

## **Quantification of Lifecycle Impact of Secondary Packaging: An Empirical Study with Special Reference to Milk Powder Carton in Colombo District, Sri Lanka**

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In the recent past, packaging is considered as one of the most vital functions in the product distribution owing to the worldwide customer base and product security. Nonetheless, augmented packaging, packaging only for marketing; most of the time, the secondary packaging fetches numerous embedded negative issues especially in terms of environment throughout its life cycle; from raw material extraction to disposal stage. Identifying and quantifying such alarms would rope in mitigating the impacts in a significant proportion. Life Cycle Assessment is one of the best tools for achieving this purpose and in attaining defined intentions in this study. The main objective of the study is to quantify the adverse environmental impact of the 400g full cream milk powder carton throughout its lifecycle in the Sri Lankan context. Apart from that, the study compared the environmental impact of the end disposal scenarios with landfilling and recycling and quantifying the monetary saving that goes parallel with environmental saving; it further engaged focusing on the avoidance of the secondary packaging with reference to milk powder carton. A cradle to grave analysis was carried out with the declared unit of one milk powder carton which is 30g of weight. Questionnaires, databases, interviews, literature reviews were useful in data collection for accomplishing the defined objectives. The methodology has followed ISO 14040 and ISO 14044. The SimaPro faculty version was used as the tool for analyzing the life cycle impact and ReCiPe 2016 is the characterization model used for generating midpoint impact categories and endpoint damage categories. The resulted major characterized figures are 0.431 kg1,4-DCB for terrestrial ecotoxicity, 0.417 kg 1,4-DCB for human non-carcinogenic toxicity, 0.146 kg CO<sub>2</sub>eq for global warming, 0.053m<sup>2</sup>a crop eq for land use and 0.036 kg oil eq for fossil resource scarcity per milk powder carton. From two disposal scenarios considered, recycling and landfilling results suggest that proper recycling would reduce the damage on the environment in a considerable proportion. If milk powder secondary packaging are eliminated from Sri Lanka, the resulting characterized the end point damage savings as 93.57 DALY (human health), 1,839,960 USD 2013 (resources) and 0.205 species yr (ecosystems). In monetary terms, a consumer saves Rs. 1.5 billion and manufacturers can have a cost reduction of Rs. 1.2 billion annually. Considering the results, it is recommended to follow proper recycling as end-of-life treatment and practicing a minimalist approach with possible products is the best way to minimize the total impact. As per the further recommendations for research it is suggested to quantify the direct and indirect benefit that a manufacturer and a consumer receive by practicing minimal secondary packaging for products.

**Keywords:** *Life cycle assessment, Milk powder carton, ReCiPe characterization model, Secondary packaging,*