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"Agricultural development within the rural-urban continuum"

Environmental Impact Analysis of Palm Oil Based Products using Life Cycle Assessment Tools

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Abstract

The growing concern of the exhaustible source of fossil fuels and the growing environmental impacts such as greenhouse gas emissions caused by combustion of crude oil based energy, have led to an increased interest in alternative fuels since the beginning of the 21st century. One promising alternative is palm oil-based biodiesel, which is currently produced in large quantities. However, instead of increasing the area of palm oil plantations, underutilised sources of biodiesel should be explored as alternative sources of biodiesel. Hence, the objective of this study is to investigate the environmental impacts caused by the production of biodiesel using palm oil compared to rubber-seed based biodiesel using Life Cycle Assessment (LCA) methodology. Both LCAs are than compared to the reference system fossil Diesel based on the functional unit of 1 MJ per produced gram of biodiesel. The results show, that palm oil-based biodiesel can mitigate up to 76,61 % of the CO_2-emissions compared to fossil Diesel, and rubber seed-based biodiesel can mitigate the emissions even further by 76,82 %. Different scenarios were conducted to see the effects of different transport distances, yield variations, fertiliser variations and the recycling of by-products. The evaluation showed that yield variations have the biggest effect on GHG emissions, with a total difference of 9,75 g CO_2-Equiv./MJ PME for palm oil-based biodiesel and 77,61 CO_2-Equiv./MJ RSME for rubber seed-based biodiesel between the highest and lowest scenarios. Results of the fertiliser scenarios showed, that decreasing the amount of applied fertiliser bears a large mitigation potential with up to 27 % in case of rubber seed-based Biodiesel, and 9,05 % in case of the palm oil-based biodiesel compared to the baseline. The usage of by-products was found to further mitigate the emissions of both biodiesel production processes in a range of 1,94 to 50,80 %. The findings were used to identify process parameters with large environmental impacts and are used to discuss further optimisation potentials in plant-based biodiesel production.

Keywords: Biodiesel, *Elaeis guineensis*, environmental impact assessment, GHG emissions, *Hevea brasiliensis*, LCA, oil palm, palm oil methyl ester, rubber seed oil methyl ester, rubber tree

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