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Short Communication

Sustainable palm oil may not be so sustainable

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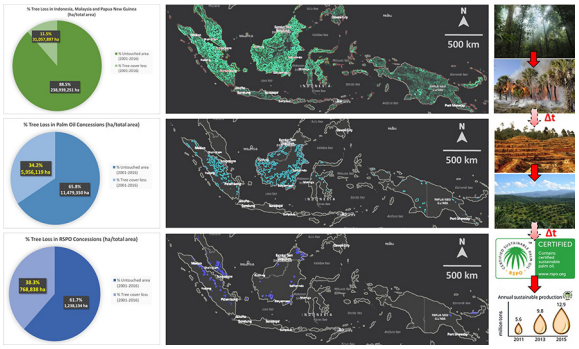
HIGHLIGHTS

- The significant forest loss and ecosystem degradation caused by palm oil have attracted attention worldwide.
- Although some of the palm oil production has been certified as sustainable, concerns emerge.
- From 2001 to 2016 in about 40% of the area located in certified palm oil concessions there is evidence of forest loss.
- We detect significant tree loss before and after the start of certification schemes.
- Certified concessions do not differ much from non-certified ones in terms of forest degradation.

GRAPHICAL ABSTRACT



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ABSTRACT

The globalization of the palm oil trade poses a menace to the ecosystem integrity of Southeast Asia. In this short communication, we briefly discuss why palm oil certifications may have failed as an effective means to halt forest degradation and biodiversity loss. From a comparison of multiple new datasets, we analysed recent tree loss in Indonesia, Malaysia, and Papua New Guinea, and discovered that, from 2001 to 2016, about 40% of the area located in certified concessions suffered from habitat degradation, deforestation, fires, or other tree damages. Certified concessions have been subject to more tree removals than non-certified ones. We also detect significant tree loss before and after the start of certification schemes. Beyond non-governmental organisations' concern that Roundtable on Sustainable Palm Oil (RSPO) and Palm Oil Innovation Group (POIG) certifications allow ongoing clearance of any forest not identified as of high conservation values (HCV) or high carbon stock (HCS), we suggest an alarming and previously overlooked situation, such as that current "sustainable palm oil" is often associated with recent habitat degradation and forest loss. In other words, certified palm oil production may not be so sustainable.

1. Introduction

Tropical deforestation is one of the most important threats to biodiversity and ecosystems worldwide (Geist and Lambin, 2002; Cazzolla Gatti et al., 2015). In Southeast Asia, large forest areas are managed through selective logging and clearcutting for valuable wood, paper, and pulp (Miettinen et al., 2012). More recently, the globalization of

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the palm oil trade poses a new menace to the biological diversity of this region (Fitzherbert et al., 2008). The industrial production of palm oil usually begins with clearing old-growth forests, followed by planting oil palms (*Elaeis guineensis*), and cultivating them for seed milling to derive a refined oil mainly used by the food and cosmetic industries (Wicke et al., 2011).

The massive use of palm oil products and its potential impact on tropical forest resources have attracted attention worldwide. While the consequences for human health of daily intake of palm oil are still debated (Mozaffarian and Clarke, 2009), concerns are mounting over the significant forest loss and ecosystem degradation caused by palm oil cultivation. The removal of large areas of forests in Indonesia, Malaysia and Papua New Guinea for oil-palm monoculture also endangers the three remaining species of orangutan on Earth and is considered unsustainable by many (Fargione et al., 2008). The practice of "slash-and-burn", which is a common agricultural practice to start a new plantation in Southeast Asia (Taylor, 2010), has shown serious consequences on the atmospheric pollution (Marlier et al., 2015) and greenhouse gas emissions (Reijnders and Huijbregts, 2008). When fires are started on peats, they are extremely difficult to control or stop and the thick smog produced releases high amount of air pollutants, which affect both people and the environment (Hayasaka et al., 2014). Nowadays, the main concern is that many of these fires may have been started to burn tropical forest to create, in combination with deforestation (Abood et al., 2015), space for palm oil plantations managed by big corporations (BBC, 2013). Moreover, the development of oil palm plantations has been associated with biofuel-induced environmental and socioeconomic impacts because empty fruit bunches and other scrap materials have been used to produce biodiesel (Obidzinski et al., 2012; Mukherjee and Sovacool, 2014).

2. A sustainable palm oil production?

In 2004, the Roundtable on Sustainable Palm Oil (RSPO), a group composed of retailers, banks, investors, and environmental and social non-governmental organisations (NGOs), was launched to create a market for sustainable palm oil (Boons and Mendoza, 2010). The goal of RSPO (which now has >3000 members) was to develop a set of environmental and social criteria with which companies must comply to produce Certified Sustainable Palm Oil (CSPO) (Laurance et al., 2010). According to RSPO, when these criteria are properly applied, the negative impact of palm oil cultivation on the environment and communities in palm oil-producing regions can be minimized (RSPO, 2018).

Nevertheless, since its establishment under Article 60 of the Swiss Civil Code, the RSPO certification is being challenged as an effective means to halt forest degradation and biodiversity loss (May-Toben and Goodman, 2014). In principle, RSPO-certified companies are required to ensure that forests are assessed for their high conservation values (HCV) before new plantings and - since the recent reinforcement by the Palm Oil Innovation Group (POIG) - plantations must not touch high carbon stock (HCS) areas (Laurance et al., 2010). In addition to environmental NGOs' major concern that RSPO-POIG certifications allow ongoing clearance of any forests not identified as HCV or HCS (Greenpeace International, 2013), we further suggest a previously overlooked but even more devastating evidence that current "sustainable palm oil" is often associated with recent habitat degradation. In other words, due to the latest loss of forests in areas where the concessions are currently located, certified palm oil may not be considered sustainable.

3. 15 years of tree loss in palm oil plantations

From a comparison of multiple new datasets (see Supplementary materials) provided by Hansen et al. (2013) and the Global Forest Watch Initiative (2018) on tree loss, Greenpeace International (2013) on Southeast Asian deforestation and palm oil production, the Indonesian Ministry of Forestry on oil palm plantations ("*Oil palm concessions*" Accessed through Global Forest Watch on 10/02/2018: www.globalforestwatch.org), and the Roundtable on Sustainable Palm Oil (RSPO) Member Companies and Aidenvironment ("*RSPO concessions*" Accessed through Global Forest Watch on 10/02/2018: www.globalforestwatch.org) on certified concessions, we analysed 15 years of recent tree loss (with a canopy cover >30%) in three countries - Indonesia, Malaysia, and Papua New Guinea - which account for >90% of the annual global export of palm oil and derived products.

From 2001 to 2016, these three Southeast-Asian countries lost about 31 million hectares of tree cover (Fig. 1a), 11% of their total land area (Fig. 2a). During the same period, total tree loss in palm oil concessions ($n = 2210$) was close to 6 million hectares (Fig. 1b), equivalent to 34.2% of the area covered by the concessions (Fig. 2b). A year-by-year analysis shows that the trend of overall tree loss in the three countries matches well with the loss rate in palm oil concessions, with the highest peaks in 2009, 2012, 2014, and 2016. Satellite maps (Fig. 1a and b) also unequivocally show the spatial overlap between areas with high tree cover loss and palm oil concessions.

4. Does certification in highly deforested areas help sustainability?

Similarly, most certified RSPO concession boundaries (Fig. 1c) overlap with areas with a high amount of tree loss since 2001. In these certified areas the trend of annual loss went downward between 2006 and 2010, possibly because of the entry into force of the RSPO agreement in 2004. However, there appears to be another upward trend in annual loss since 2010. In general, the net loss was high, totalling 750 k hectares in 15 years (41.5 k ± 7.2 k ha/year, on average, from 2007 to 2016). This loss represents 38.3% of the surface covered by certified concessions (Fig. 2c), even higher than in non-certified ones (34.2%). In none of the concessions under investigation, both certified and non-certified, did we detect zero tree removal in 15 years.

Recently, the effect of certification on deforestation and fire in Indonesia was reconsidered but any significant reduction of forest loss was mostly revealed in older plantations that contained little remaining forest (Carlson et al., 2018). In fact, from our analysis of the percentage tree loss in the 2001–2016 time-series (Fig. 2d), although a reduction in RSPO concessions is more evident after 2007 than in non-certified areas, two important aspects emerge. First, before the decreasing trend started in 2007 in RSPO concession, we show that the highest percentage of tree loss was right in certified areas, confirming that the current plantations of "sustainable palm oil" are often associated with a previous significant forest degradation. Secondly, after 2007, the percentage of tree loss continued to be high even in certified areas (also with respect to that of the total area) and from 2013 to 2016 was comparable to, and sometimes higher (i.e. in 2015) than, non-certified areas.

5. Certified palm oil is not completely deforestation-free

In summary, our analysis supports three facts: a) from 2001 to 2016 about 40% of the area located in RSPO concessions suffered from forest loss (either from deforestation, fires, or other tree damage); b) we detect significant tree loss prior to and following the initiations of the RSPO agreements (in 2004) and POIG initiative (in 2013); and c) certified concessions do not differ much from non-certified ones (and show, sometimes, even higher levels) in terms of percentage of tree removal. Thus, we conclude that certified productions of palm oil still lead to severe deforestation and may be no more sustainable than non-certified productions.

As global palm oil market continues to grow under an increasing demand for food and cosmetic industry ("*Market Watch - Palm oil*" Accessed through https://www.marketwatch.com/press-release/global-palm-oil-market-growth-is-driven-by-increasing-demand-for-palm-oil-in-food-and-cosmetic-industry-globally-2018-05-07 on 15/08/2018), it is urgent to thoroughly quantify economic and

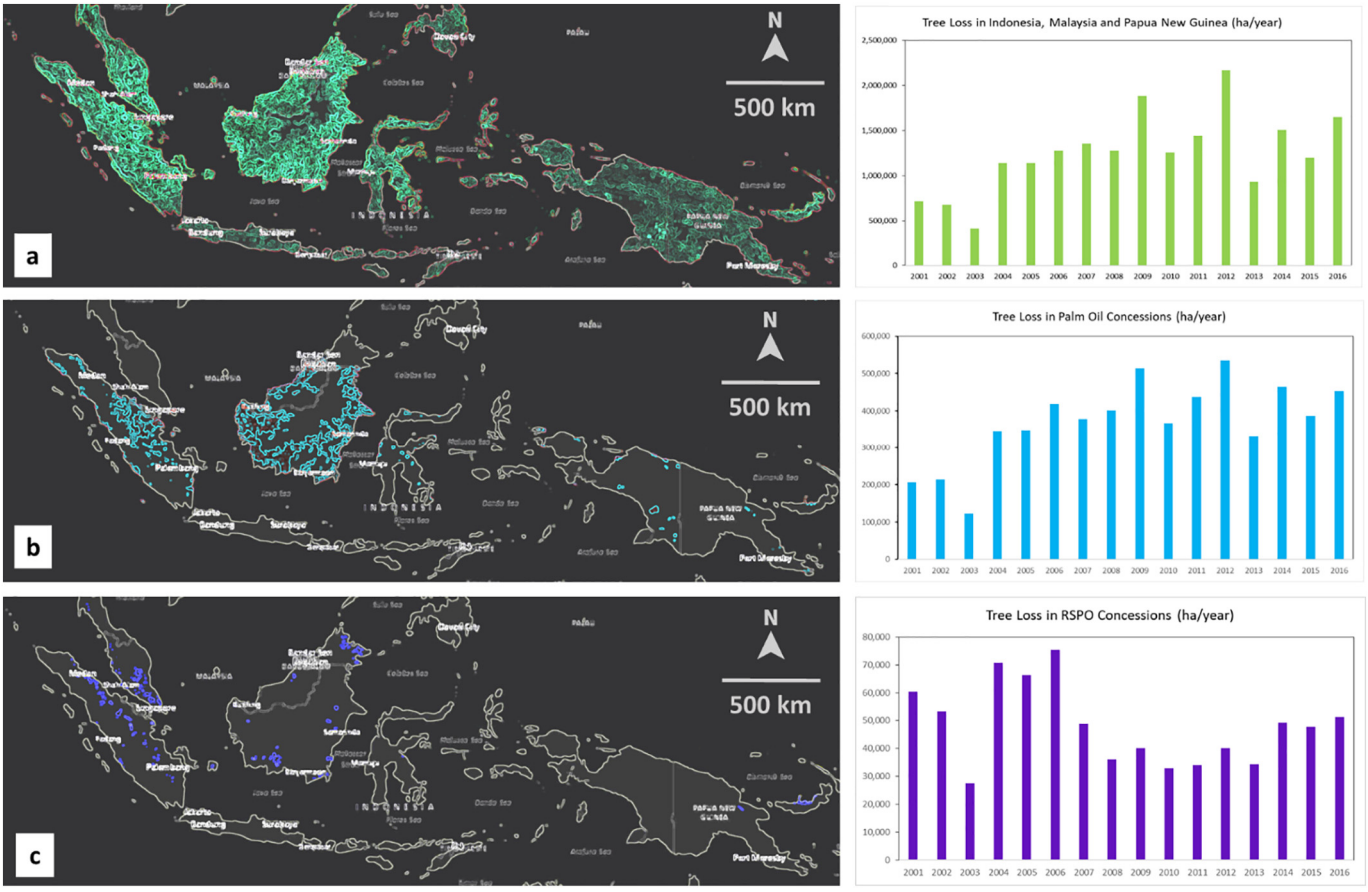

Fig. 1. Tree loss in Southeast Asia and palm oil concessions. 15 years (2001–2016) of tree loss distribution (left panels) and annual tree loss (right panels) in a) the whole territory, b) all palm oil concessions, and c) only RSPO concessions of Indonesia, Malaysia and Papua New Guinea.

environmental costs and benefits of current sustainable palm oil practice, based on over one decade of data, and examine alternative policy instruments for improved effectiveness. Substitutes of palm oil that have less environmental impacts should be another priority of research, but until the environmental costs of palm oil production are reflected in its price, palm oil may still dominate the market and continue to exert

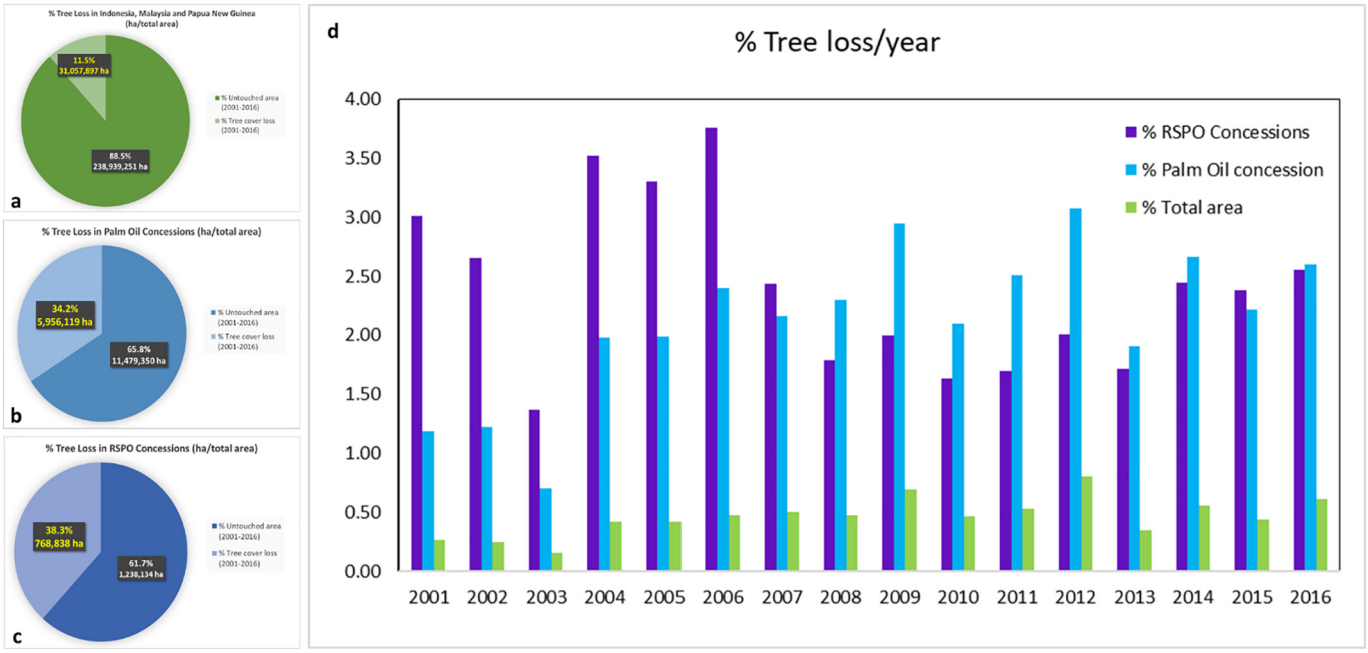

Fig. 2. Percentage and coverage in hectares of total tree loss (2001–2016) compared to the untouched area in a) the whole territory, b) palm oil concessions, and c) RSPO concessions; d) percentage of tree loss in the time-series from 2001 to 2016 in in the whole territory, all palm oil concessions, and only RSPO concessions of Indonesia, Malaysia and Papua New Guinea.

catastrophic consequences on tropical forests. We suggest that worldwide movements, through economic incentives or social learning, to reduce the consumption of fatty and unhealthy food and promote the use of non-tropical domestically-grown oils (e.g. rapeseed, canola, olive, sunflower, flax oil etc.) in food products and cosmetics could be more effective than certification schemes for the environmental sustainability. Future studies that also take into account other environmental impacts (e.g. fire, atmospheric pollution, etc.), human health issues, and the economy of these tropical productions, supported by our preliminary findings on forest degradation, are needed to further assess the actual sustainability of certified palm oil in the current environmental debate.

Authors' contributions

This short communication was designed by RCG, the data were gathered by AV and RCG, the data analysis was conducted by RCG and JL and the manuscript was written and revised by all authors. All authors approved and revised the final version.

Competing interests

The authors declare no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2018.10.222.

References

Abood, S.A., Lee, J.S.H., Burivalova, Z., Garcia-Ulloa, J., Koh, L.P., 2015. Relative contributions of the logging, fiber, oil palm, and mining industries to forest loss in Indonesia. Conserv. Lett. 8 (1), 58–67.

BBC, 2013. Accessed through. https://www.bbc.com/news/business-23026219 on 08/10/2018.

Boons, F., Mendoza, A., 2010. Constructing sustainable palm oil: how actors define sustainability. J. Clean. Prod. 18 (16–17), 1686–1695.

Carlson, K.M., Heilmayr, R., Gibbs, H.K., Noojipady, P., Burns, D.N., Morton, D.C., Walker, N.F., Paoli, G.D., Kremen, C., 2018. Effect of oil palm sustainability certification on deforestation and fire in Indonesia. Proc. Natl. Acad. Sci. 115 (1), 121–126.

Cazzolla Gatti, R., Castaldi, S., Lindsell, J.A., Coomes, D.A., Marchetti, M., Maesano, M., Di Paola, A., Paparella, F., Valentini, R., 2015. The impact of selective logging and clearcutting on forest structure, tree diversity and above-ground biomass of African tropical forests. Ecol. Res. 30 (1), 119–132.

Fargione, J., Hill, J., Tilman, D., Polasky, S., Hawthorne, P., 2008. Land clearing and the biofuel carbon debt. Science 319 (5867), 1235–1238.

Fitzherbert, E.B., Struebig, M.J., Morel, A., Danielsen, F., Brühl, C.A., Donald, P.F., Phalan, B., 2008. How will oil palm expansion affect biodiversity? Trends Ecol. Evol. 23 (10), 538–545.

Geist, H.J., Lambin, E.F., 2002. Proximate causes and underlying driving forces of tropical deforestation. Bioscience 52 (2), 143–150.

Global Forest Watch Initiative, 2018. Accessed through. http://www.globalforestwatch.org/about on 10/02/2018.

Greenpeace International, 2013. Certifying Destruction: Why Companies Need to Go Beyond the RSPO to Stop Forest Destruction (Amsterdam (The Netherlands)).

Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., Kommareddy, A., 2013. High-resolution global maps of 21st-century forest cover change. Science 342 (6160), 850–853.

Hayasaka, H., Noguchi, I., Putra, E.I., Yulianti, N., Vadrevu, K., 2014. Peat-fire-related air pollution in Central Kalimantan, Indonesia. Environ. Pollut. 195, 257–266.

Laurance, W.F., Koh, L.P., Butler, R., Sodhi, N.S., Bradshaw, C.J., Neidel, J.D., Consunji, H., Mateo Vega, J., 2010. Improving the performance of the roundtable on sustainable palm oil for nature conservation. Conserv. Biol. 24 (2), 377–381.

Marlier, M.E., DeFries, R.S., Kim, P.S., Koplitz, S.N., Jacob, D.J., Mickley, L.J., Myers, S.S., 2015. Fire emissions and regional air quality impacts from fires in oil palm, timber, and logging concessions in Indonesia. Environ. Res. Lett. 10 (8), 085005.

May-Toben, C., Goodman, L.K., 2014. Donuts, Deodorant, Deforestation: Scoring America's Top Brands on Their Palm Oil Commitments. Union of Concerned Scientists, Cambridge (MA).

Miettinen, J., Hooijer, A., Shi, C., Tollenaar, D., Vernimmen, R., Liew, S.C., Malins, C., Page, S.E., 2012. Extent of industrial plantations on Southeast Asian peatlands in 2010 with analysis of historical expansion and future projections. GCB Bioenergy 4 (6), 908–918.

Mozaffarian, D., Clarke, R., 2009. Quantitative effects on cardiovascular risk factors and coronary heart disease risk of replacing partially hydrogenated vegetable oils with other fats and oils. Eur. J. Clin. Nutr. 63 (S2), S22.

Mukherjee, I., Sovacool, B.K., 2014. Palm oil-based biofuels and sustainability in Southeast Asia: a review of Indonesia, Malaysia, and Thailand. Renew. Sust. Energ. Rev. 37, 1–12.

Obidzinski, K., Andriani, R., Komarudin, H., Andrianto, A., 2012. Environmental and social impacts of oil palm plantations and their implications for biofuel production in Indonesia. Ecol. Soc. 17 (1), 25.

Reijnders, L., Huijbregts, M.A.J., 2008. Palm oil and the emission of carbon-based greenhouse gases. J. Clean. Prod. 16 (4), 477–482.

RSPO, 2018. About Website. Accessed through Global Forest Watch. https://rspo.org/about on 10/02/2018.

Taylor, D., 2010. Biomass burning, humans and climate change in Southeast Asia. Biodivers. Conserv. 19 (4), 1025–1042.

Wicke, B., Sikkema, R., Dornburg, V., Faaij, A., 2011. Exploring land use changes and the role of palm oil production in Indonesia and Malaysia. Land Use Policy 28 (1), 193–206.