UDC 658.7: 656.502.1

LIFE CYCLE ASSESSMENT TO IDENTIFY THE KEY CARBON FOOTPRINT POINTS IN SUPPLY CHAINS

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Abstract. *Considering the importance of sustainable production and logistics, there is a need to apply a set of tools to analyze the direct impact of daily operations on the environment. Life Cycle Assessment serves as a perceptive compass to pinpoint pivotal nodes within the supply chains that yield the most substantial environmental impacts, comprehending it across all stages of logistics chain.*

The increase in carbon emissions in recent decades, a fundamental cause of global climate change and a threat to natural systems and human security, is closely linked to the growth of the world's population. As a result, more intensive patterns of production and consumption were seen. A modern complex supply chain includes many value chain participants that produce, process, package, distribute, prepare and finally sell goods and dispose of waste. These steps require efficient logistics using road, air and water transport to get these products to every link in the supply chain on time. In this context, production and transportation patterns that involve excessive use of resources and fossil energy have created a significant unsustainable impact on the world ecosystem.

Such impact is one of the main concerns when considering strategies for developing sustainable logistics. The carbon footprint gauges greenhouse gas emissions, typically in kilograms of CO_2 equivalent, tied to a product's entire life cycle. By converting various gases into CO_2 equivalents, comparability is enhanced. Ultimately, the potential optimization of pollutive inputs volumes steers industries and organizations towards sustainable practices by offering a holistic perspective on their product's environmental impact. This informed approach empowers decision-making for reduced carbon footprint and a more sustainable future.

On the example of food products, according to [1], today's food supply chain creates approximately 13.7 billion metric tons of carbon dioxide equivalents (CO2eq), 26% of anthropogenic GHG emissions. A further 2.8 billion metric tons of CO2eq (5%) are caused by nonfood agriculture and other drivers of deforestation. Food production creates about 32% of global terrestrial acidification and 78% of eutrophication. These emissions can dramatically alter the species composition of natural ecosystems, reducing biodiversity and ecological resilience. The farm stage dominates, representing 61% of food’s GHG emissions (81% including deforestation), 79% of acidification, and 95% of eutrophication [1].

Between the farm or factory and the consumer, food passes through a complex supply chain that includes many value chain participants. To properly estimate environmental potentials to make society aware of the eco-toxic content, a Life Cycle Assessment or LCA approach has been used.

Life cycle assessment is a "methodological approach used to assess the environmental impacts of a product or service throughout its life cycle, covering the stages from raw material sourcing to final disposal. This involves examining not only the direct emissions and resource consumption associated with the product, but also secondary effects from activities such as transportation and the entire supply chain" [2]. The main objective of LCA is to enable organizations and industries to identify opportunities for improvement, reduce environmental impacts and take informed measures to promote sustainable development. This comprehensive methodology analyzes all aspects of a product's existence, including its creation, transportation, disposal and finally end-of-life processes. By providing a holistic understanding of a product's environmental impact, assessment helps make informed decisions and identify opportunities for improvement (Fig. 1).

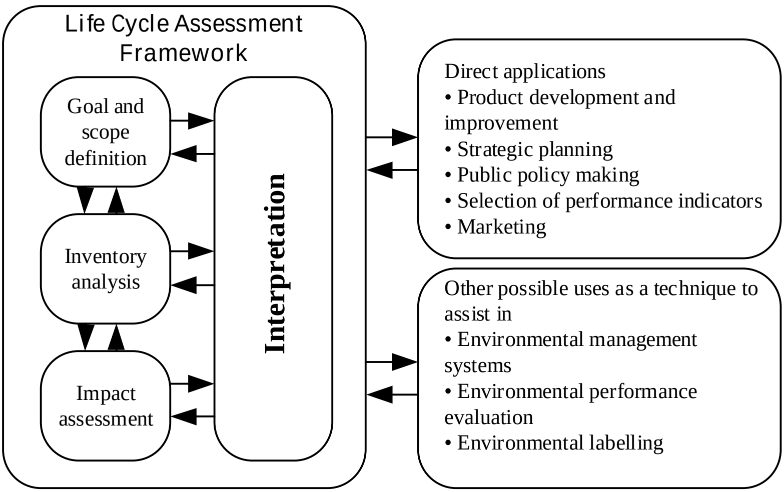

Fig. 1 - Framework of Life Cycle Assessment application (Based on [3])

In the context of climate change projections, LCA involves calculating the carbon footprint of a product or process. This involves quantifying the amount of greenhouse gases emitted at different stages of the life cycle, such as production, transportation, and use. These emissions are then translated into a standardized impact assessment using characterization factors that take into account the global warming potential of different gases. Similar process is conducted for resource depletion analysis; the focus is on assessing the extraction and consumption of finite resources such as minerals, metals, and water. The environmental impacts of these activities are assessed in terms of their contribution to scarcity, habitat destruction, and potential ecosystem disruption.

In the landscape of the integrated logistic support sector, Life Cycle Assessment emerges as an indispensable tool for comprehensively evaluating the ecological implications associated with production, processing, distribution, and ultimate disposal. This methodology stands as a crucial asset for organizations seeking to decipher the intricate web of environmental influences within their operations and subsequently formulate targeted strategies for sustainable enhancement.

Conlusions

Life Cycle Assessment encounters challenges within the sector of research due to intricate supply chains involving diverse stakeholders. Overcoming data collection difficulties is crucial for insightful analysis, leading to advancements in food safety, sustainability, and emissions reduction. By pinpointing emission-heavy areas like transportation and processing, the sector can strategize for improved efficiency, curbing its carbon footprint.

References

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