ABSTRACT

The world produces 49.4 billion tons CO_2 eq of greenhouse gas (GHG) emissions annually. The energy, waste, and agriculture sectors are the three most prominent contributors to the annual increase in GHG emissions in Indonesia. The palm oil industry, which boosts Indonesia's economic growth in the agricultural sector, is often exposed to negative issues due to activities that harm the environment. The high GHG emissions, thus, encourage international consumers to demand sustainability in the supply chain of the palm oil industry.

To increase awareness of the environment, the Ministry of Life and Forestry of the Republic of Indonesia has created a Company Performance Rating Program in Environmental Management (PROPER). PROPER has five ranks: Gold, Green, Blue, Red, and Black. PROPER measures five main environmental control performances and eight additional aspects beyond compliance criteria. The beyond compliance criteria are intended for companies that aspire to achieve Gold and Green ranks.

Life cycle assessment (LCA) is one of the criteria in the Gold and Green rating, which aims to identify and evaluate the environmental impact of the entire product life cycle and design improvement strategies. The LCA study in PROPER refers to the framework of SNI ISO 14040:2016 and SNI ISO 14044:2016 on Environmental Management. The four stages in the LCA study are goal and scope definition, inventory analysis, impact assessment, and interpretation.

PT Agra Sawitindo received a Blue rank in PROPER 2021, indicating PT Agra Sawitindo has complied with environmental management regulations set by the government but has not yet achieved beyond compliance criteria. The root cause identification process shows that one of the causes of PT Agra Sawitindo failed to achieve beyond compliance criteria was because PT Agra Sawitindo has not yet conducted an LCA study. Without an LCA study, PT Agra Sawitindo cannot devise an improvement strategy for the processes with the most significant environmental impact as an LCA study can design an improvement in the environmental management and improve the sustainability of a company. Therefore, this capstone project aims to design an LCA model that can measure environmental performance in supply chain activities at PT Agra Sawitindo and propose improvement strategies that can improve the environmental performance of PT Agra Sawitindo.

OpenLCA is an LCA software tool used in this capstone project to measure the environmental impact of Fresh Fruit Bunches (FFB) processing activities. ReCiPe method is chosen as the impact assessment method because of its ability to calculate 18 impact categories.

The scope of this LCA study is cradle-to-gate, commencing with the FFB plantation process, FFB transportation to the mill, Crude Palm Oil (CPO) production at the mill, and CPO transportation to the refinery plant, with a one-year period data from June 2021 to May 2022.

The design begins with the development of flow, process, and product systems in the OpenLCA application. After the stakeholders verify the LCA model at PT Agra Sawitindo, the impact assessment is carried out using the ReCiPe method. The results of the impact assessment calculation demonstrate that the most significant impact category lies in global warming, with a value of 839,156,764.09 kg CO_2 eq. FFB transportation to the mill, CPO transportation to the refinery plant, and the FFB plantation process are the three most considerable contributors to global warming impacts. One of the factors causing high emissions in the transportation process is the diesel consumption for trucks. Therefore, the recommended improvement for the suppliers and PT Agra Sawitindo is to invest in converting diesel-fueled trucks with natural gas. The simulation of this scenario illustrates a 27% emission reduction in the FFB transportation process and a 15% reduction in CPO transportation processes in the global warming impacts.

*Keywords — **life cycle assessment, kelapa sawit, cradle-to-gate***