Carbon Emissions and Palm Oil

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Efeca Briefing Note

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1 Introduction

Climate change is an issue of ever-increasing prominence and urgency, and sustainable land use and production of agricultural commodities like palm oil will play a key role in our efforts to limit its impacts. According to the IPCC, greenhouse gas emissions from deforestation and forest degradation account for around 10% of global emissions, but if protected and restored forests could provide up to 37% of the greenhouse gas mitigation needed to ensure a good chance of stabilising warming to below 2˚C between now and 2030.[1] Sustainable production of commodities like palm oil, which does not contribute to deforestation, has a significant role to play in the mitigation of climate change.

Carbon emissions are a major area of focus in the fight against climate change, with initiatives such as the Race to Zero campaign showcasing a growing cross-sector commitment to take action. Scope 3 emissions (occurring in a company's supply chain) are of growing importance as supply chain actors look to address their broader emissions footprints.

This briefing brings together a summary of scientific research into the carbon emissions impact of palm oil, and how sustainable palm oil can reduce carbon emissions.

Note: Greenhouse gas (GHG) emissions are presented below as tonne of carbon equivalent emissions per tonne of palm oil, or t CO_2 eq t^{-1}.

2 The key messages

Land use change is often the main source of palm-related emissions. Research suggests that the cradle-to-gate carbon footprint of oil palm grown on converted peat soils is more than 6 times greater than the average for oil palm.[2] For palm grown on peatland, approximately 85% of life cycle emissions take place at the plantation, with processing and transport together responsible for 15% of the carbon footprint.[2] This emphasises the importance of sustainable production practices that prohibit development on peatland (amongst other principles) to limiting palm oil's carbon emissions impact.

The carbon footprint of oil palm production is similar to that of other oil crops. Evidence shows that palm oil has an average carbon footprint per unit of energy lower than soybean oil and groundnuts and equal to cotton and rapeseed.[3] When developed on low carbon stock lands, palm oil may have a lower emissions factor than comparative oil crops.[3] This research shows that palm oil has a similar carbon emissions impact to its potential alternatives.

Sustainable palm oil has a lower carbon footprint than conventional palm oil. It has been estimated that RSPO certified sustainable palm oil has an average emissions factor 35% lower

1 https://www.pnas.org/content/114/44/11645

2 http://www.globalbioenergy.org/uploads/media/0811_Danielsen_et_al_-_Biofuel_plantations_on_forested_lands.pdf

3 Life cycle assessment of five vegetable oils – ScienceDirect

than that of conventional palm oil, demonstrating the significant impact sustainable production can have on reducing palm oil's emissions impact.[4] RSPO compliance has been found to reduce plantation-level emissions by 21% and mill emissions by 97%.[4]

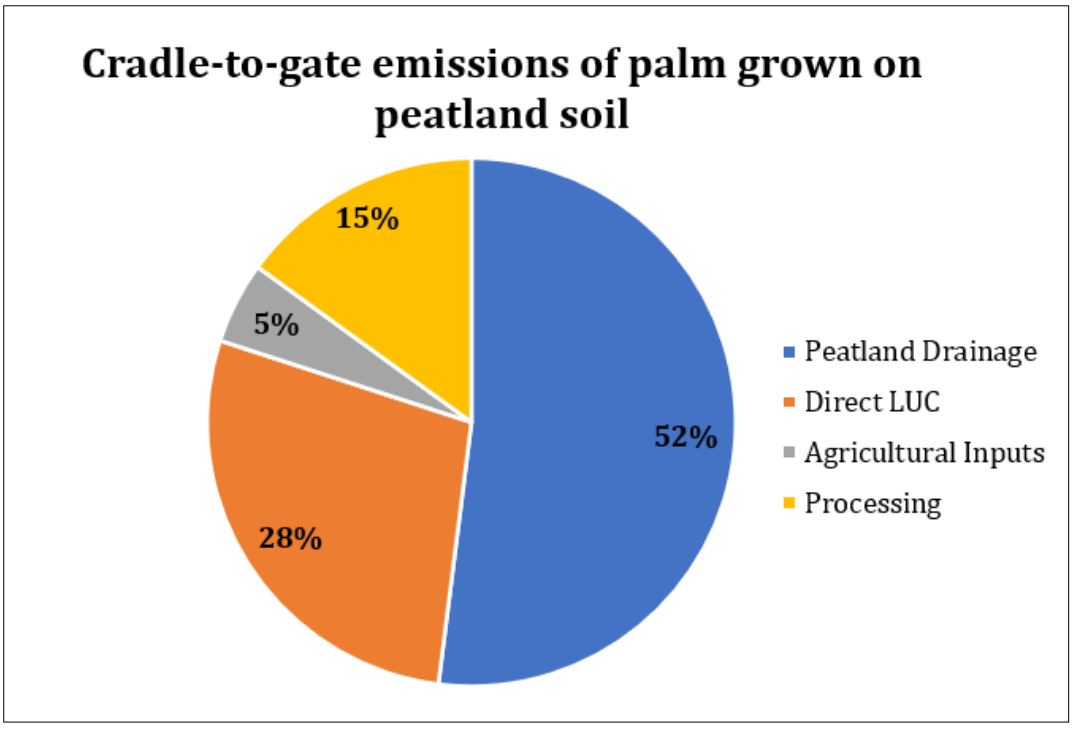
3 Summary of findings

The sub-sections below summarise research into the factors that contribute to palm oil's carbon footprint, how it compares to that of other vegetable oils, and how sustainable production practices can reduce its emissions impact.

The carbon footprint of palm oil

A number of scientific studies have investigated the carbon footprint of palm oil and the various emissions sources that contribute to it. A 2010 study cited by the European Commission calculates that growing and refining 1 metric tonne of crude palm oil on an already established plantation produces on average 0.86 tonnes of carbon equivalent emissions.[5] The same study estimates a carbon footprint of 5.69 t CO_2 eq t^{-1} per tonne of palm oil grown on converted peat soils. Similarly, Liedke et al calculate a global average cradle-to-gate emissions factor of 5.73 t CO_2 eq t^{-1} for palm when it is grown on peatland.[6] The contributing factors to these emissions are illustrated in Figure 1 and further detailed below.

Figure 1 Cradle-to-gate emissions share of palm grown on peatland soil, global average (Data from Liedke et al[6])



4 https://lca-net.com/publications/show/comparative-life-cycle-assessment-of-rspo-certified-and-non-certified-palm-oil/

5 https://ec.europa.eu/environment/forests/pdf/palm_oil_study_kh0218208enn_new.pdf

6 https://www.erasm.org/index.php/publications/40-life-cycle-inventories-publications/98-report-for-the-erasm-surfactant-life-cycle-and-ecofootprinting-sle-project-july-2017

Land use change (LUC) emissions are a key component of the carbon footprint of conventional oil palm production. Across the life cycle of oil palm grown on peatland plantations, Liedke et al estimate the drainage of peat soils to be responsible for 52% of emissions, and direct LUC for 28% (See Figure 1 above).[6] According to Danielsen et al,[7] an estimated 163 tonnes of carbon per hectare of land is emitted to the atmosphere when rainforest is converted to oil palm. Converted peatland can emit an additional 1,550 tonnes of carbon per hectare of land due to the continuous oxidation of organic carbon,[8] emphasising the importance of preserving peatlands and well as forests to our efforts to reduce carbon emissions. As opposed to conventional production, sustainable production of oil palm does not contribute to deforestation or development on peatlands, thus reducing the carbon footprint of the palm oil produced. See below where research into how sustainable production can reduce the carbon footprint of palm oil is further explored.

In addition to LUC, other emissions sources also contribute to palm oil's carbon footprint. For example, Liedke et al estimate that agricultural inputs account for 5% of life-cycle emissions of oil palm grown on peatland soil, and that processing (including treatment of waste products and transport) account for 15%.[6] Jamaludin et al identify wastewater generation due to palm oil mill effluent (POME) to be the primary emissions source at the mill and processing facility, followed by diesel, and electricity use.[9]

Fertilisers are another source of emissions across the agricultural sector, with the emissions factor of fertilisers ranging from 0.04 to 2.9 t CO_2 eq t^{-1} depending on the type of product and its application.[10] Furthermore, whilst palm oil is used domestically in producer countries, it is also a global market, with large volumes exported around the world. Pehnelt and Vietze calculate an average transport emissions factor of 0.13 t CO_2e t^{-1} for palm oil exports to the EU.[11]

Vegetable oil comparison

It is important that the carbon footprint of palm oil is considered in the context of other vegetable oils, to gain an impression of its relative impact. According to Schmidt,[12] per tonne of crude oil, palm oil (5.0 t CO_2 eq t^{-1}) has a carbon footprint lower than peanut oil (7.8 t CO_2 eq t^{-1}), equal to soybean oil (5.00 t CO_2 eq t^{-1}), and greater than rapeseed oil (3.00 t CO_2 eq t^{-1}) and sunflower Oil (3.8 t CO_2 eq t^{-1}).

More recent research by Meijaard et al[13] concludes that, per Megajoule (MJ), palm oil (1.2 kg CO_2e MJ) has a carbon footprint lower than soybean (1.3 kg CO_2e MJ) and groundnuts (1.3 kg CO_2e MJ), equal to cotton and rapeseed (1.2 kg CO_2e MJ), and greater than maize (0.7 kg CO_2e MJ) and sunflower oil (1 kg CO_2e MJ). This data is displayed in Figure 2 below.

7 http://www.globalbioenergy.org/uploads/media/0811_Danielsen_et_al_-_Biofuel_plantations_on_forested_lands.pdf

8 https://lca-net.com/publications/show/comparative-life-cycle-assessment-of-rspo-certified-and-non-certified-palm-oil/

9 https://www.sciencedirect.com/science/article/abs/pii/S0959652619310285

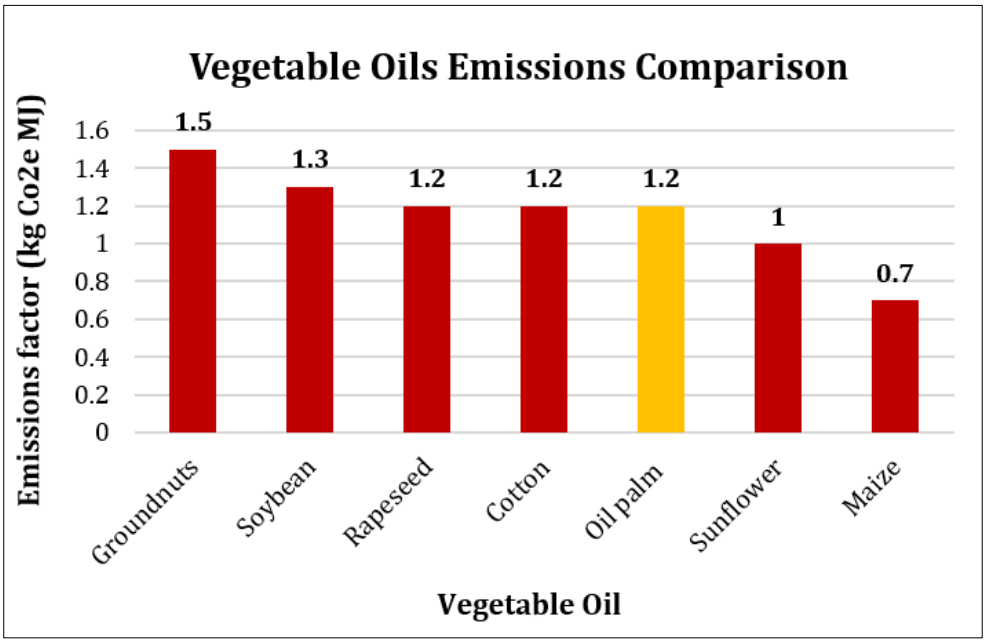
10 https://ec.europa.eu/environment/forests/pdf/palm_oil_study_kh0218208enn_new.pdf

11 Recalculating GHG emissions saving of palm oil biodiesel | SpringerLink

12 (PDF) Greenhouse gas footprints of palm oil production in Indonesia over space and time (researchgate.net)

13 The environmental impacts of palm oil in context | Nature Plants

Figure 2 Comparison of carbon emissions of different vegetable oils (Data from Meijaard et al[13])



Sustainable production reduces palm oil's carbon footprint

Research shows that sustainable oil palm production practices can considerably reduce the emissions associated with the crop's production. For example, when developed on low carbon stock lands, palm oil may have an even lower emissions factor than comparative oil crops.[14] Furthermore, Lam et al estimate that preventing expansion on forest and peat land, banning burning for land clearance, and using methane capture technology at mills, can reduce the life-cycle emissions of palm oil by 42%.[15]

Looking specifically at certified sustainable palm oil (CSPO), according to Schmidt and de Rosa, RSPO CSPO has an average emissions factor 35% lower than that of conventional palm oil.[16] They attribute this to higher yields, reduced occurrence on peat soils, and biogas capture at mills. Saswattecha et al found RSPO compliance to reduce plantation-level emissions by 21% and mill emissions by 97%.[17] RSPO certified plantations use less fertilisers, glyphosates and gasoline than non-certified plantations, and transportation emissions are often lower.

14 Life cycle assessment of five vegetable oils - ScienceDirect

15 (PDF) Greenhouse gas footprints of palm oil production in Indonesia over space and time (researchgate.net)

16 https://lca-net.com/publications/show/comparative-life-cycle-assessment-of-rspo-certified-and-non-certified-palm-oil/

17 https://www.researchgate.net/publication/277625199_Assessing_the_environmental_impact_of_palm_oil_produced_in_Thailand