

Economic and Environmental Sustainability Assessment of Recycling Versus Upcycling Surplus Bread

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Abstract

Effectively managing surplus bread is essential due to the considerable environmental and economic burden associated with disposing of excess bakery products. Inadequate bread waste management contributes to increased waste production and inefficient use of resources. However, the implementation of upcycling methods offers a valuable solution by transforming surplus bread into valuable products. This approach not only mitigates the adverse environmental impacts of bread waste but also fosters a more sustainable and circular economy. By adopting efficient upcycling techniques, the challenges associated with bread waste management can be addressed, resulting in enhanced resource utilization, reduced waste generation, and potential economic advantages. While upcycling is generally considered beneficial for reducing waste and promoting resource efficiency, it is essential to conduct combined environmental sustainability and economic viability assessments to ensure environmental sustainable economic investment implying that potential unintended consequences or negative impacts are not overlooked. This evaluation is invaluable for decision-making, enabling the identification of areas for improvement and the implementation of strategies to maximize the sustainability of upcycling practices. Life cycle assessment (LCA) is an environmental analysis tool that provides a comprehensive framework for evaluating the environmental impacts associated with the entire life cycle of upcycling methods. This study aims to examine the environmental impacts of upcycling surplus bread in Slovakia. The system boundary is defined from the inclusion of bread waste in the production process to the final production of BetaFerm. The functional unit for this research is set as the treatment of one ton of surplus bread. In the next step, all energy, emissions, and materials are calculated and recorded to complete the life cycle inventory. Then, environmental characterization is performed using the ReCiPe2016 hierarchy as midpoint levels. The results are interpreted, and short-term and long-term solutions are discussed. Ultimately, it can be concluded that the integration of environmental assessment, particularly LCA, in bread waste management facilitates the development of more sustainable practices and supports the transition towards a circular economy.

Keywords: BetaFerm, Bread waste, Life cycle assessment, ReCiPe2016, Upcycling