Review of Peat Emission Factor used for the Renewable Fuel Standard by US-EPA

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Outline

- Background
- Emission factor for peat under oil palm plantation
- Analyses of land use changes
- Our proposed recalculation of the emission reduction

Background

US-EPA was studying the possibility of using palm oil as a feedstock to produce

- biodiesel and
- renewable diesel

starting in 2022 under the Renewable Fuel Standard (RFS) program using lifecycle greenhouse gas (GHG) emission analysis.

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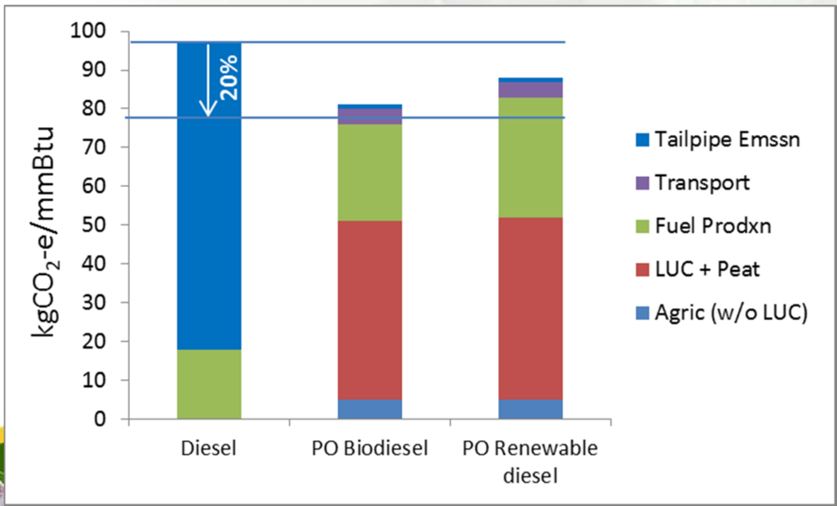
ENVIRONMENTAL PROTECTION AGENCY
[EPA–HQ–OAR–2011–0542; FRL–9608–8]

Notice of Data Availability Concerning Renewable Fuels Produced From Palm Oil Under the RFS Program

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of data availability (NODA).

EPA analysis: biodiesel and renewable diesel from palm oil do not meet the minimum 20% lifecycle GHG emission reduction threshold. Why?



Emission Factor from Peat

- EPA chosen value is 95 Mg CO2 ha^{-1} yr^{-1}
- Our chosen value is 38 Mg CO2 ha^{-1} yr^{-1}

Why??

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White Paper Number 15 | September 2011
Indirect Effects of Biofuel Production Series

REVIEW OF PEAT SURFACE GREENHOUSE GAS EMISSIONS FROM OIL PALM PLANTATIONS IN SOUTHEAST ASIA

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www.biogeosciences.net/9/1053/2012/
doi:10.5194/bg-9-1053-2012

Biogeosciences

Subsidence and carbon loss in drained tropical peatlands

A. Hooijer[1], S. Page[2], J. Jauhiainen[3], W. A. Lee[4], X. X. Lu[5], A. Idris[6], and G. Anshari[7]

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What observations actually needed to derive emission factor?

- Change in C stock
  - change in peat bulk density (BD),
  - change in peat C content, and
  - peat volume (thickness and area)

Or

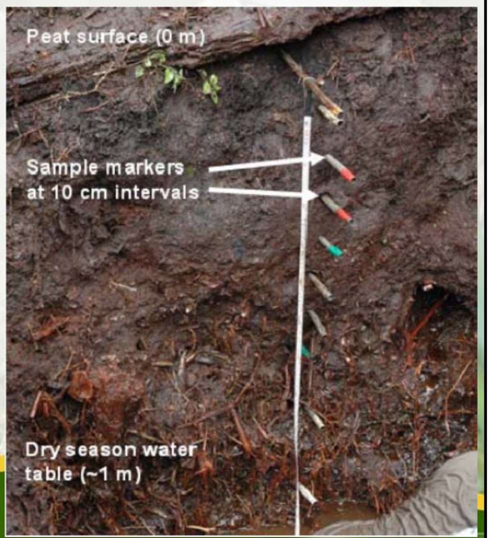
- CO_2 (GHG) flux

What did Hooijer et al. (2012) measure?

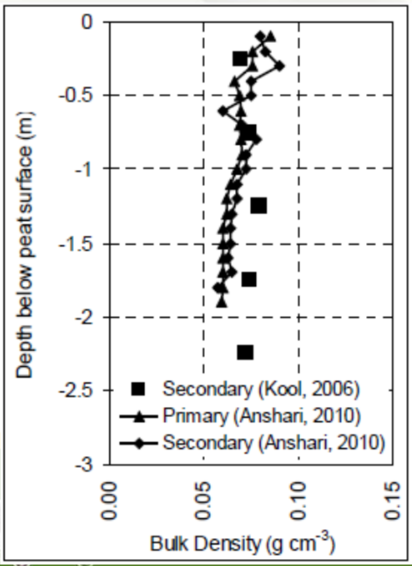
- Peat subsidence at 215 sites (points); 125 in *Acacia* plantation, **39 in oil palm plantation** and 51 in peat swamp forest
- From the 39 monitoring points on OP plantations, peat BD was monitored at 10 points (pits)
- Duration of peat subsidence measurement on OP plantation was one year (July 2009 to June 2010), twice per month
- Long term peat subsidence trend were based on observations from locations 2, 5–7 and 18 years after drainage commencement, under different land uses

Other things missing ?

- No data for initial BD, it was assumed the same as the current BD below the average water table.
- No observastion of organic matter content, it was assumed 55% throughout the profile, across land uses



Is the assumptions of same BD throughout the profile acceptable?



Other issues about subsidence technique

REFERENCE	DESCRIPTION	CO_2 EMISSION (Mg CO_2 ha^{-1} yr^{-1}) AT DIFFERENT PLANTATION DRAINAGE DEPTHS (cm)				
		50	60	70	85	100
Wösten et al. (1997)	Relationship predicts emissions of 13 Mg $CO_{2\text{-eq}}$ ha^{-1} yr^{-1} for each additional 0.1 m drainage depth. Based on subsidence rate of 0.45 m yr^{-1}, 60% decomposition, bulk C density of 0.06 g C m^{-3}.	65	78	91	110.5	130
Delft Hydraulics (2006) and Hooijer et al. (2010)	Relationship predicts emissions of 0.91 Mg $CO_{2\text{-eq}}$ ha^{-1} yr^{-1} for each additional 0.1 m drainage depth. Model is based on the subsidence model of Wösten et al. (1997) combined with closed chamber measurements.	45.5	54.6	64	77.4	91
Couwenberg et al. (2010)	Original model. Predicts emissions of 0.9 Mg $CO_{2\text{-eq}}$ ha^{-1} from each additional 0,1 m drainage depth, assuming 40% decom-position and a bulk carbon density of 0.068 g C cm^{-3}.	45	54	63	[illegible]	90
	Decomposition contributes 60% of subsidence, bulk carbon density of 0.068 g C cm^{-3}.	67	81	94	115	135
	Decomposition contributes 40% bulk carbon density of 0.138 g C cm^{-3} in upper 0.5 m of peat profile; from Ywih et al. (2010), values only calculated for drainage of 0.5 m.	89	–	–	–	–

From 23 Mg CO2 ha^{-1} yr^{-1}, reinterpreted to

????

Wide estimate of emission/subsidence ratio → high uncertainty

How did Page *et al.* (2011) develop the EF of 95 Mg CO_2 ha^{-1} yr^{-1}?

Extrapolation of Hooijer et al. (2012)

NUMBER OF YEARS	CO_2 EMISSION (Mg $CO_{2\text{-eq}}$ ha^{-1} yr^{-1})
5	178
10	121
20	106
25	100
30	95
40	90
50	86

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Page et al. (2011): Hooijer et al. (2012) result is comparable to Jauhiainen et al. (2012) on Acacia Plantation.

Yes, but:

- Different crop
- Different location

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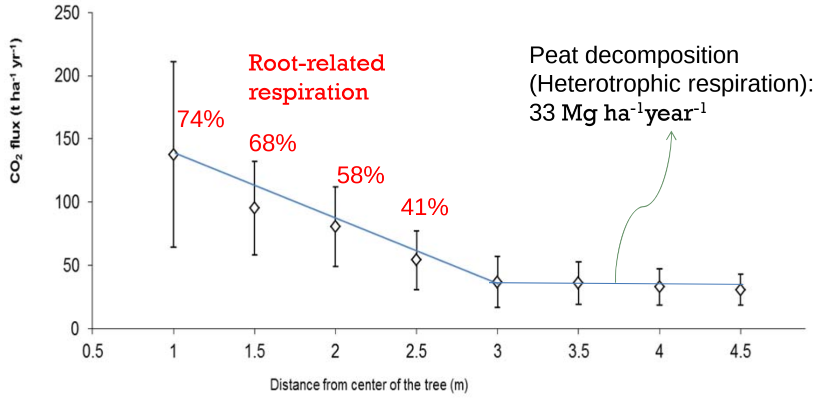
Peat emissions based on CO2 flux measurements

20-56.5 (average of 38 Mg CO_2 ha^{-1} yr) (Fargione et al. 2008; Reijnders & Huijbregts 2008; Wicke et al. 2008; Murdiyarso et al. 2010; Murayama & Bakar 1996 ; Jauhiainen et al. 2001; Melling et al. 2005; Melling et al. 2007; Agus et al. 2010.

↓

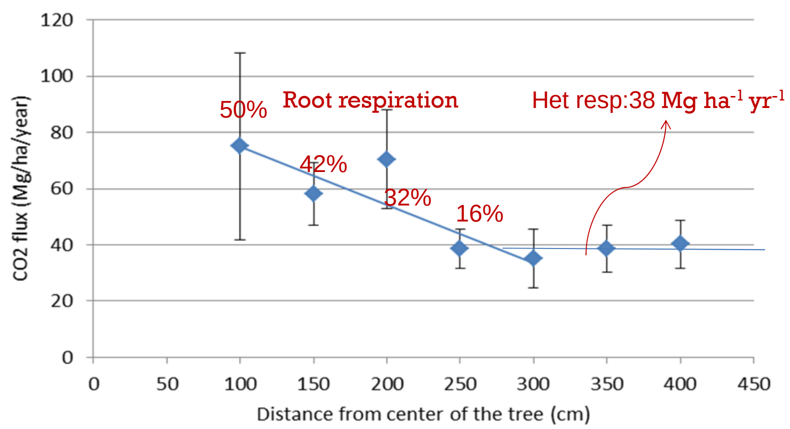
High geographic representation, although mostly from short term measurement

Our recent findings: Jambi (15 yr old OP)



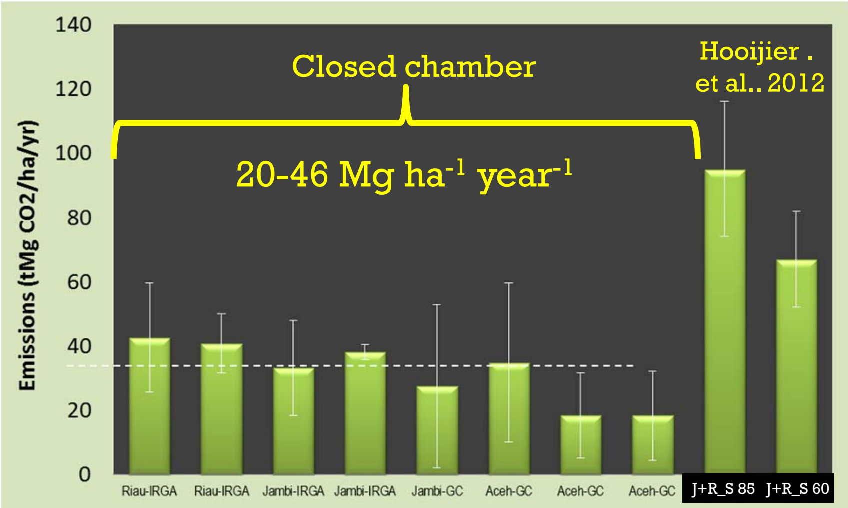
Average total respiration = 63 Mg ha^{-1} year^{-1}
Least root-affected respiration (peat decomposition): 33 t CO2/ha. This is the value that should be accounted in GHG issues.

Arang-arang, Jambi (6 yr old OP)



Average total respiration = 51 Mg ha^{-1} yr^{-1}; Peat decomposition 38 t CO2/ha

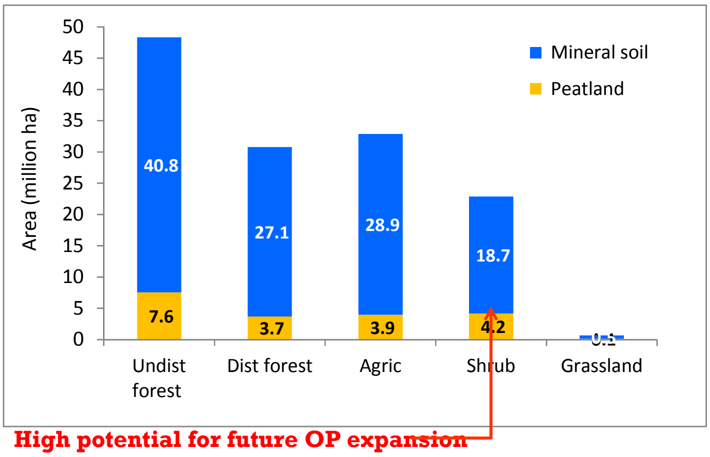
OP Plantations: Sites and Methods matter



Land cover types impacted by oil palm plantation expansion in Indonesia, based on EPA and Agus *et al.* (2011) estimates

Land cover types	EPA Projection for 2022 (Table II.5., NODA), based on 2000-2009 trend	Agus et al. (2011)	
		Historical 1990-2010	Historical 2000-2010, for Sumatra and Kalimantan only (a recalculation)
Forest	43%	34% (6% Pr Forest)	28%
Mixed	38%	34%[1)]	26%
Shrubland	0%	26%	23%
Savanna	10%		
Grassland and Croplands	8%	6%	23%
Wetland	1%		

Land cover for Sumatra, Kalimantan and Papua in 2010 (Agus et al. 2012)



Revised estimate of peatland area in Indonesia

Island	Peatland area (ha)		
	Wahyunto et al. (2003, 2004, 2006)	Revised Wahyunto et al. (2003, 2004, 2006) by Ritung et al. (2011)	Difference
Sumatra	7,212,798	6,436,649	776,149
Kalimantan	5,830,228	4,778,004	1,052,224
Papua	7,759,372	3,690,921	4,868,451
Total	20,802,398	14,905,594	5,896,804

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Other considerations

- Pledge of the Indonesian government to reduce emission 26% by 2020.
- Presidential Instruction No. 10, 2011 on the moratorium of new permit for using primary forest and peatland
- Presidential Instruction, No. 26, 2011 on NAMA's, encouraging the use of shrub and low carbon stock idle lands for future development

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Recalculation of Emission reduction

Emissions Category	2005 Diesel Baseline	PO Biodiesel	PO Renewable Diesel
Net Agriculture (w/o land use change)	-	5	5
Land Use Change	-	46	47
S1: Peat EF of 38 Mg CO2/ha/yr		**32**	**33**
S2: S1 + Ind forest area affected adjusted from 43 to 28% and shrubland from 0 to 15% for Indonesia		**30**	**30**
S3: S2 + Use new peatland map of Ind (14% less peatland in Sumatra and Kalimantan)		**29**	**30**
Fuel production	18	25	31
Fuel and feedstock transport	-	4	4
Tailpipe Emissions	79	1	
Net Emissions	97	81	87
% Reduction Relative to Baseline (EPA)			
EPA estimate		**-17%**	**-11%**
S1		**-31%**	**-25%**
S2		**-33%**	**-27%**
S3		**-34%**	**-28%**

Conclusions and Recommendation

- EF for peat decomposition of 95 Mg CO_2 ha^{-1} yr^{-1}, based on subsidence measurement was not supported by valid C stock change observation.
- Our estimate as high as 38 Mg CO_2 ha^{-1} yr^{-1} represents direct measurements of CO_2 fluxes using closed chambers from several locations in SE Asia and thus more geographically representative.
- Shrubland change to OP plantation is an importat trajectory, esp. For Indonesia and this has not been considered by EPA.
- EPA should also consider the land use change policies of Indonesia and Malaysia

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