NUCLEAR TECHNOLOGIES IN GLOBAL WARMING: ASSESSING THE GREENHOUSE GAS EFFECTS CAUSED BY HUGE BIOFUEL PRODUCTION IN INDONESIA

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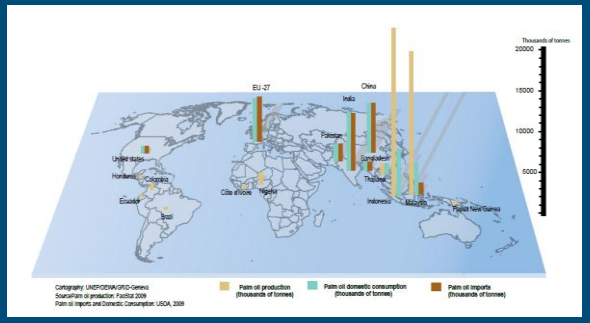
INTRODUCTION

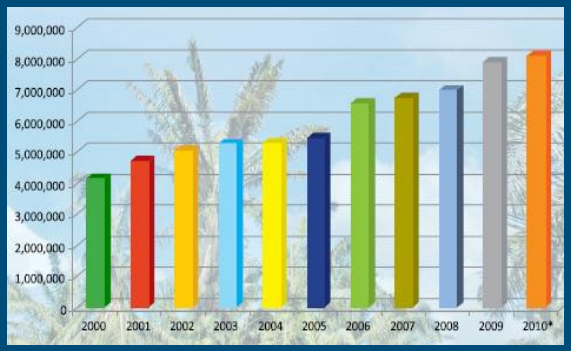


Top ten palm oil producers

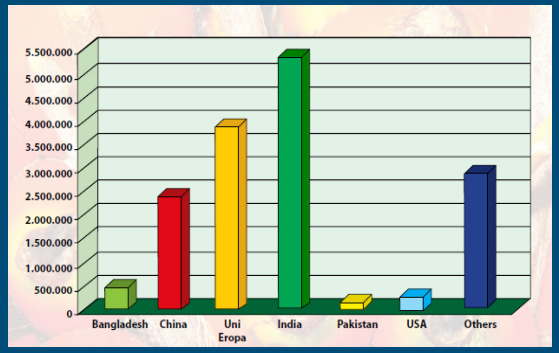
Palm oil production in Indonesia

The largest exporter

Palm oil plantation development :
11 Mha allocated in 2011 , planned up to 20 Mha.
USDA is currently estimating Indonesian palm oil production in 2010/11 at a record 23.0 million tons



Palm oil plantation in Indonesia (ha)



Export of Indonesian Palm oil

DEFORESTATION 2 %/ YEAR

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IMPACTS OF OIL PALM PLANTATION

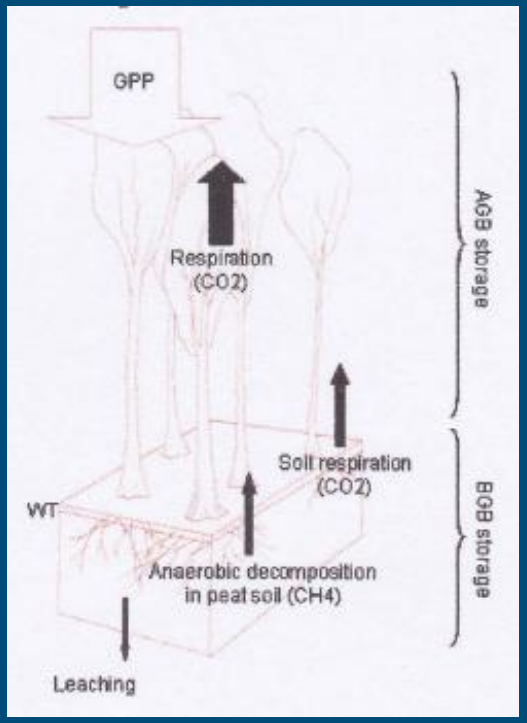
- **Large-scale forest conversion** (Deforestation & degradation)
- **Loss of critical habitat** for endangered :the most species of trees per hectare, but a huge amount of other biodiversity as well
- **Soil erosion** (Erosion & degradation occurs during forest clearing and plantation establishment when the soil is left uncovered)
- **Air pollution** (Burning, N fertilizer)
- **Soil & water pollution** (Fertilizers and Pesticides, Chemicals/FOME)
- **Climate change** (CO_2 emission According to the World Bank, Indonesia is the world's third largest emitter of CO_2 after the United States and China, and 80 percent of its current emissions reportedly come from deforestation and landuse change, including the drying, decomposing, and burning of peatland)
- **Competition Biofuel and Food Crops** (Land and water)

A huge OP plantation was developed at last decade in Indonesia, 11 Mha had been allocated in 2011 and it is planned up to 20 Mha. Deforestation rate in Indonesia in periods of 2000-2006 was 2 % (≈ 1.87 Mha)yr^{-1}, and decreased the forest areas from 119.7 Mha in 1985 to only 88.5 Mha in 2005.

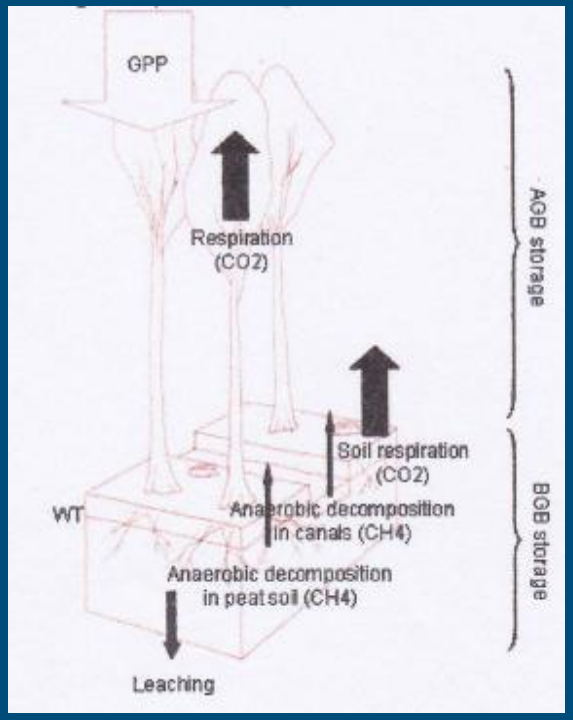
GHG emissions occur at all points in the OP biofuel production. Annual CO2em from direct land conversion alone is estimated around 1.83 Gt CO2, higher on OP plantation on peatland. OP plantation on peat lands requires ground water levels of 80 cm below soil surface, enhances decomposition rates and CO2 emissions to the atmosphere, contributing 98 % or more of the totalcombined global warming potential. Soil respiration rates in OP plantations are about 15 t C ha-1 year-1. Fargione et al (2008) calculated that the conversion from forest peatland to OP releases 3452 tCO2/ha and need >420yr to repay the debt

Scarcity of water is the main limiting factor for biofuel feedstock production in many contexts. Therefore biofuel production would pressure local water resources, such as the oil palm crop which has a relatively high water requirement for commercial yield levels, and increase scarce in many countries. Competition in production between biofuel and food for land and Water resources could not be avoided.

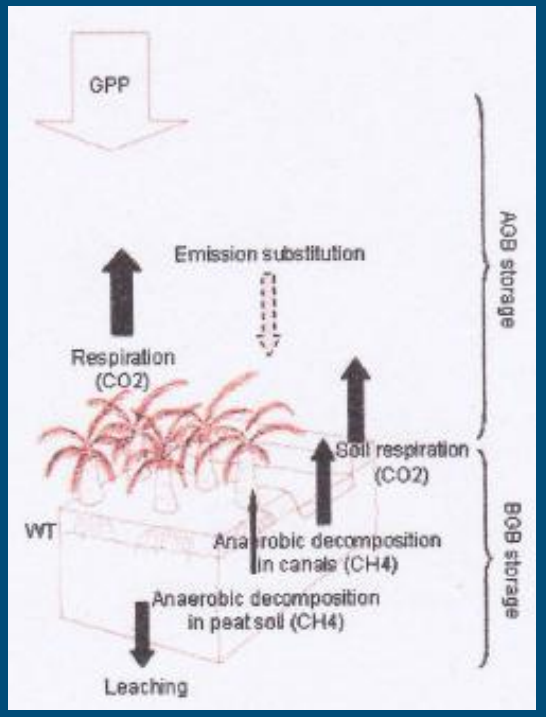
Land based C fluxes (Verwer et al, 2008)



Primary/undrained



Drained+partly looged peat swamps forest ecosystem



Oil Palm plantation peat

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PRESENT POSITION OF FOREST MANAGEMENT

Evaluation of management for conservation of forest resources. Since if current trends continue, the total rainforest area in Indonesia would be Reduced by 29 % as compared to 2005, and would only cover about 49 % of the Original area from 1990.

Reduce GGE and lower its contribution to global climate change by planting I billion trees /year, and 3.2 billion trees have been already planted 2010/11.

Fostering vigorous national economic development

Moratorium palm oil industry a two-year (2011 – 2013).
Norway $1 billion for developing the national REDD+ policy, laws, regulations, and institutions. The ultimate goal is to provide Indonesia with an internationally verified measure of the amount and current value of carbon sequestered in its forests, as well as carbon credits for preventing future deforestation , creation of implementing and forest monitoring institutions

STABLE ISOTOPE TECHNOLOGY (SIT)

Land-use and land-cover changes interact with other global change factors and have impacts on terrestrial, aquatic, and atmospheric processes and the services they supply to humans

Conservation, sustainable management and increasing carbon stock is mandatory after government of Indonesia have pledged to reduce 26 % CO_2 emmision in 2020 (+ 15 % with international support). > 50% is to Come from LULUFC

Monitoring, Reporting and Verivication (MRV) system is highly requirred. This system is expected to give a data or information, clearly, consistent, comparable, complete and precise

SIT has long been recognized as a very efficient and refine tool for studying physical, biological and biogeochemical aspects of how the global ecosystem functions. Their applications in environmental research are abundant, and can be implemented at all levels of research

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SIT can be used in either basic research to investigate the processes of GHG production in ecosystem and gain better understanding The main factors influencing the GHG production and consumption processes or applied research to assess the value or effectiveness of selected management practices on the mitigation of GHG emissions in agro-ecosystem

Measurement of stable isotope ratios (H, C, N, O, and S) present at natural abundances in the environment, integrate source and process information, and often more sensitive to ecological perturbations than are elemental or compound concentrations or fluxes in nature

Stable isotope measurements capture a fundamentally different aspect and dimension of ecosystem change

APPLICATION OF SITs

I. Carbon Cycle $\delta^{13}C$: Photosynthesis, Respiration and Organic matter decomposition

Identification of seasonal changes and sources of atmospheric CO2 at different ecosystem and assessing Plant Water Use Efficiency

Analysis of the $\delta^{13}C$ of the tree rings is one of the powerful ways to reconstruct ecological and physiological changes in plants (stress of soil water or nitrogen availability, low light and salinity)

Annual fluctuation of ci/ca calculated from $\delta^{13}C$ of cellulose extracted from wood rings remarkable correspondence with annual fluctuation in precipitation

Land use changes and deforestation liberate organic matter and induce shifts in ecosystem metabolism (decomposition) lead to change atmospheric $\delta^{13}C$

Identifying sources of pollutants and understanding their movement and Transportations (dissolved in-organic and organic matters)

II. Variation δ ^{18}O and δ ^{2}H Hydrologic Processes

Fresh Water is the most critical resource needed to sustain human health and welfare. Understanding ecological impacts of drought and human use and alteration of fresh water resources is very essential.

Excellent Tracers for detection of the origin, recharge and cycling of water within hydroecological system

There are 2 important effects that influence the isotope composition of water. Seasonality : changes in condensation temperature of precipitation, latitude and altitude seasonality impact condensation temperature, water loss (rainout) and phase condensate have a marked and important influence on the isotopes composition

Continentality : distance an air mass containing water traveled over land from coastal zones, amount effect during heavy rainfall where greater quantities of precipitation are lost from air mass. Evaporation of water, transpiration of plants, condensation, advection, convection led to dew or fog formation. All of these processes have associated isotope effects on the water involved in the process

δ^{18}O tree ring cellulose changes with climate or land use change this provide powerful way to document ecological transformation

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III. Variation δ ^{15}N Biogeochemical processes

N is a key limiting nutrient for both plants and animals, understanding of N cycle is very important.δ ^{15}N can be use to understand how the isotope fractionate during catabolic reactions, in soil and plants related to utilization, transformation and N fixation, interaction of Predators and their prey in a diversity marine, aquatic and terrestrial ecosystems

SI ratio analyses provide important information about the important of biological diversity within the ecosystem. δ ^{15}N has been used to study the invasion of cheatgrass on soil N. Invaded sites have consistently greater δ ^{15}N values, indicating that loss of N was greater than new inputs.

SIratio measurements are usefull for quantifying impacts of land-use changes. Such as identifying sources of pollutants and understanding their movement and transportations (stream particulate and dissolved organic matter, δ ^{15}N and N δ^{18}O stream of nitrate). Mayer et al (2002) showed how δ ^{15}N and δ ^{18}O values of stream Nitrate reflected impacts of land-use changes. Nitrate conc. And δ ^{15}N values were Lowest in streams draining from forested watersheds, while in watersheds in Urban and agricultural land areas were high. Combination of δ ^{15}N and N δ^{18}O can Distinguish terrestrial pollutants and soil denitrification from atmospheric nitrate Deposition sources to watershed outflow.

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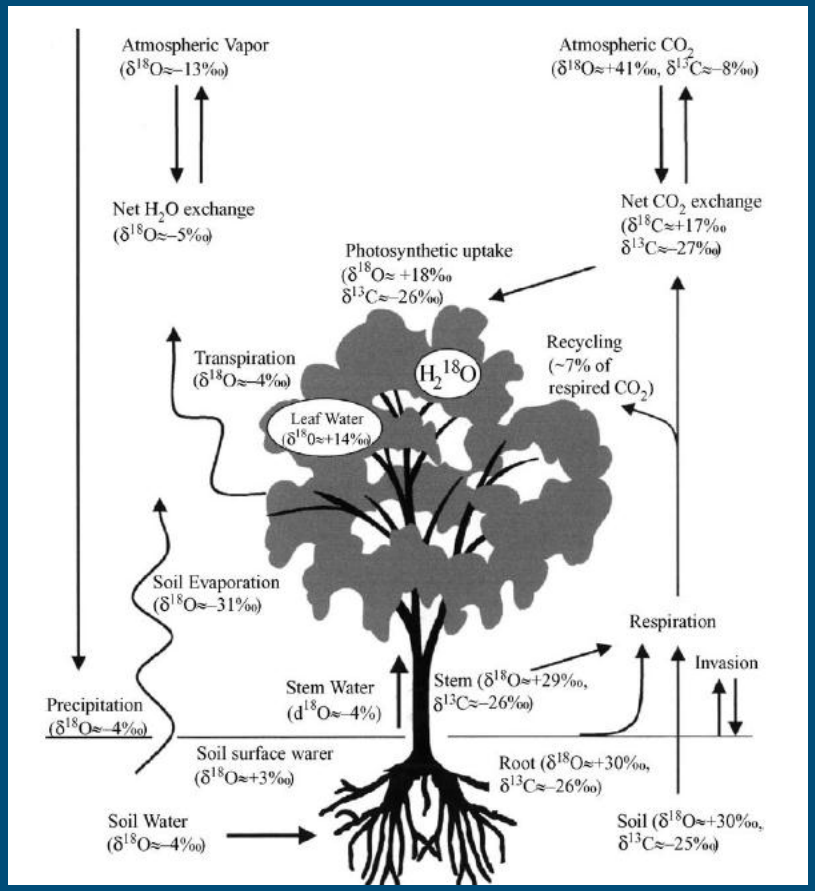
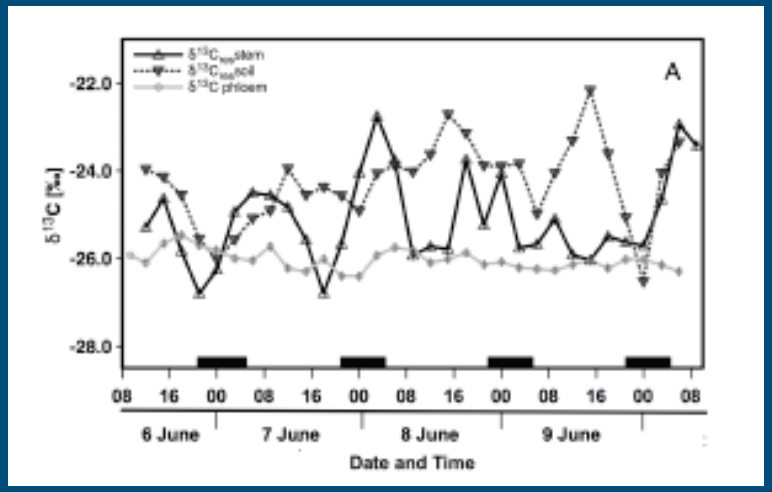


Isotopic composition of C, O and H pools in Terrestrial ecosystems. The values are approximations and will vary considerably with geographical location and environmental Conditions (Ghosh & Brand, 2003)



Soil and Stem $\delta^{13}C_{res}$ from a Pinus Sylvestris forest compared to $\delta^{13}C$ of phloem exudates (Werner & Gessler, 2011)

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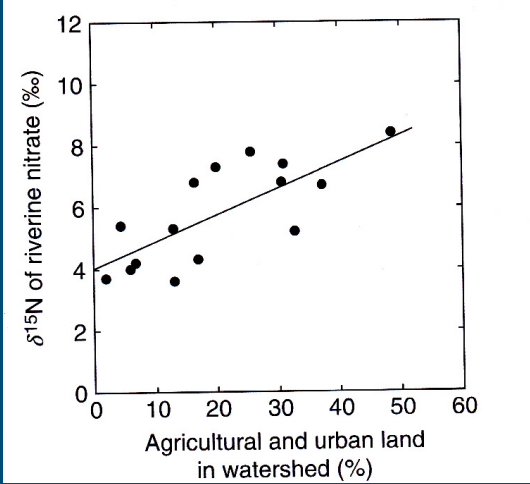
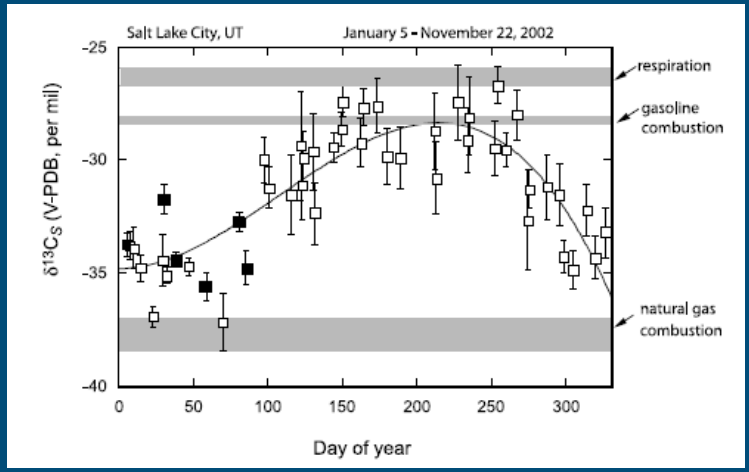
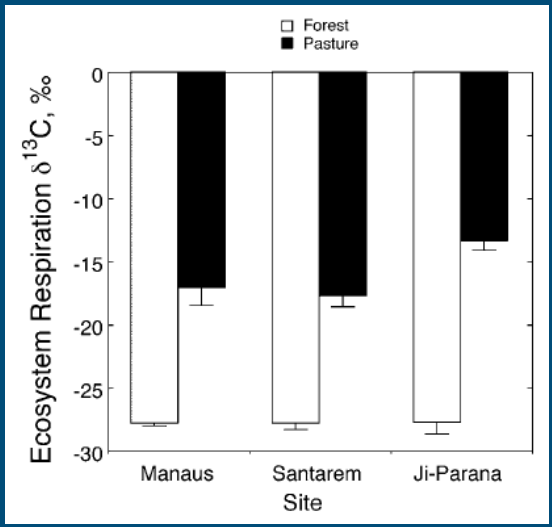


Mean N isotope ratio of nitrate in rivers draining 16 Watersheds (William et al 2007)



Carbon isotope ratio of the Urban CO_2 source (δ ^{13}Cs) estimated by the Keeling plot method (Pataki et al, 2003)



Comparison of the average carbon isotope composition of total ecosystem respiration measured in forest and pasture sites in three locations in Brazilian Amazon Basin (Ometto et al, 2002)

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IV. Variation $\delta^{34}S$

Measurements of total sample $\delta^{34}S$ and $\delta^{13}C$ in deposition inputs have the potential to more clearly distinguish industrial from urban sources of pollutants and identify inputs derived from beyond continental boundaries

V. Fallout Radionuclides (FRN) such as Cs-137, Pb-210 and Be-7, Naturallly Occuring Radionuclides (NOR) such as K-40, Ra-226 and Th-232, Compound Specific Stable Isotope (CSSI) and conventional (modelling) techniques can be used for soil erosion and sedimentation studies

CONCLUSION

As no 1 in the world for Oil Palm producer, Indonesia is very sexy, and land use change and deforestation could not be avoided???

Combining stable isotope measurements with other approaches are essensial for quantification and mitigation potentially damaging alterations to natural environments due to the development of palm oil plantation, and could serve as an early-warning system to quantify activities that are affecting ecosystem functions

Stable isotope monitoring and the development of an isotope-monitoring network can greatly assist and inform well environmental policy makers of government of Indonesia in managing efforts for mitigation to cope the global climate change within REDD+ scheme in which Indonesia has pledged to reduce GHG 26 % by 2020

Employment of nuclear – isotope techniques in Indonesia with large forest areas and the people still rely on agriculture, could contribute well in achieving the Millennium Development Goals of food security and environmental Sustainability

TERIMA KASIH

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