# COMPARATIVE ENVIRONMENTAL LIFE-CYCLE ASSESSMENT OF COCONUT BIODIESEL AND COVENTIONAL DIESEL FOR PHILIPPINE AUTOMOTIVE TRANSPORTATION AND INDUSTRIAL BOILER APPLICATION

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Coconut biodiesel is a promising fuel alternative derived from the transesterification of coconut oil to methyl ester. This study quantitatively assessed the total environmental impacts from emissions and energy consumptions of coconut biodiesel and petroleum or conventional diesel from the raw materials to the final use using environmental life cycle assessment (LCA). Matrix-based calculations are used for the Life Cycle Inventory (LCI), which are coded in Microsoft Excel spreadsheet environment. The Life Cycle Impact Assessment (LCIA) is performed through the use of critical volumes method and ecological footprint. Input data for model calibration are derived from theoretical mass and energy balances, technical publications, industry average values and government databases. The model covers both automotive transport and industrial boiler applications.

The sensitivity analysis presented four scenarios that will assess the effect of data uncertainty on the model. Scenarios 1 and 2 represent automotive application with and without coproduct utilization, respectively. Meanwhile, scenarios 3 and 4 represent industrial boiler application with and without coproduct utilization, respectively. Coproduct utilization means that the coconut residues such as the shell and husk from the farming process will be used to cogenerate electricity. Results show that total emissions of biodiesel and diesel appear approximately the same for both scenario 1 and 3. Meanwhile, for scenario 2 and 4, biodiesel has approximately 15% to 60% reduction on total emissions as compared to diesel. Higher volumes were also observed for CO, NOx, $PM_{10}$, and $N_2O$ mainly due to the coproduct utilization, which increases these upstream emissions. In general, emissions that were reduced upon the use of coconut biodiesel are VOC, SOx, $CH_4$, and $CO_2$, ranging from approximately 25% to 100%.

The ecological footprint of coconut biodiesel is lower than the conventional diesel in four scenarios, which may be due to the nature of production of conventional diesel. Biodiesel has approximately 96% reduction in total energy impacts based from ecological footprint in all scenarios presented.

Critical volumes method used for the LCIA appears to be the best methodology in determining the total emissions impact of the two fuels above other methods due to its ability to calculate total impacts. Also, ecological footprint measure appears to be the best determinant on which has greater impact in terms of energy use between the two fuels as compared to other methods since it can compare both the renewable and non-renewable resources.

Finally, it can be seen based from the scenario analyses that the use of coconut biodiesel poses great advantage in reducing the global emissions impacts and the energy impacts accounted for using conventional diesel.

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