ASB Partnership for the Tropical Forest Margins

Policybrief 49

When can oil palm production qualify for a 'carbon neutral' claim?

(Photo: World Agroforestry Centre/Meine van Noordwijk)

Establishment of oil palm plantations is one of the most important drivers of land conversion in Indonesia and associated carbon emissions. Emerging standards for 'carbon neutrality' claims by the industry address the concerns of those global consumers who take responsibility for the carbon footprint of products they buy. A recent proposal by key players in the industry (Raison et al 2015) takes a stance on where carbon neutrality can be claimed – our results differ.

Key findings

1. The approximately 15% of oil palm grown in Indonesia on peat soil currently cause emissions of around 40 Mg CO_2 ha^{-1} y^{-1}, with higher values for deeper drainage.
2. Over the lifetime of an oil palm plantation the aboveground carbon (AGC) increases from around 8 to 72 Mg C ha^{-1}, with 40 Mg C ha^{-1} as average for accounting purposes, with tight confidence intervals.
3. Soil C concentrations can be expected to decline after establishment of oil palm but to increase once root turnover of the root system increases, with approximately net neutral effects over an oil palm life cycle.
4. Landscape-level compensation for net emissions in oil palm by protection and recovery of carbon stocks in forest patches above a baseline of degradation can justify **company** claims of being 'carbon neutral', but not the **palm oil** as product.

Implications

- In site-specific carbon footprints the percentage of peat-based oil palm dominates the calculation for each plantation or company; where it is more than approximately 5% palm oil is a net emitter of carbon regardless of preceding vegetation.
- The recently proposed threshold of 75 Mg C ha^{-1} in AGC as proposed by Raison et al (2015) is too high for a claim to be carbon neutral at plot level.
- When vegetation of less than 40 Mg C ha^{-1} is converted, it is safe to assume that soil carbon stocks can be kept stable with good agricultural practice.
- Further discussion is needed in society how the term 'carbon neutrality' can be used at plantation, company and value chain level to avoid loss of credibility in the term for any user.

Management Swing Potential

There is long standing debate on the appropriate scale(s) for carbon accounting in commodities such as palm oil (and derivatives). Initially public policy used a single estimate per commodity, independent of its specific source and in the 'indirect land use change' parts of accounting an average is still used. It was recognized, however, that there is considerable 'management swing potential', or difference between worst and best ways of producing any commodity. According to Davis et al (2013) oil palm has the widest management swing potential of all currently known biofuels, as it can be both the worst and the best of the range. Standards, such as RSPO or the claim of 'carbon neutrality' draw a line within this range and promise (or guarantee?) the end consumer that it at least meets this standard.

Experiment to test the direct impact of fertilizer application on peat subsidence and emissions in Jambi (Indonesia). (Photos: World Agroforestry Centre/Ni'matul Khasanah)

Oil palm covers around 10.5 million hectare in Indonesia or approximately 5.5% of the nation's land area (Direktorat Jenderal Perkebunan, 2013). Indonesia is the world's biggest exporter of palm oil. The commodity has been the centre of controversy mostly because of the conversion of natural forests into oil palm plantations (Sheil et al 2009). Certified sustainable palm oil has grown to 25% of the global market according to RSPO statistics. Most of the results described here were obtained in a survey of 25 oil palm plantations across the main relevant strata in Indonesia (Dewi et al 2012; Khasanah et al 2012) and were further analysed in two recent peer reviewed publications (Khasanah et al 2015a,b). A broad based literature review was presented to the Roundtable of Sustainable Palm Oil (RSPO) by Agus, 2013a,b.

Key findings

1. The approximately 15% of oil palm grown in Indonesia on peat soil is a net emitter of carbon.

About 15% of the oil palm grown in Indonesia is on peat soil. According to the current IPCC guidelines, the attributed CO_2 emissions to oil palm on peat are approximately 40 Mg CO_2eq ha^{-1} y^{-1} (see earlier ASB Policy Brief van Noordwijk et al 2013a). The carbon-dioxide emissions this causes are a major concern that led to the establishment of guidelines to avoid peat for new plantings. On peatland, emissions from conversion and continuing emissions from the drained peatland ranged 12.3–73.6 Mg CO_2eq ha^{-1} y^{-1} across 8 of the 23 plantations that had some peatland. Emissions varied by the percentage of peat within the plantations in combination with the original aboveground carbon stock. Calculations with the Biofuel Emission Reduction Estimator Scheme (van Noordwijk et al 2013b) that when more than 4-5% of a source of palm oil is derived from drained peat soils it is not possible to achieve the modest emission reduction targets for biofuel (Khasanah et al 2012), let alone claim 'carbon neutrality'.

2. Conversion into oil palm plantations of land with up to 40 Mg C ha^{-1} in aboveground carbon stock can be carbon neutral

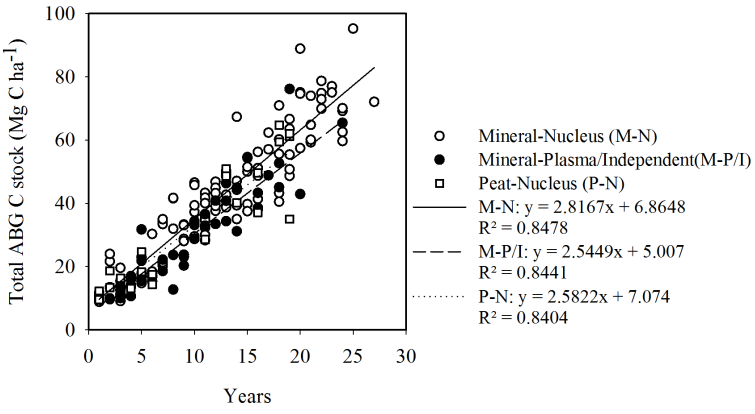

Figure 1. Correlation between age of palm (years) and total aboveground C stock (Mg C ha^{-1}) of oil palm plantation under different soil types and plantation managements.

The appropriate time scale to make such a comparison between land use systems is the 'production life cycle', that considers the fate of a plantation from initial planting till the end of economic life cycle and replanting. During this period the aboveground C stock (AGC) will increase

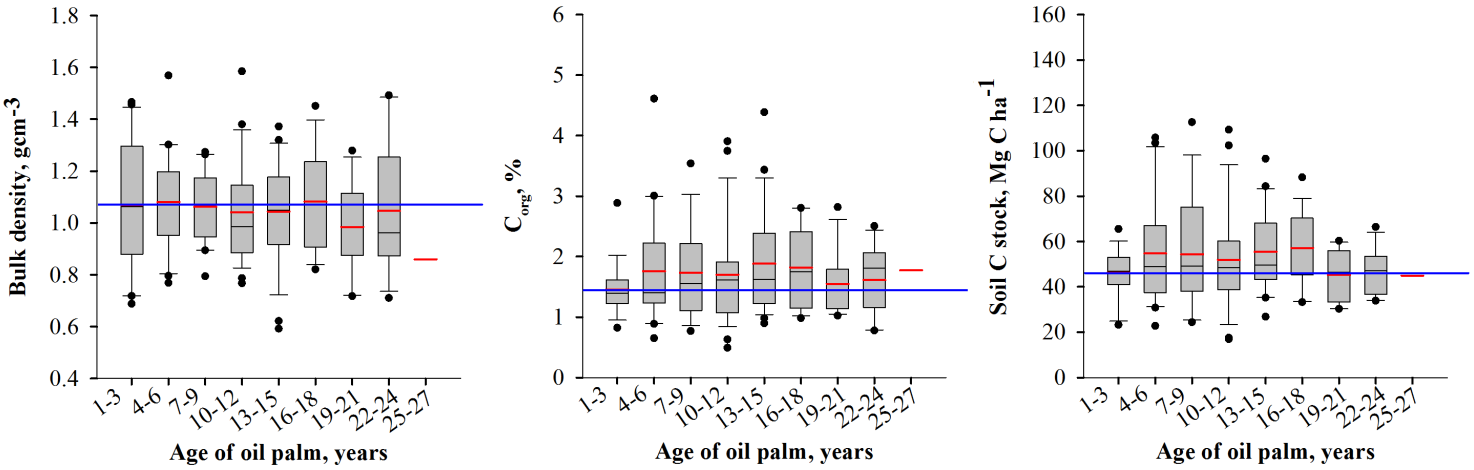

Figure 2. Weighted average over four management zones (weeded circle, interrow, frond stack, and harvest path) of soil bulk density (g cm^{-3}), soil organic carbon (%), and corrected soil C stock (Mg C ha^{-1}) at 0–30 cm depth at different oil palm ages. Black and red line within the box marks are the median and the mean. Blue line is a line at the mean of the first box (year 1-3), it can be easy to recognize weather the mean of the last box (year 25) increase or decrease compared to the first box.

– but its time-averaged value can be derived from measurements. Current estimates range from 36 Mg C ha^{-1} (Agus et al 2013b) to the said 75 Mg C ha^{-1} (Raison et al 2015). This value of 75 is considerably higher than what has so far been considered and opens up opportunities to convert a range of secondary forest and agroforest vegetation types.

Khasanah et al (2015b) used the largest data set available for Indonesian oil palm so far (180 measurement plots from 25 plantations) to derive a time-averaged ACG estimate stratified across all the major settings in which oil palm is found in Indonesia. Results ranged from 37.76 ± 0.33 Mg C ha^{-1} to 42.07 ± 0.03 Mg C ha^{-1} depending on management conditions, with 40 as a single ballpark number (Figure 1). Soil type and plantation management are sources of variation around these values and the values include four C pools: oil palm biomass, standing litter stock comprising pruned fronds, understorey vegetation, and preceding necromass stock (dead wood).

This value of 40 Mg C ha^{-1} in time-averaged AGC of oil palm plantation is much lower than the upper threshold accepted by Raison et al (2015).

3. Soil carbon dynamics on mineral soils during an oil palm life cycle

A parallel study on the changes in soil carbon stock of oil palm plantations on mineral soils (Khasanah et al 2015a) concluded that if good management practice is followed there is no changes in mineral soil carbon stock of oil palm plantations derived from forest or non-forest in Indonesia (Figure 2). With these results, at plot level, conversion of land with 40 Mg C ha^{-1} in aboveground carbon stock into oil palm plantation is carbon neutral.

4. Carbon neutral at landscape scale?

Standards can support land-use planning for low-emissions development aimed at substantially reducing emissions while maintaining economic growth at local and national levels. If oil palm plantations play an active role in protecting and helping restore degraded forests within their concessions, the oil palm company may claim to be carbon neutral, even where the commodity palm oil is not.

This is however an aspect that needs further discussion among stakeholders to avoid undermining trust in the 'carbon neutrality' concept for anybody.

Units of carbon accounting

Emissions of carbon dioxide (CO_2) and normally quantified as a unit of weight per unit of area and unit of time. For the weight the internationally agreed standard is mega-gram or Mg or million gram or thousand kg. In spoken language it can be referred to as a (metric) ton. Carbon stocks, carbon sequestered in living vegetation (biomass) or derived dead materials (necromass) is normally expressed as Mg C ha^{-1}. Where it is emitted, by burning or decomposition one unit of C becomes 3.67 (=44/12) units of CO_2.

References

Agus F, Henson IE, Sahardjo BH, Harris N, van Noordwijk M, Killeen TJ. (2013a). Review of emission factors for assessment of CO_2 emission from land use change to oil palm in Southeast Asia. In T. J. Killeen & J. Goon (Eds.), *Reports from the technical panels of the second greenhouse gas working group of the roundtable for sustainable palm oil (RSPO)* (pp. 7–27). Kuala Lumpur: RSPO. Retrieved from http://www.rspo.org/file/GHGWG2/3_review_of_emission_factors_Agus_et_al.pdf

Agus F, Gunarso P, Sahardjo BH, Harris N, van Noordwijk M, Killeen TJ. (2013). Historical CO_2 emissions from land use and land cover change from the oil palm industry in Indonesia, Malaysia and Papua New Guinea. In: T. J. Killeen & J. Goon (eds.) *Reports from the Technical Panels of the Second Greenhouse Gas Working Group of the Roundtable for Sustainable Palm Oil (RSPO)*; RSPO, Kuala Lumpur. pp 65-88. http://www.rspo.org/file/GHGWG2/5_historical_CO2_emissions_Agus_et_al.pdf.

Davis SC, Boddey RM, Alves BJR, Cowie A, Davies C, George B, Ogle SM, Smith P, van Noordwijk M, van Wijk M, 2013. Management swing potential for bioenergy crops. *Global Change Biology Bioenergy* 5, 623–638.

Dewi S, Ekadinata A, Rahmanulloh A, Khasanah N, Rahayu S, van Noordwijk M, Budidarsono S. 2012. *The carbon efficiency of oil palm plantations: an opportunity cost analysis.* Technical Brief 28: palm oil series. Bogor, Indonesia: World Agroforestry Centre Southeast Asia Program.

Direktorat Jenderal Perkebunan. 2014. *Statistik perkebunan Indonesia (tree crop estate statistics of Indonesia), 2013-2015, kelapa sawit (oil palm)*. Direktorat Jenderal Perkebunan, Kementerian Pertanian, Jakarta.

Khasanah N, van Noordwijk M, Ekadinata A, Dewi S, Rahayu S, Ningsih H, Octaviani R. 2012. *The carbon footprint of Indonesian palm oil production*. Technical Brief, 25. Bogor: World Agroforestry Centre - ICRAF, SEA Regional Office.

Khasanah N, van Noordwijk M, Ningsih H, Rahayu S. 2015a. Carbon neutral? No change in mineral soil carbon stock under oil palm plantations derived from forest or non-forest in Indonesia. *Agriculture, Ecosystems and Environment* 211(15): 195-206.

Khasanah N, van Noordwijk M, Ningsih H. 2015b. Aboveground Carbon Stocks in Oil Palm Plantations and the Threshold for Carbon-Neutral Vegetation Conversion on Mineral Soils. *Cogent Environmental Science*. http://dx.doi.org/10.1080/23311843.2015.1119964.

Raison J, Atkinson P, Chave J, DeFries R, Joo GK, Joosten H, Navratil P, Siegert F. 2015. *HCS+, A new pathway to sustainable oil palm development, Draft Extended Summary*. http://www.carbonstockstudy.com/carbonstockstudy/files/f6/f63fcf9e-10e1-47f8-bfbd-3b9e01505cec.pdf, last accessed October 7, 2015.

Sheil D, Casson A, Meijaard E, van Noordwijk M, Gaskell J, Sunderland-Groves J, Kanninen M. 2009. *The impacts and opportunities of oil palm in Southeast Asia*. Bogor: Center for International Forestry Research (CIFOR).

van Noordwijk M, Agus F, Maswar, Handayani EP, Marwanto S, Dariah A, Khasanah N. 2013a. *Reassessing peat-based emissions from tropical land use*. ASB Policy brief 36. Nairobi: ASB Partnership for the Tropical Forest Margins.

van Noordwijk M, Khasanah N, Dewi S. 2013b. Biofuel emission reduction estimator scheme (BERES): Landuse history, production systems and technical emission factors. In: M van Noordwijk, B Lusiana, B Leimona, S Dewi, D Wulandari (Eds.), *Negotiation-support toolkit for learning landscapes* (pp. 157–162). Bogor: World Agroforestry Centre (ICRAF) Southeast Asia Regional Program.

Blogs

http://blog.worldagroforestry.org/index.php/2012/10/31/making-oil-palm-carbon-efficient/

http://blog.worldagroforestry.org/index.php/2012/10/24/carbon-footprint-of-oil-palm-in-indonesia/

http://blog.worldagroforestry.org/index.php/2015/07/08/oil-palm-on-mineral-soil-in-indonesia-is-not-changing-soil-carbon/

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The ASB Partnership for the Tropical Forest Margins is working to raise productivity and incomes of rural households in the humid tropics without increasing deforestation or undermining essential environmental services.

ASB is a consortium of over 90 international and national partners with an eco-regional focus on the forest–agriculture margins in the humid tropics, with benchmark sites in the western Amazon Basin of Brazil and Peru, the Congo Basin forest in Cameroon and DRC Congo, southern Philippines, northern Thailand, and the island of Sumatra in Indonesia.

The ASB Policybriefs aim to deliver relevant, concise reading to key people whose decisions will make a difference to poverty reduction and environmental protection in the humid tropics.

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