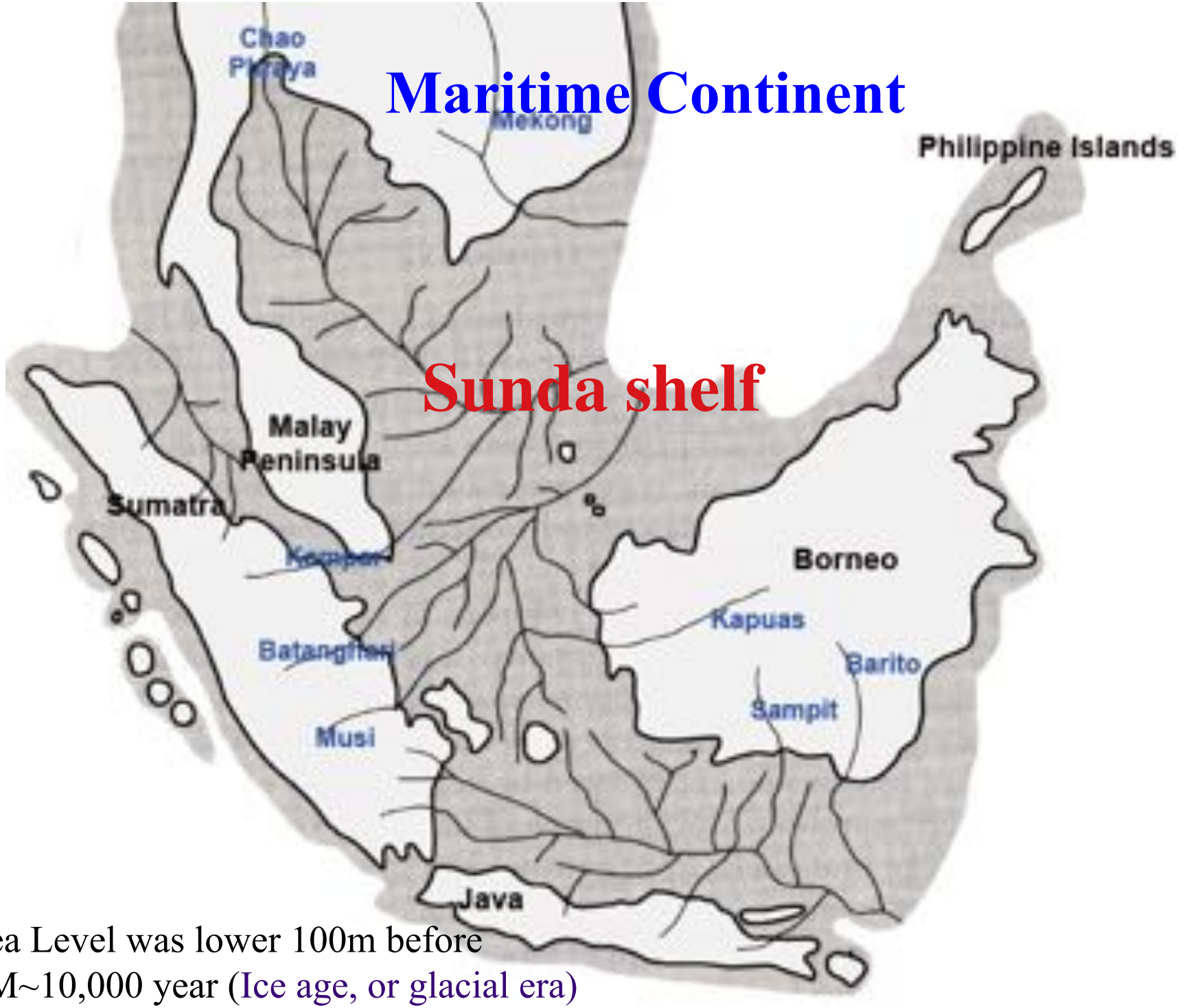
2) Costal Ecosystem (Mangrove/Sea grass/Coral): **Blue Carbon**

3) Permafrost: **Silver Carbon**

No responsible management!
No sustainable management!

Dark/Dirty Carbon

Maritime Continent

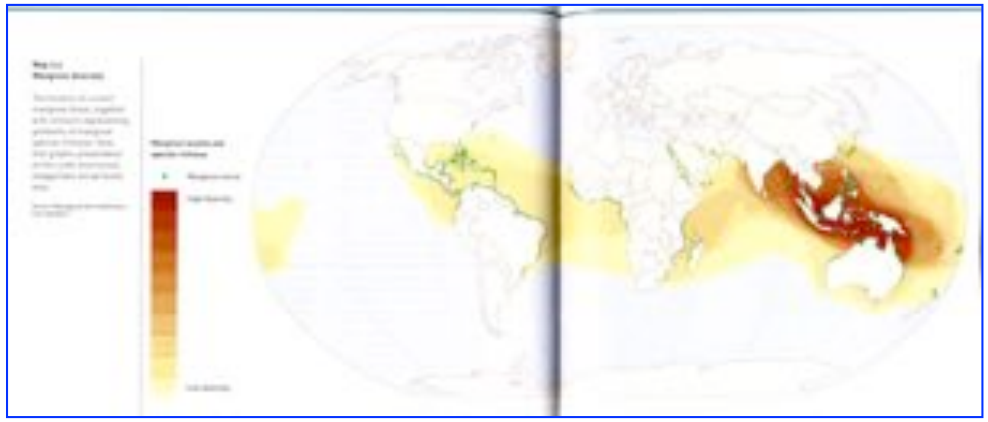


Sea Level was lower 100m before
2M~10,000 year (Ice age, or glacial era)

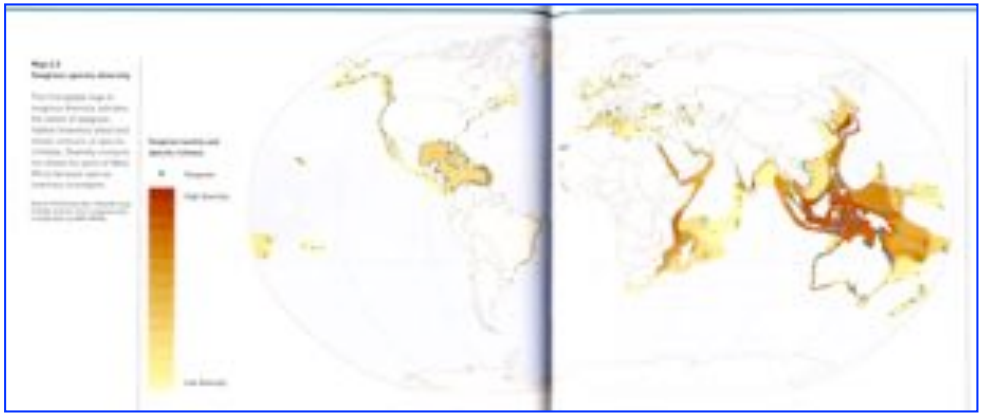
Blue Carbon

From World Resources 2000-2001, ELSEVIER SCIENCE 2000

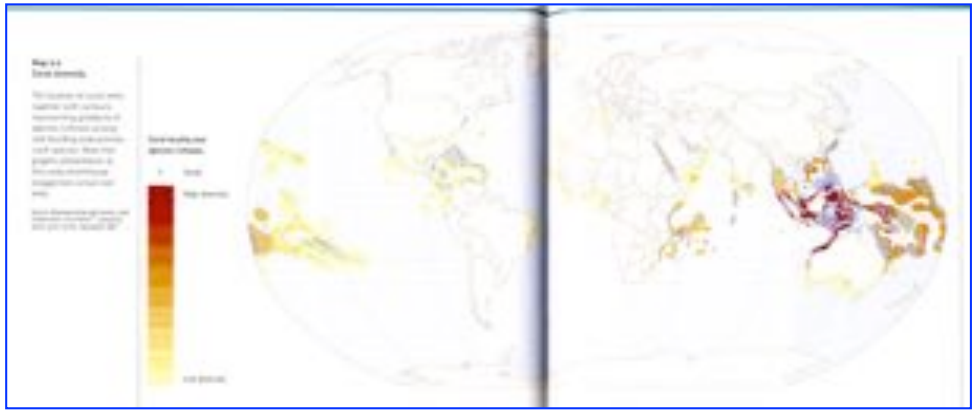
Mangrove diversity



Seagrass diversity

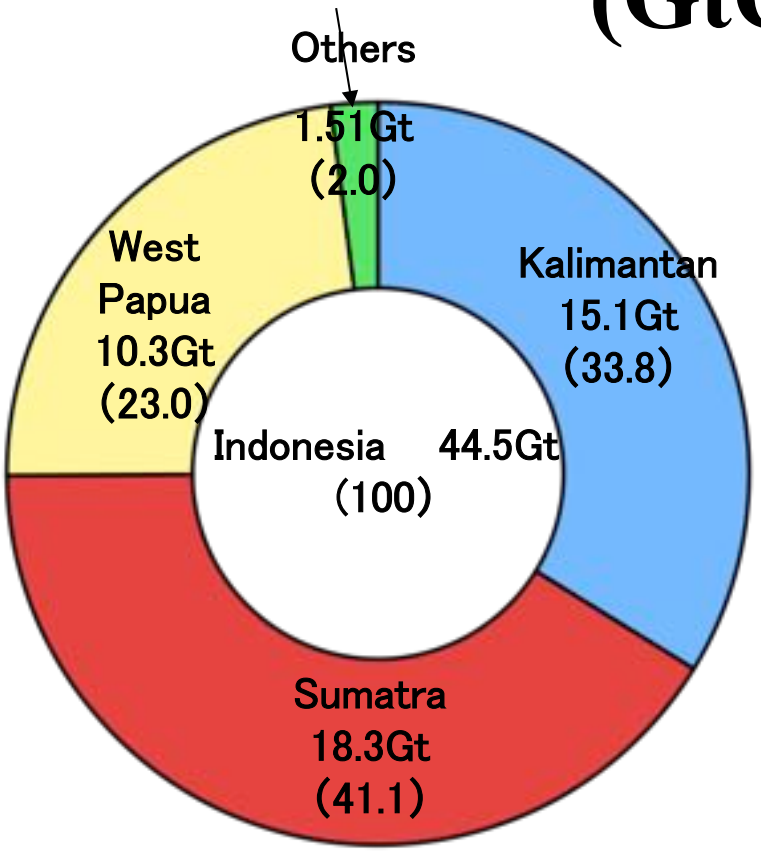


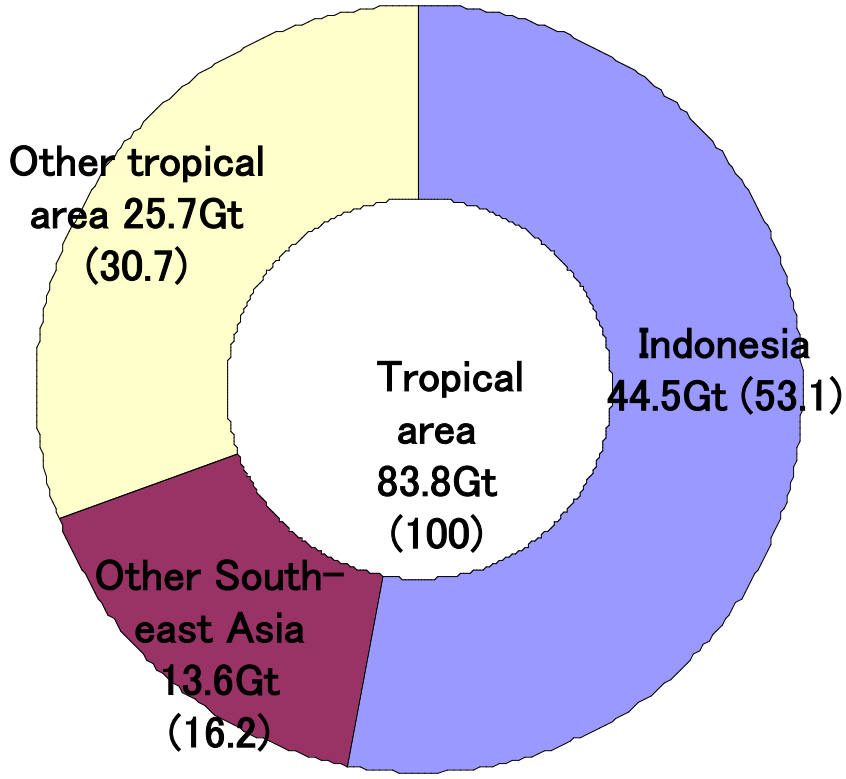
Coral diversity




Malay Peninsula
Borneo
Papua
Sunda shelf
Sumatra
Jawa

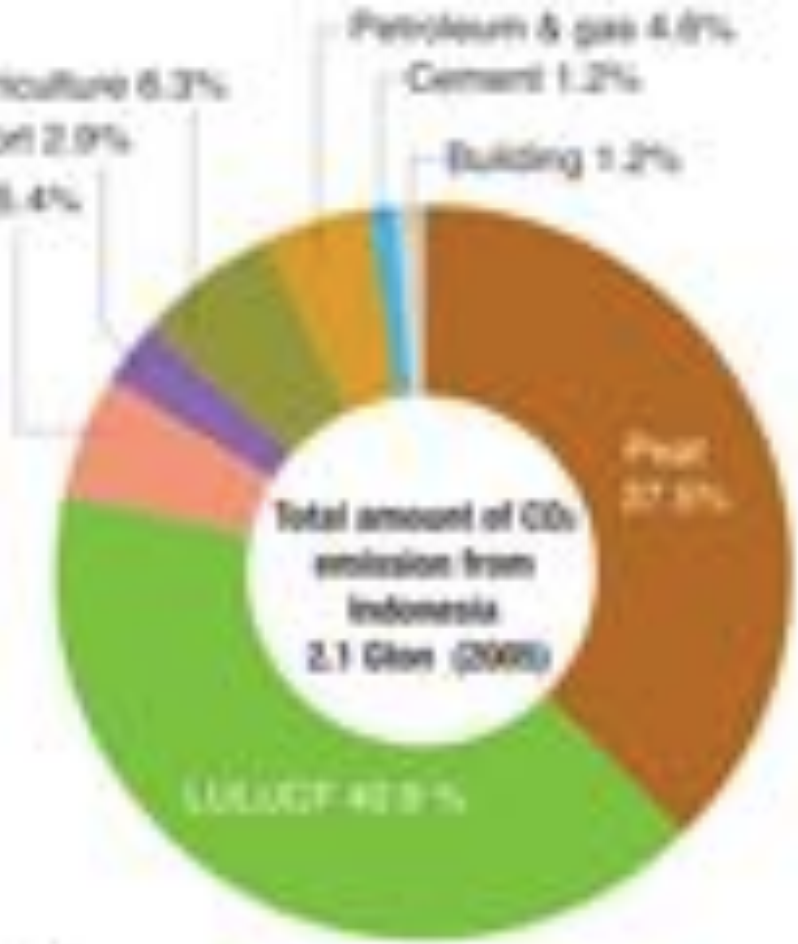
Amount of Carbon in tropical peat (GtC (%))

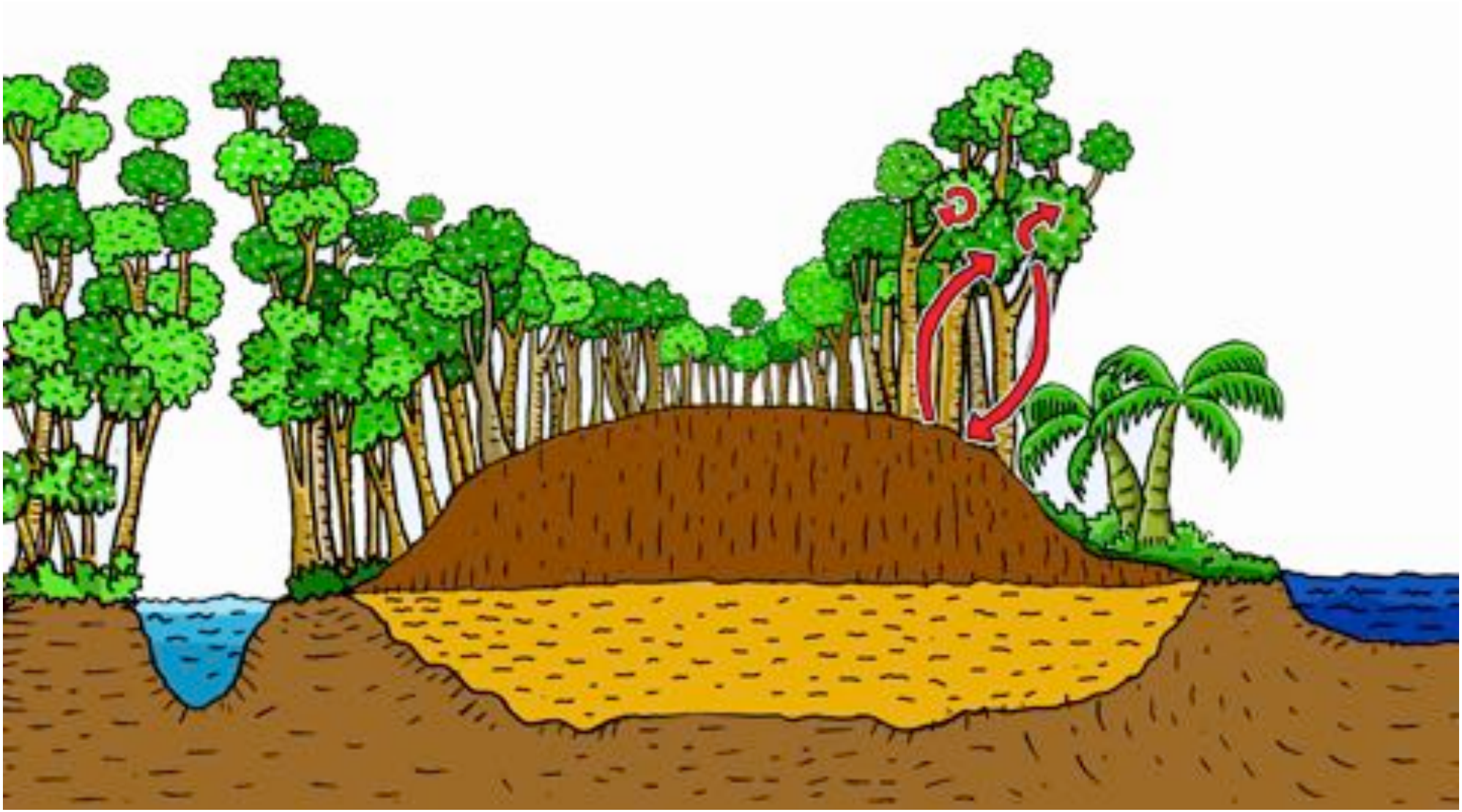




(From Maria Strack ed., 2008: Peatlands and Climate Change. International Peat Society, 223pp.)

Total amount of CO_2 emission





Gold Carbon Mechanisms

Responsible Management of Tropical Peatland

- Innovated paludiculture system with high water table-

Proposed by Mitsuru OSAKI, PhD
Professor Emeritus/Research Fellow, Research Faculty of Agriculture, Hokkaido University, Japan,
The President of Japan Peatland Society (JPS), Japan,

Gold Carbon Mechanisms

AeroHydro Culture

-High Water Table Culture
-Oxygen and Nutrients application from land surface

Integrated MRV System

-Key Model: Ground Water Table Mapping
-Sub-model: Carbon Emission, Fire, Peat depth, and Vegetation

Gold Carbon Design

-Contribute to 1) Paris Agreement (COP21), 2) SDGs, 3) Rio+20 (Natural Capital), and 4) National Security

Food and Energy Security

-Food: High Productivity and High Quality
-Biomass: High biomass productivity (Bioenergy and Biochar)

Transparency

-Project designate
-Policy making
-Evaluation of AeroHydro Culture and Gold Carbon Designate
-Sentinel

Gold Carbon Bond

- REDD+
-CSR (Corporate Social Responsibility)/ CSV (Creating Shared Value)
-ESG (Environment, Social, Governance)/ SRI (Socially Responsible Investment)

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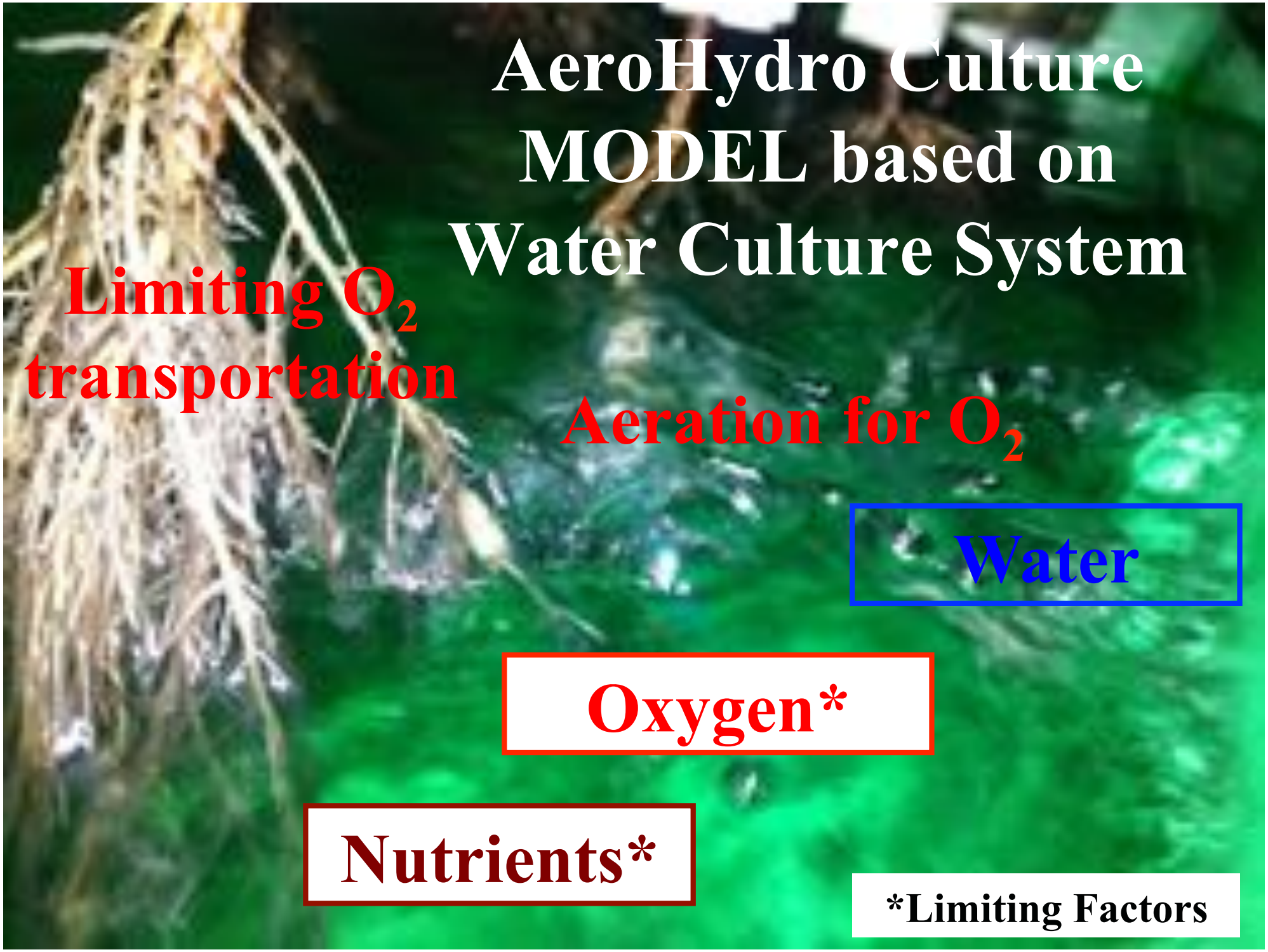
AeroHydro Culture
-High Water Table Culture-

Cultivation Methods


AeroHydro Culture
MODEL based on
Water Culture System
Limiting O_2 transportation
Aeration for O_2
Water
Oxygen*
Nutrients*
*Limiting Factors

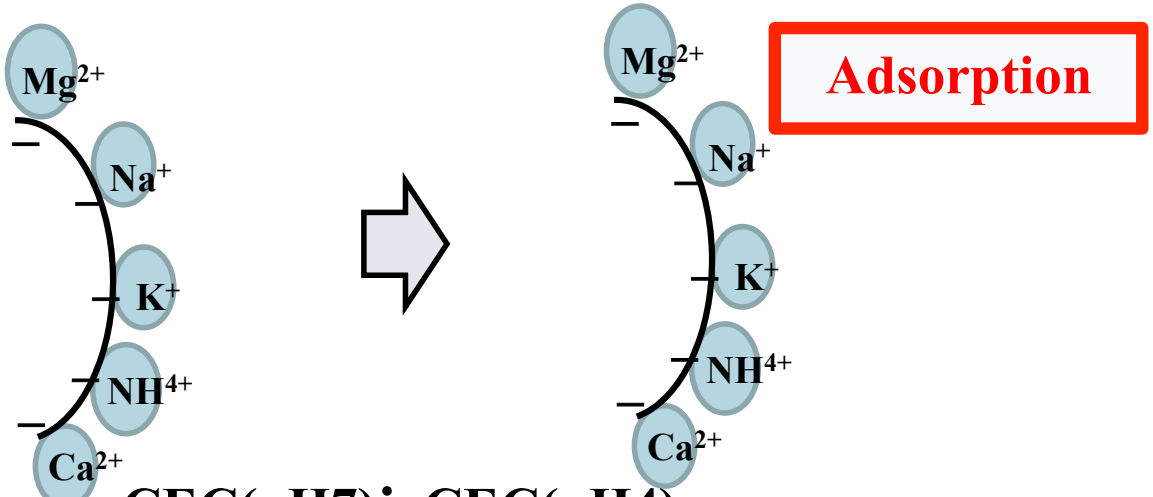
Oil Palm grown at 50~70 cm water table @PT Meskom Agro Sarimas, RIAU PROVINCE
30 August 2017

1) From 2002
2) Land area: Inti (HGU) seluas 3.705 Ha + Plasma seluas 3.889 Ha.
3) Productivity (FBB): 17t /ha/year
4) Peat depth: ?
5) Water table: 50-70 cm
6) Tidal effect: small (6.5 km)
7) Fertilizer: FBB ash (7 kg/year/stand) & compound fertilizer (N:P:K=7:6:36)(6 kg/year/stand)
8) Weeds: high competition with weeds

Serious K^+ deficiency even in <u>low water table (50-70 cm)</u> and <u>extreamly K^+ high application</u>, indicating that Water Table is not key factor on oil palm production

Cation Retention on Clays and Organic Matter

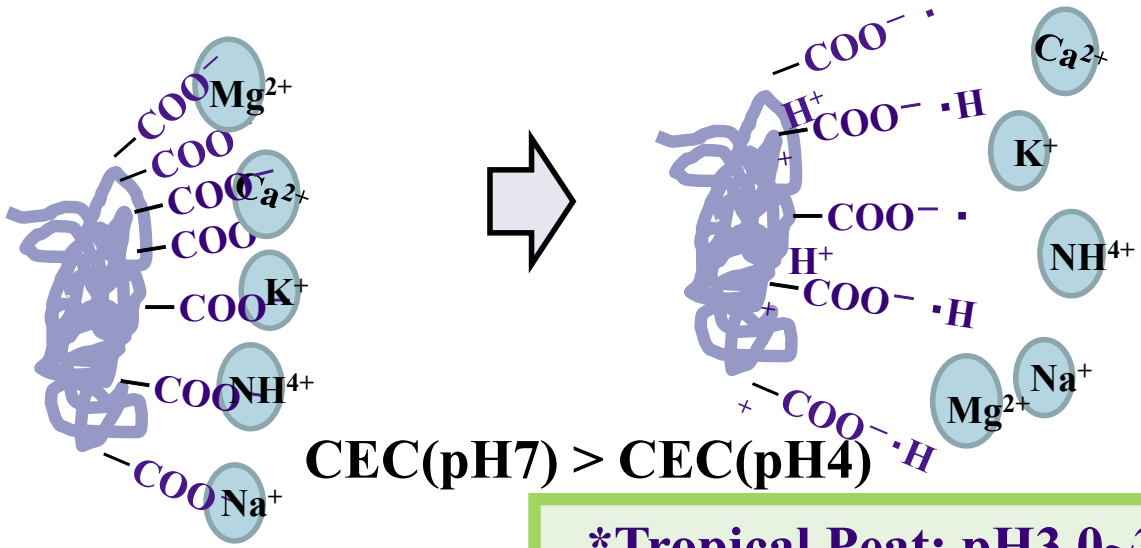
Soil Clays
Permanent charge



CEC(pH7)≒CEC(pH4)

pH7 **pH4** **Desorption**

Soil Organic Matter (SOM):
Variable charge (pH-depended)



CEC(pH7) > CEC(pH4)

***Tropical Peat: pH3.0~3.4**

Unique system for nutrient application from land surface

Oil Palm grown high water table @Mega Timur Village, Sungai Ambawang District, Kubu Raya Regency, Pontianak

1) 8 years palm for 14 ha by Mr. Suparjo (farmer)
2) High productivity: 40 ton/ha/year (very high productivity)
3) Sallow peat (1~2 m depth)
4) High water table (10~20 cm from surface)
4) Final stage of peat
5) Tidal effect
6) Soil surface management by organic matters

Research Topics

1) Root matte distributed at only surface (shallow peat, organic matter application), which is main reason of high water table tolerance
2) Tidal effect (keeping wet, supplying O_2, nutrients supply (K/Na or micro nutrients)

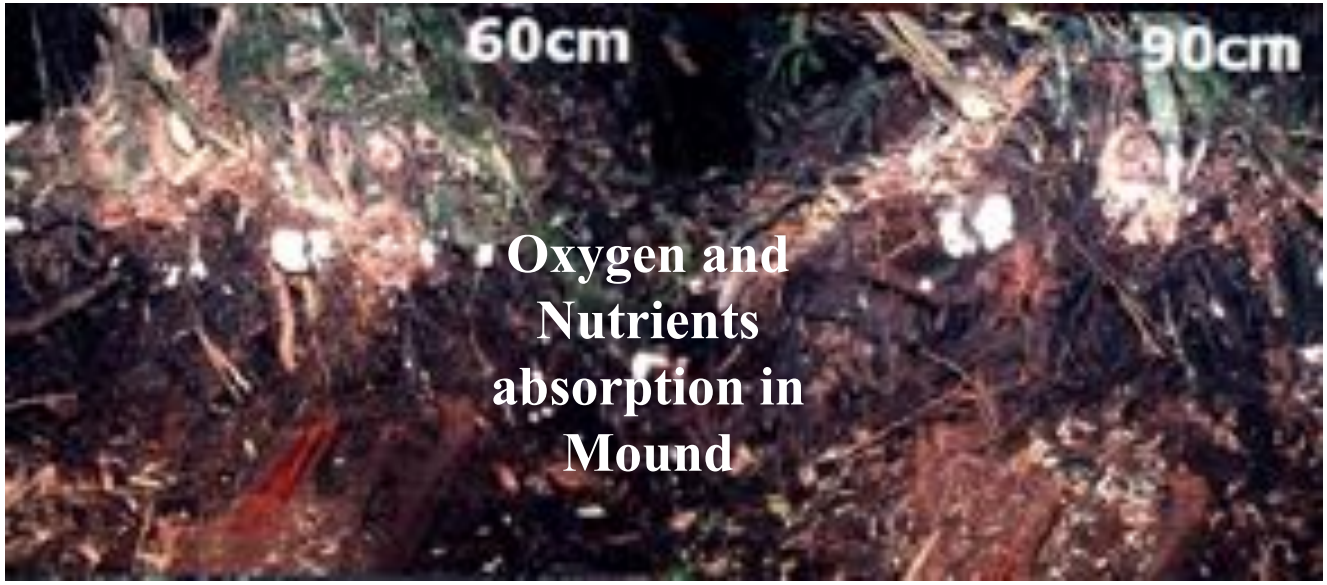
“United Plantations Berhad”
-Oil Palm Plantation in Malaysia-

- High Water Table

The world’s first certified producer of sustainable palm oil by “The Roundtable on Sustainable Palm Oil (RSPO)” on the 26th August 2008.

1. Applied Plants with Aerial Root Formation

2. Applied Plants with Mound Root Formation

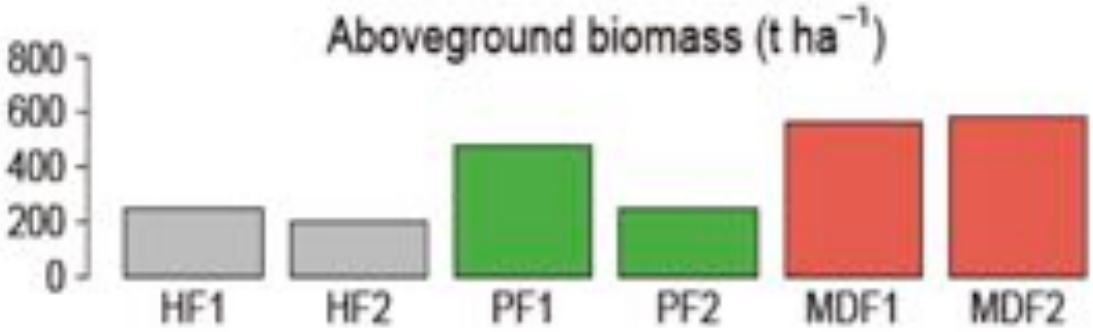


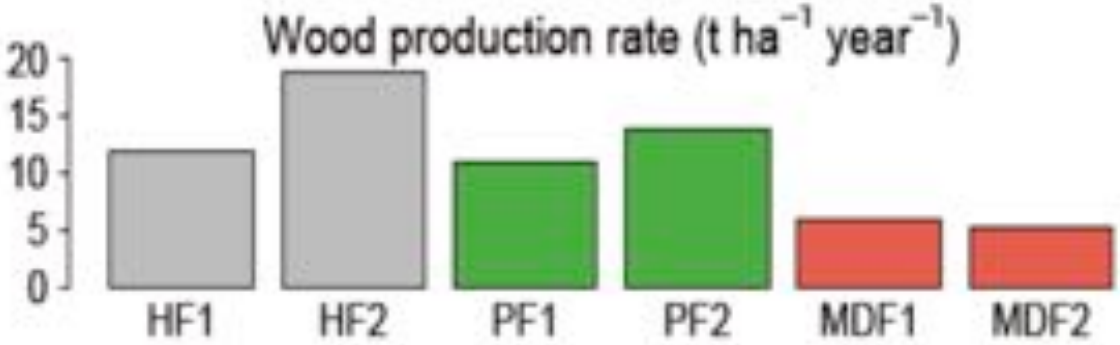
Mound Root of Jelutong （*Dyera costulata* Hook f.)

AeroHydro Culture
-High Water Table Culture-

Biomass Utilization

Extreamly High Biomass Productivity in Peatland





Sago based- Peatland Restoration @ SEI TOHOR VILLAGE, MERANTI DISTRICT, RIAU PROVINCE

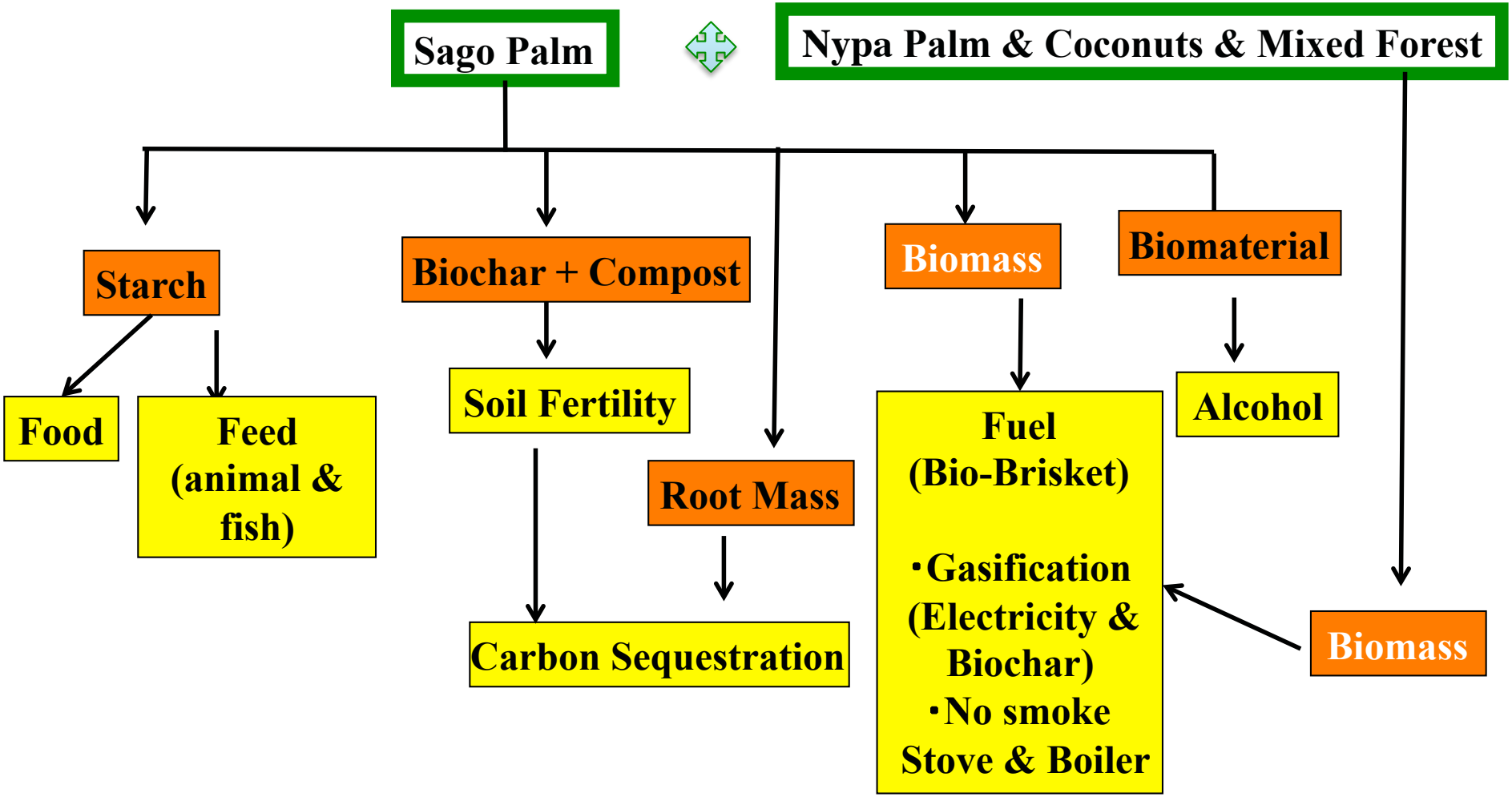
Ideal Sago Production

1) Semi-natural Conditions
***High Water Table**
***Mixed Forest**
***Production of 100 sago stand/ha/year**

2) High Starch Production
300kg starch/ sago stand, then 30ton starch /ha/year (more than 10 time of rice)

3) High Biomass Productivity
1 ton biomass/ sago stand, then 100 ton biomass/ ha/year

Whole Usage of Biomass in "Sago based Ecosystem"

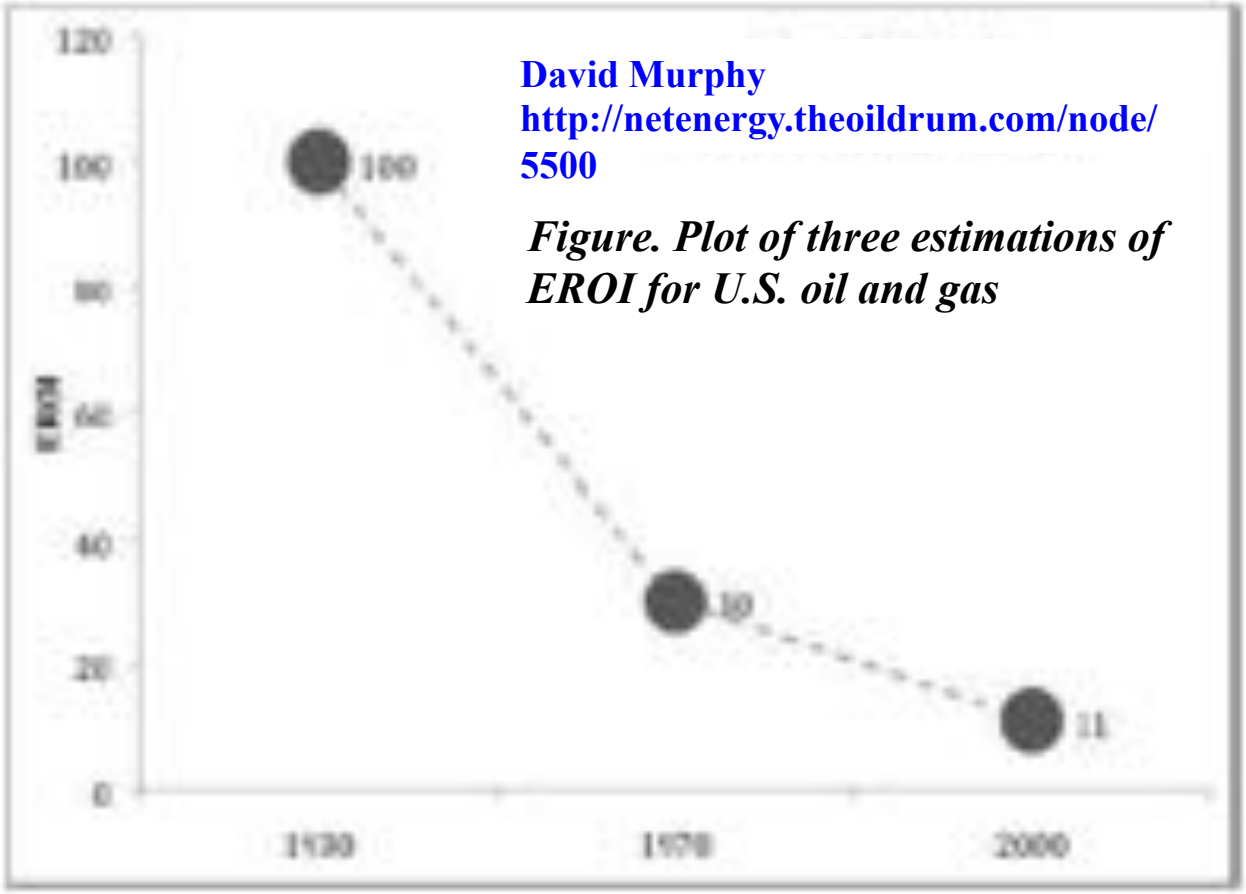


Energy Profit Ratio (EPR) =Derived Energy/Invested Energy

Rabbit Limit:

An Indian cannot survive even if he can catch many rabbits, when energy derived from the caught rabbits is smaller than energy required to catch the rabbits.

Energy Return on (Energy) Investment (EROI)



David Murphy
http://netenergy.theoildrum.com/node/5500

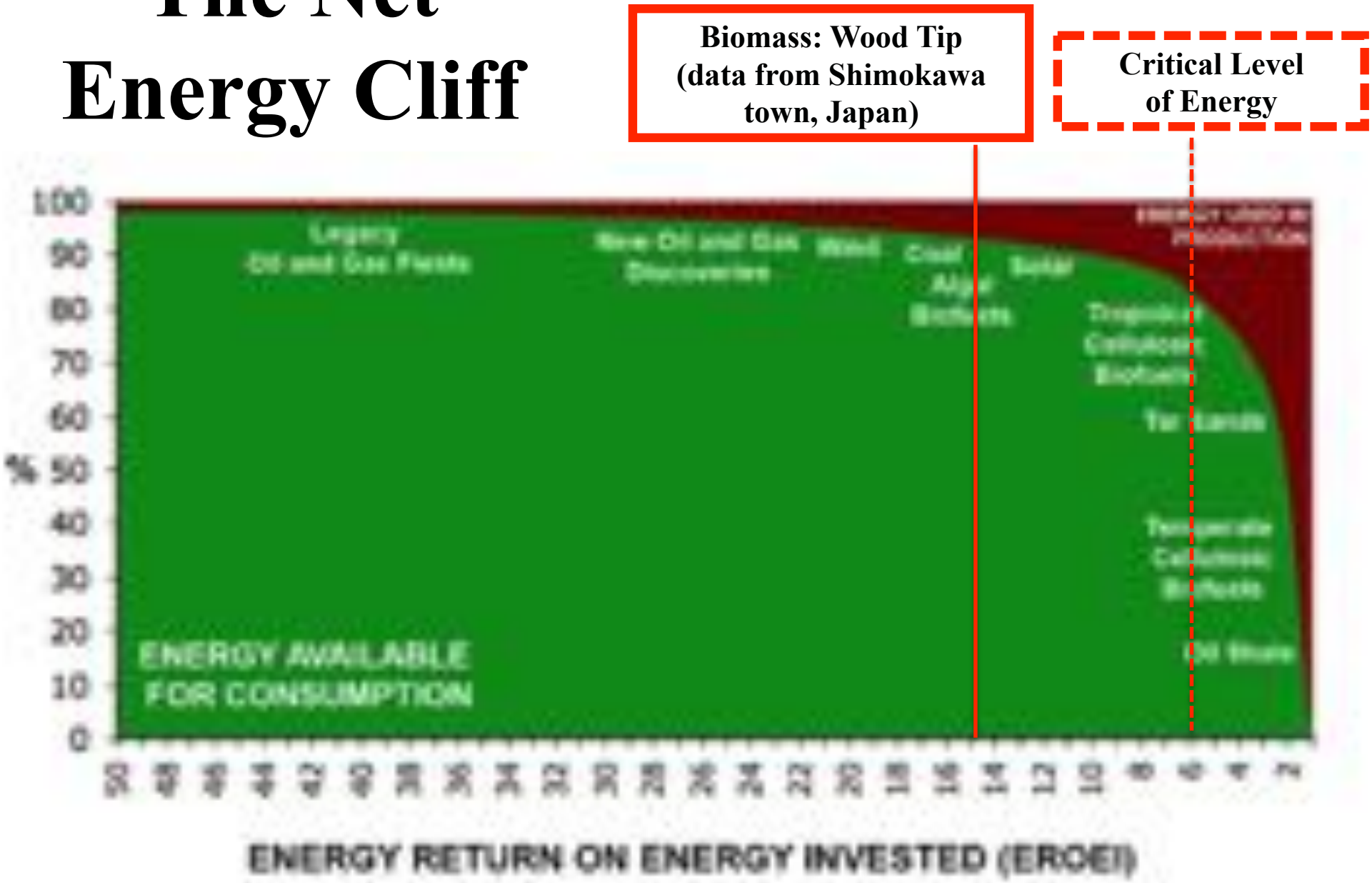
Figure. Plot of three estimations of EROI for U.S. oil and gas

The Net Hubbert Curve: What Does It Mean?
Posted by David Murphy on June 22, 2009 - 10:30am in The Oil Drum: Net Energy

Cutler Cleveland of Boston University has reported that the EROI of oil and gas extraction in the U.S. has decreased from 100:1 in the 1930's to 30:1 in the 1970's to roughly 11:1 as of 2000 (Figure 1). But beyond the fact that society receives currently around 11 barrels of oil for every 1 barrel that it spends getting that oil, What does this mean?

The Net Energy Cliff

Ugo Bardi 2013 http://www.europarl.europa.eu/cmsdata/78337/bardi_presentation_en.pdf



Wood Chip Production

Stock yard in the forest

Stock yard at the plant

Primary shredding

Chip yard

Gold Carbon Mechanisms

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-Oxygen and Nutrients application from land surface

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Transparency

-Project designate
-Policy making
-Evaluation of AeroHydro Culture and Gold Carbon Designate
-Sentinel

Gold Carbon Bond

- REDD+
-CSR (Corporate Social Responsibility)/ CSV (Creating Shared Value)
-ESG (Environment, Social, Governance)/ SRI (Socially Responsible Investment)

Micro-Hydrological Unit Management

Deforestation Impact

- Drying of ground surface
- Decreasing water holding capacity

Climate Change Impact

- El Niño: Drying
- La Niña: Wetting

Drainage Impact

- Decreasing water table
- Drying of ground surface

Water Table Decrease & Dryness of Surface

Carbon Assimilation Decreasing by Forest Degradation

Carbon Emission by Fire

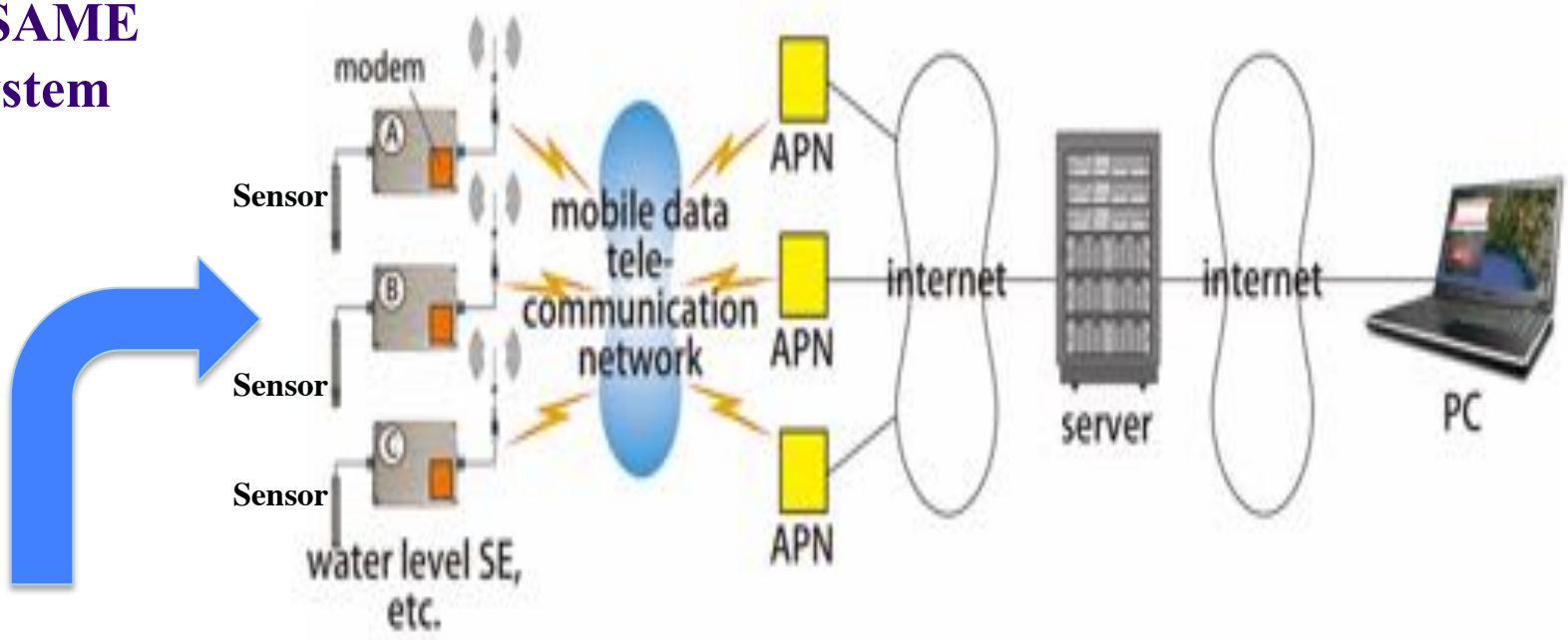
Carbon Emission by Microorganisms' Oxidation

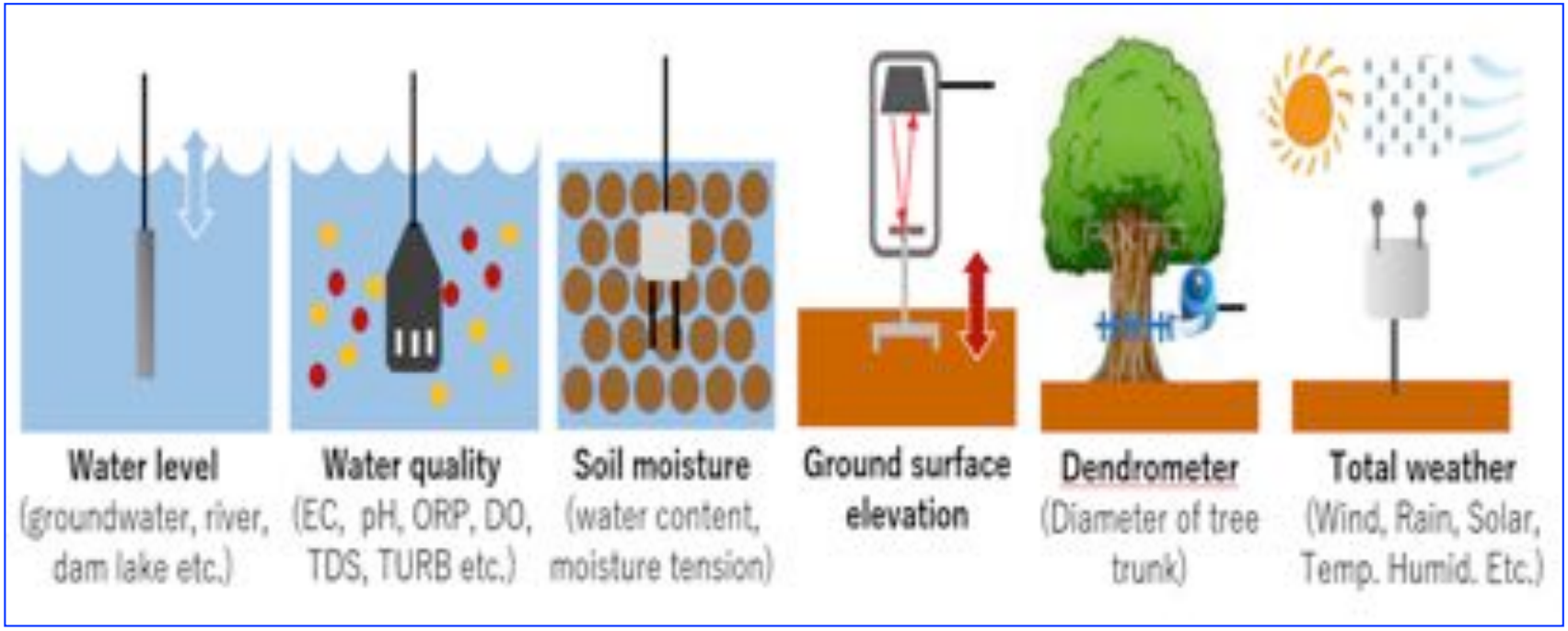
Biodiversity Loss inside Native-Forest

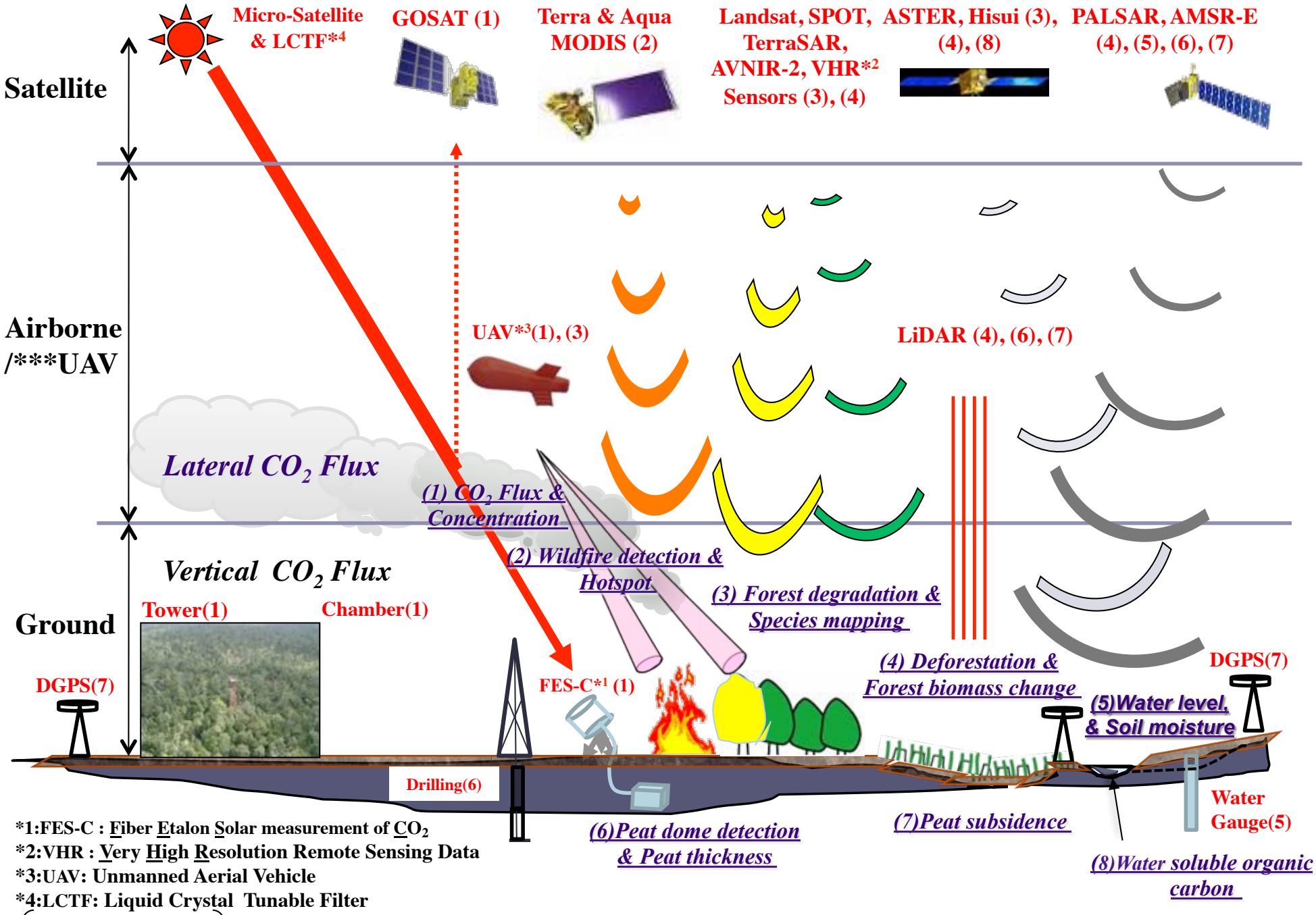
Biodiversity Loss by burning in surrounding Native-Forest

Carbon Loss through Water

SESAME System



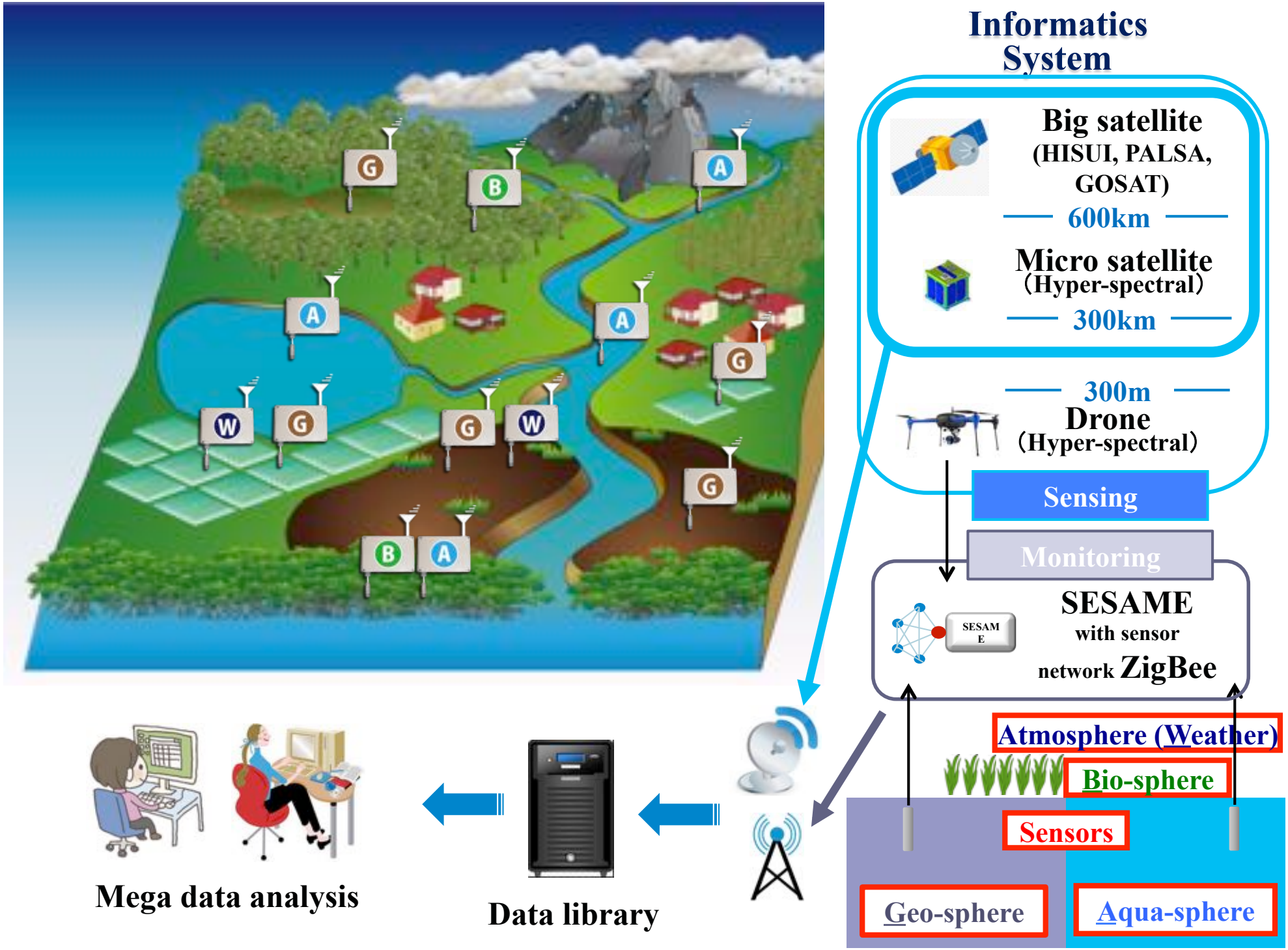




*1:FES-C : Fiber Etalon Solar measurement of CO_2
*2:VHR : Very High Resolution Remote Sensing Data
*3:UAV: Unmanned Aerial Vehicle
*4:LCTF: Liquid Crystal Tunable Filter

Red: Instrument
Black: Target

Key Elements of Tropical Peatland MRV System

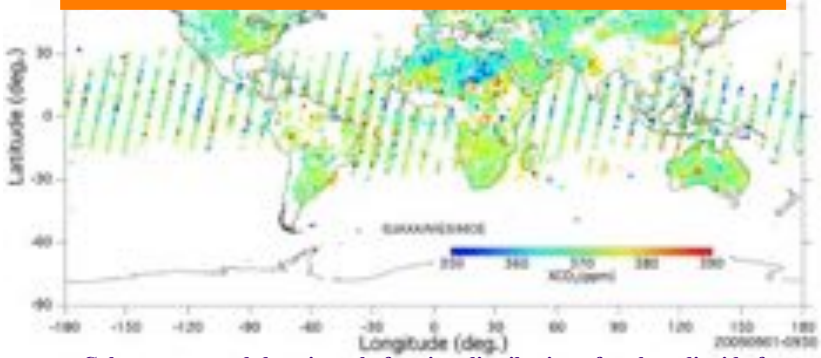

Informatics System
Big satellite
(HISUI, PALSA, GOSAT)
600km
Micro satellite
(Hyper-spectral)
300km
300m
Drone
(Hyper-spectral)
Sensing
Monitoring
SESAME
with sensor network ZigBee
SESAME
Atmosphere (Weather)
Bio-sphere
Sensors
Geo-sphere
Aqua-sphere
Mega data analysis
Data library

Top-down
- satellite
- airplane
- inverse model

Carbon Budget Map

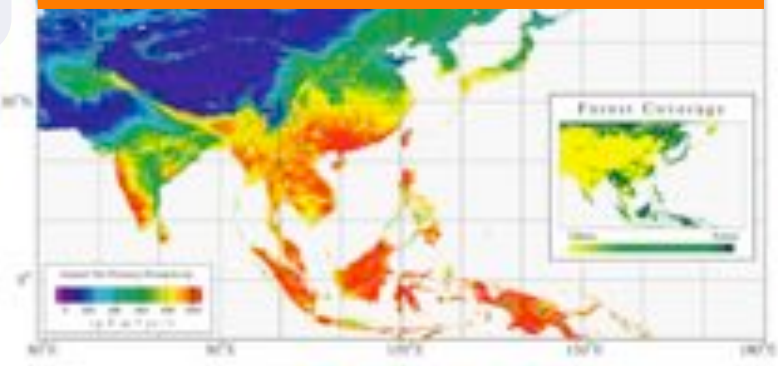
Bottom-up
- field survey
- flux obs.
- process model

Satellite GOSAT "IBUKI" Senescing: Atmosphere CO_2



Column averaged dry air mole fraction distribution of carbon dioxide for the month of September, 2009, obtained from IBUKI observation data (unvalidated) By JAXA

Simulator: SimCycle-Visit for East Asia



Subsidence Model

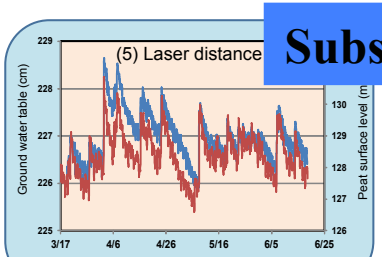
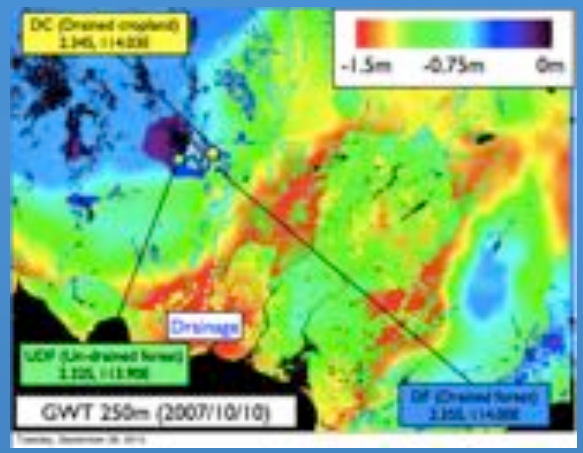


Fig. B Relationship between ground water level (blue) and peat surface level (red)

Presented by Kawasaki (2013)

Carbon-Water Simulation



- Carbon Emission by Fire
- Carbon Loss through Water
- Carbon Emission by Microorganisms Degradation
- Tree Growth/Mortality
- Pest subsidence

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Gold Carbon Design

SDGs and National Security

SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

Goal 1. End poverty in all its forms everywhere
Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
Goal 3. Ensure healthy lives and promote well-being for all at all ages
Goal 4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all
Goal 5. Achieve gender equality and empower all women and girls
Goal 6. Ensure availability and sustainable management of water and sanitation for all
Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10. Reduce inequality within and among countries
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12. Ensure sustainable consumption and production pattern
Goal 13. Take urgent action to combat climate change and its impacts*
***Acknowledging that the UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change.**
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

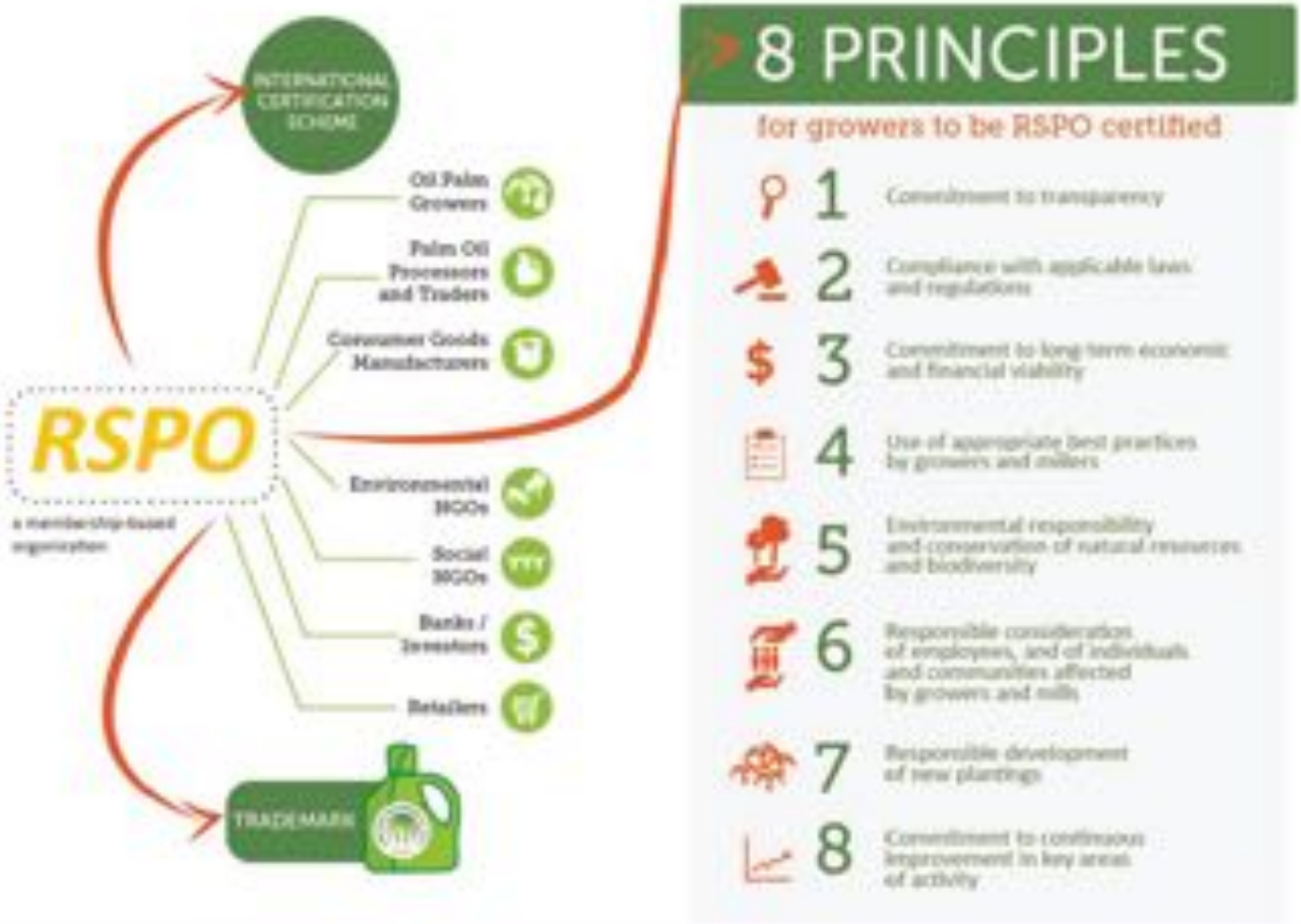
United Nations Department of Economic and Social Affairs, Division for Sustainable Development, "Outcome Document - Open Working Group on Sustainable Development Goals" URL:http://sustainabledevelopment.un.org/focussdgs.html

ABCDEFGs Securities in Peatlands to Global Crisis

-Aquatic /water security: Water Reservoir Ecosystem
-Biodiversity security: High biodiversity by mix-planting and nature-conservation around peat dome
-Climate Change security: Mitigation as Carbon Emission Reduction & Adaptation as High Biomass Production (enough water) against El Niño
-Disaster security: Fire & Haze Protection
-Energy security: Biomass energy from sago starch and residuals, and other biomass materials in Sago based Ecosystem
-Food/Feed security: Sago starch for food and feed (animal husbandry and fish culture)
-Global Partnership as global security: International safety networks on Peatland/Wetland
-social security: REDD+, PES, CSR&CSV, and ESG&SRI

Gold Carbon Design

RSOP
(Roundtable on
Sustainable Palm Oil)



Transforming the market to make sustainable palm oil the norm

Source: RSPO website

Key policies of RSPO NEXT:

Unilever Sustainable Palm Oil Sourcing Policy – 2016

In 2015, we were the largest end user of physically certified palm oil (close to 300,000 tonnes) in the consumer goods industry. We continue to work with our partners to accelerate and reach our target of achieving 100% physically certified palm oil and its derivatives (RSPO Mass Balance, RSPO Segregated or equivalent standard that is independently verified by a third party) for our core volumes[5] by 2019 as per the following glide path:

	2015	2016	2017	2018	2019
Total Physical Certified (RSPO MB, SG or equivalent)	19%	30%	50%	80%	100%

Natural Peatland

Extreamly High Natural Capital

-High Carbon Reservoir
-High Water Reservoir
-High Biomass Productivity
-High (Bio)diversity

Drain/Low Water Table

(Re-)Wetting/High Water Table

Dryness-peatland
In case of Oil Palm

-Decline of ABCDEFGs security
-Low goal marks of Paris Agreement @ COP21 & SDGs
-Decline of Sustainability of National Economy

Extreamly Low for SDGs

Wetness-peatland
In case of Sago Palm

-Enhancement of ABCDEFGs security
-High goal marks of Paris Agreement @ COP21 & SDGs
-Enhancement of Sustainability of National Economy

Extreamly High for SDGs

Gold Carbon Design

Global Sustainable Investment Alliance (GSIA):

reporting on

"Global Sustainable Investment Review"

2016

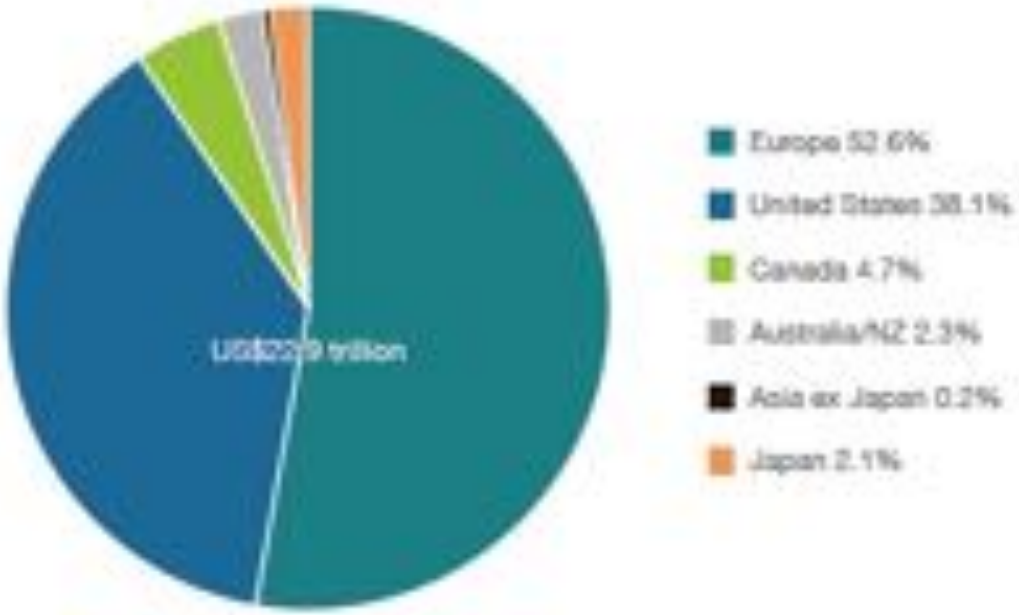
Global Sustainable Investment Review

GLOBAL SUSTAINABLE INVESTMENT ALLIANCE GSIA

Sustainable investment encompasses the following activities and strategies:

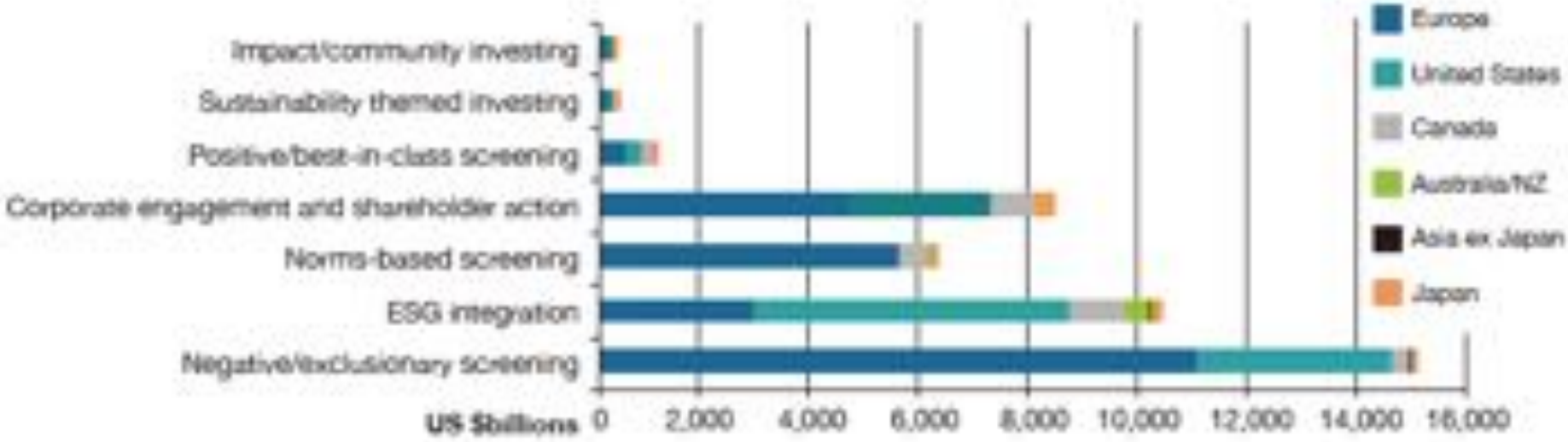
1. Negative/exclusionary screening, $15.02 trillion
2. Positive/best-in-case screening,
3. Norms-based screening,
4. Integration of ESGs factors, $10.37 trillion
5. Sustainability themed investing,
6. Impact/community investing, and
7. Corporate engagement and shareholder action. $8.37 trillion

Figure 1: Proportion of Global SRI Assets by Region



Over this two-year period, Japan, tracked separately in this year's *Review*, has been the fastest growing region, due in part to new surveys by JSIF that provided information for the first time on numerous large asset owners. (See Regional Highlights for additional information.) This is followed by Australia and New Zealand, and then Canada and the United States.

Figure 2: SRI Assets by Strategy and Region



Great Increasing after COP21 (Paris Agreement, 2015)

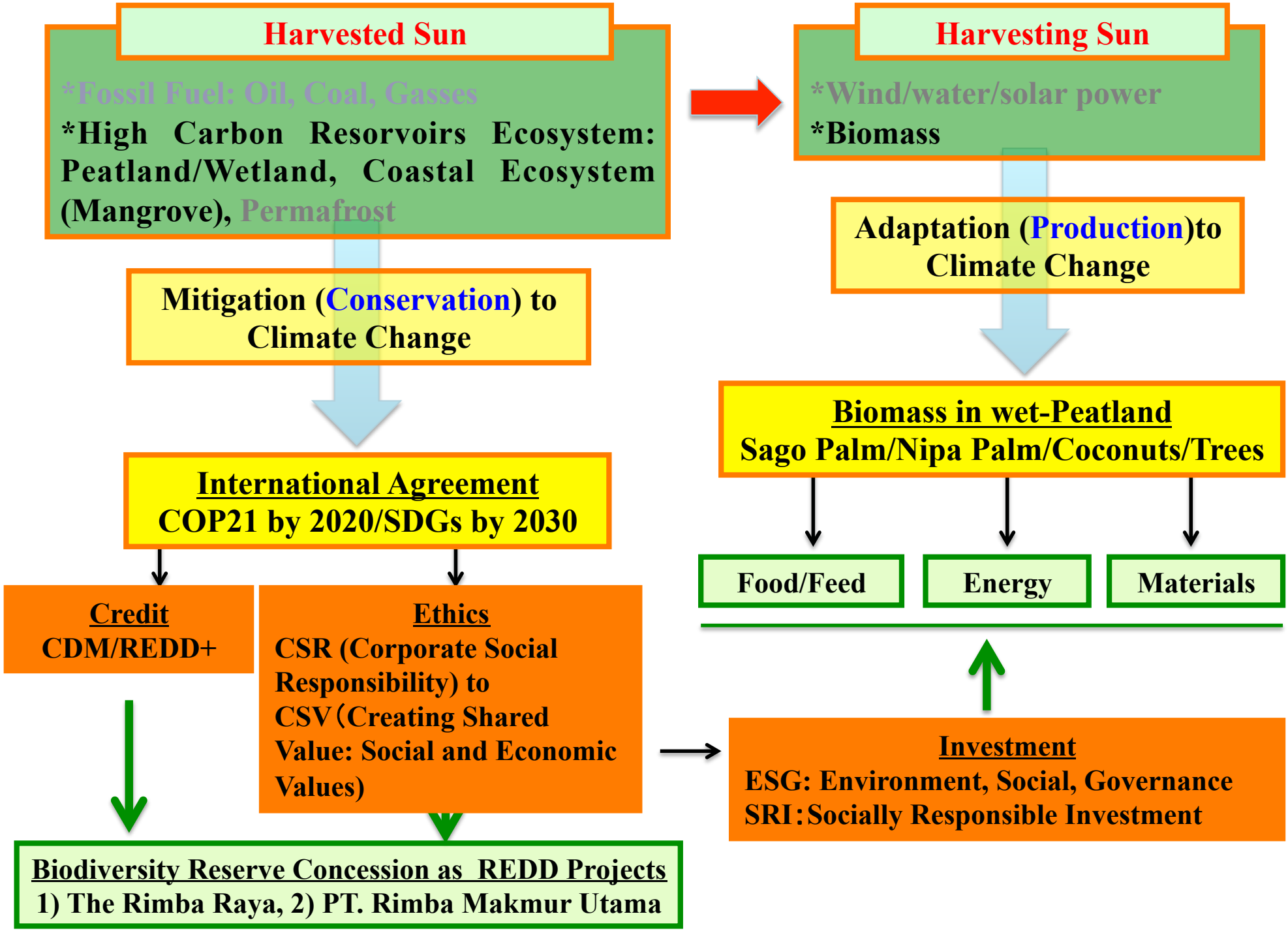
Australia and New Zealand

The most recent two years have seen high profile allocations of capital being made in green finance that include:

- Green themed bonds: These have been issued by major banks in Australia, by property managers, and by a state government.
- Low carbon tilting of portfolios: A major superfund in Australia implemented a low carbon tilt across its full international equities allocation.
- Private equity allocations: Major asset owners in the region have been putting in place more active private equity strategies with explicit targets for low carbon or clean energy companies that offer renewable energy or energy efficiency solutions.
- Green property funds: Australian's listed property groups have long been leaders in managing ESG issues in the built environment, and more property funds (largely commercial real estate) are positioning themselves as green themed funds where assets are managed to a very high environmental standard.
- Sustainable agriculture: As more large institutional investors are focusing on the opportunities in agriculture, the ESG and sustainability related risks and opportunities are starting to become key features of investment deals across agriculture, horticulture and forestry.
- Impact investment products: The first water bond was recently issued, and there are now clean energy venture capital impact funds.

Gold Carbon Bond

Mechanisms Construction


Harvested Sun
*Fossil Fuel: Oil, Coal, Gasses
*High Carbon Resorvoirs Ecosystem: Peatland/Wetland, Coastal Ecosystem (Mangrove), Permafrost
Harvesting Sun
*Wind/water/solar power
*Biomass
Mitigation (Conservation) to Climate Change
Adaptation (Production)to Climate Change
International Agreement
COP21 by 2020/SDGs by 2030
Biomass in wet-Peatland
Sago Palm/Nipa Palm/Coconuts/Trees
Food/Feed
Energy
Materials
Credit
CDM/REDD+
Ethics
CSR (Corporate Social Responsibility) to
CSV（Creating Shared Value: Social and Economic Values)
Investment
ESG: Environment, Social, Governance
SRI：Socially Responsible Investment
Biodiversity Reserve Concession as REDD Projects
1) The Rimba Raya, 2) PT. Rimba Makmur Utama

The green bond program of the World Bank (International Bank for Reconstruction and Development, rated Aaa/AAA) supports the transition to low-carbon and climate resilient development and growth in client countries. This includes both mitigation of and adaptation to climate change—all while observing the World Bank's safeguard policies for environmental and social issues.

Green Bond: 10,000,000,000 (10B) US dollars

http://treasury.worldbank.org/cmd/pdf/ImplementationGuidelines.pdf

Conclusion

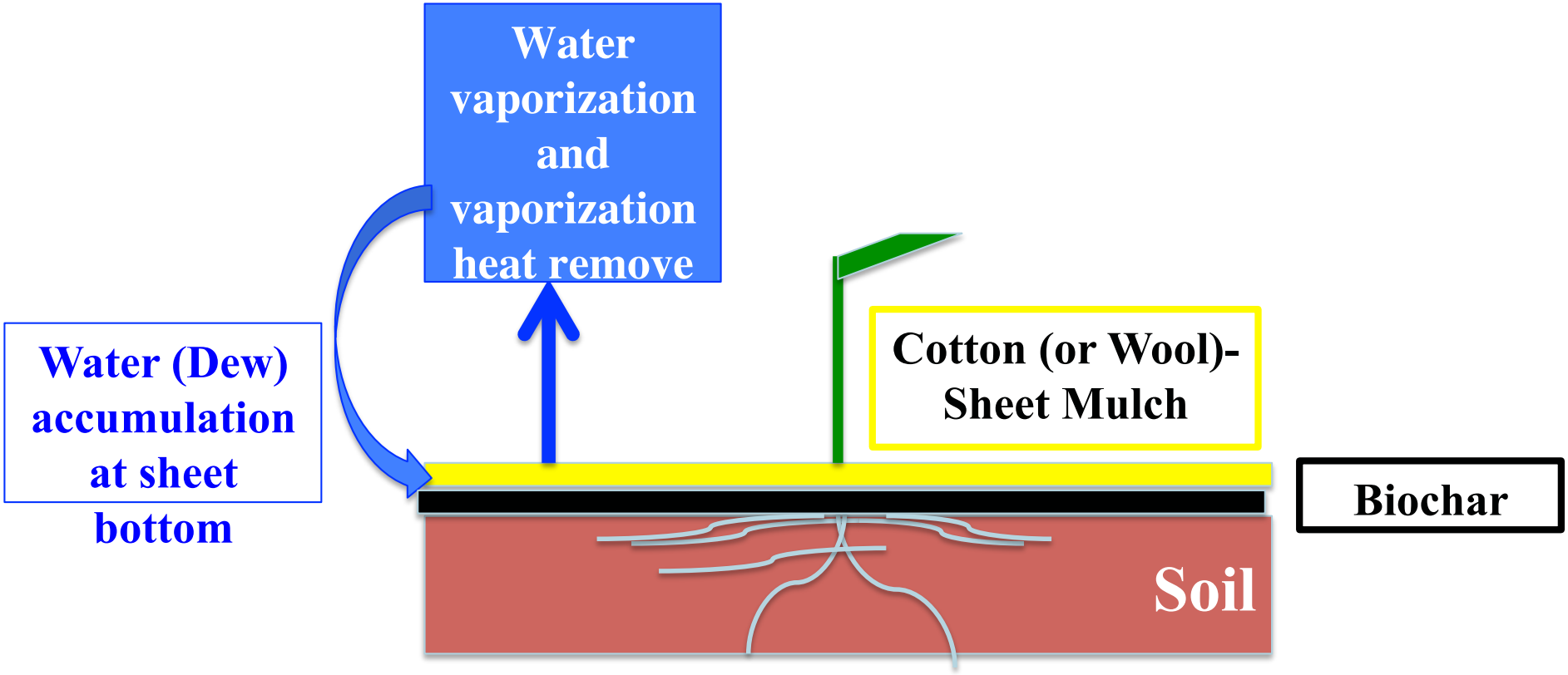
- Responsible Management of Tropical Peatland-

1. General Model on AeroHydro Culture System (High water table)
2. Biomass Utilization (Bioenergy)
3. Evaluation of Responsible Management by MRV System (Transparency)
4. Design on Economic Implementation (Investment)

↓

Branding of Gold Carbon

Mechanisms of high moisture condition in surface soil



1st; Cotton has high porosity
2nd; Water vaporize with vaporization heat
3rd; Cotton mulch sheet became cool, especially in bottom, even in dry condition
4th; Dew is formed under the cotton mulch sheet
5th; Roots can grow well on the surface of soil because of high oxygen supply and good moisture conditions
6th; Surface roots produce hormone such as Cytokines, which contribute to active shoot growth and to disease tolerance

Tsuchidology:
Land Surface Management

Optimization

Oxygen

Water

Nutrients

20th Century

Physiology:
- Plant type (photosynthesis)
- Heterosis

Material:
- Chemical fertilizer

21st Century

Physiology:
- Photosynthates distribution into root
- Heterosis

Tillage/ Multi/ Fallow/ Mix-cropping/ Inter-cropping/ Crop rotation

Material: Slow release fertilizer/ Organic matter/ Biochar
Function: Rhizosphere (plant-soil-microorganisms)

Portfolio for Gold Bond

- Green Bond
- Carbon Bond
- Water Bond
- Sustainable Agriculture Bond (ESG)

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Thanks for
your attention!
Gold Carbon