Supporting Information

Murdiyarso et al. 10.1073/pnas.0911966107

SI Text

The data presented in Tables 1 and 2 in the main text of this article were adopted from calculated data obtained from published literature including journal articles, theses, and conference proceedings. They are organized into two categories: first, the calculated average C stocks in the aboveground biomass of the trees in virgin peat swamp forests, oil-palm plantations on peat, and the loss of peat C stock from land-clearing fire, shown in Table S1, and second, the calculated C fluxes accumulation rate in virgin peat swamp forests, litterfall, root mortality, soil respiration, root respiration, heterotrophic soil respiration, and dissolved and particulate organic C loss rates in oil-palm plantations on peat, as shown in Table S2. For both tables, when the C content of dry matter in the phytomass was not provided by the authors, a value of 50% of dry matter was used. In all calculation we used a peat C density of 0.05 g of C per cm^{-3} (1).

Uncertainty estimates are reported as standard errors. The Gaussian error propagation (GEP) method was used for propagating uncertainties. This method is adequate for stepwise calculations that are intended for computation of ecological quantities. The latter can then be expressed as an analytical model using mathematics to calculate C stocks or fluxes (2). The method assumes that uncertainties can be considered independent and normally distributed. In the calculation of the average of N values, whenever the uncertainty of at least one value was missing, the average uncertainty was calculated as the standard error of the N values. In such a case, a comparison was made between the two calculated uncertainties: the standard error of the N values (SE_{Values}) and the standard error calculated by using the GEP method (SE_{GEP}). In all cases, the largest error value was reported. When there was no uncertainty we assigned a high standard error amounting to 50% of the average value.

Calculation of C Stocks. ***Calculation of aboveground C stocks of peat swamp forests.*** The average C stock in the aboveground biomass of the trees in virgin peat swamp, adopted in this article, is the average of the values found in the literature. In ref. 3, the tree aboveground biomass C pool includes C in the stems of the trees only, estimated from trees diameter at breast height (DBH) and height (H) measurements. This reference comprises three mixed swamp forests, one tall pole forest, and one low pole forest. In ref. 4, the tree aboveground biomass C pool includes C in the stems, branches, and leaves of the trees calculated applying the allometric relationship of five to DBH and H measurements. This reference comprises one mixed swamp forest, one low pole forest, and one tall interior forest.

Calculation of aboveground C stocks of oil-palm plantations on peat. The average C stock in the aboveground biomass of the trees in oil-palm plantations on peat adopted in this article is the value calculated in the literature (5). In this paper, the aboveground C pool of tree biomass was calculated by developing a relationship between the age of the oil-palm plantations and C stocks in the aboveground tree biomass in 51 case studies. Integration of the equation and dividing by a 25-y rotation provided the time-averaged C stock in the aboveground biomass of oil palms. This calculation is based on oil-palm plantations grown on mineral soil. Hence, we assume that oil palm grow similarly on peat soil as it does on mineral soil, because almost no biomass values were available for oil-palm plantations on peat soils.

Calculation of C loss from land-clearing using fire. The loss of peat C stock from land-clearing fire was calculated as the product of the depth of peat burnt and the peat C density. The adopted depth of peat burnt (6) from land-clearing fire was used to calculate the stock.

Calculation of C Fluxes. ***Peat C accumulation rate in the peat swamp forest.*** The peat C accumulation rate was calculated as the product of the peat accumulation rate and the peat C density. We used an intermediary value (1.5 $mm\,y^{-1}$) in the range of peat accumulation rate (1–2 $mm\,y^{-1}$) from the literature (7).

C inputs from litterfall in oil-palm plantations on peat. The average C input from litterfall in oil-palm plantations on peat adopted in this article is the average of the values from the published literature (8). The litterfall rates were measured in two oil-palm plantations in Indonesia, Malaysia, and Benin grown on mineral soil. Hence, we assume that litterfall rates of oil palms grown on a peat soil are similar to that of oil palms grown on mineral soil.

C inputs from root mortality in oil-palm plantations on peat. The average C input from root mortality in oil-palm plantations on peat adopted in the article is the average of the values from the published literature (8) of studies in Indonesia Malaysia and Benin and from a case study in Malaysia (9) with oil-palm densities of 120, 160, and 200 palms ha^{-1}. In the first reference the oil-palm plantations were grown on mineral soils, whereas in the second reference they were grown on peat.

Soil respiration in oil-palm plantations on peat. The average soil respiration in oil-palm plantations on peat adopted in this article is the average of two case studies in Malaysia (10, 11).

Root respiration in oil-palm plantations on peat. The average root respiration in oil-palm plantations on peat adopted in this article is the average of the values from a case study (9) in Malaysia of 16-y-old oil palms planted on peat at densities of 120, 160, and 200 palms ha^{-1}. This ecophysiological study simulated the maintenance and growth respiration of biomass components (roots, trunk, fronds, and bunches) by using a dynamic model validated with data obtained from the plantations. The procedures and coefficients used in the model are described in the two studies (9, 12).

Heterotrophic soil respiration in oil-palm plantations on peat. The heterotrophic soil respiration in oil-palm plantations on peat is calculated as the difference between total soil respiration and root respiration.

Dissolved organic carbon (DOC) and particulate organic carbon (POC). The average DOC + POC losses were estimated by using the combined maxima of what was observed in northern peatlands for POC and DOC (13). Indeed in some recent studies (14, 15) DOC concentrations in tropical peat swamp forests were observed to be twice (50–124 mg of C per L) that in Northern peatlands (9) (20–60 mg of C per L).

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Table S1. Aboveground C stocks of the trees in peat swamp forests and in oil-palm plantations growing on peat, and loss from the peat after land-clearing fire

Source	C stocks, Mg of C per hectare	Refs.	Adopted value, Mg of C per hectare
Tree biomass of peat swamp forests	254.5 ± 57.0	3	179.7 ± 38.2
	262.0 ± 58.5	3	
	244.3 ± 52.3	3	
	65.5 ± 23.0	3	
	9.25 ± 3.1	3	
	156.0	4	
	124.5	4	
	321.5	4	
Tree biomass of oil palm	24.2 ± 8.1	5	24.2 ± 8.1
Peat fire during land clearing	−(20 cm burnt)	6	100.0 ± 50.0

Values are mean ± standard error.

Table S2. C fluxes in peat swamp forest and oil-palm plantations on peat

Source	C flux, Mg of C per hectare per year	Refs.	Adopted value, Mg of C per hectare per year
Peat accumulation in the forest	−(1–2 mm y^{-1})	7	0.75 ± 0.25 (1.5 ± 0.5 mm y^{-1})
Litterfall in oil palm	1.33	8	1.5 ± 0.1
	1.79	8	
	1.5	8	
	1.24	8	
Root mortality in oil palm	5.44	8	3.6 ± 1.1
	5.26	8	
	3.45	8	
	8.44	8	
	0.59	9	
	0.82	9	
	1.05	9	
Soil respiration in oil palm	10.0	10	12.7 ± 2.7
	15.4 ± 4.4	11	
Root respiration in oil palm	2.7	10	3.4 ± 0.4
	3.5	10	
	4.0	10	
Soil heterotrophic respiration in oil palm			9.3 ± 2.7
DOC	0.01–0.5	13	1.0 ± 0.5 (DOC + POC)
POC	0.02–0.4	13	

The data sources and value adopted in the article are presented. Values are mean ± standard error.