

Efficient and Cost-effective Food Waste Compost Production through Life Cycle Assessment Approach

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Abstract

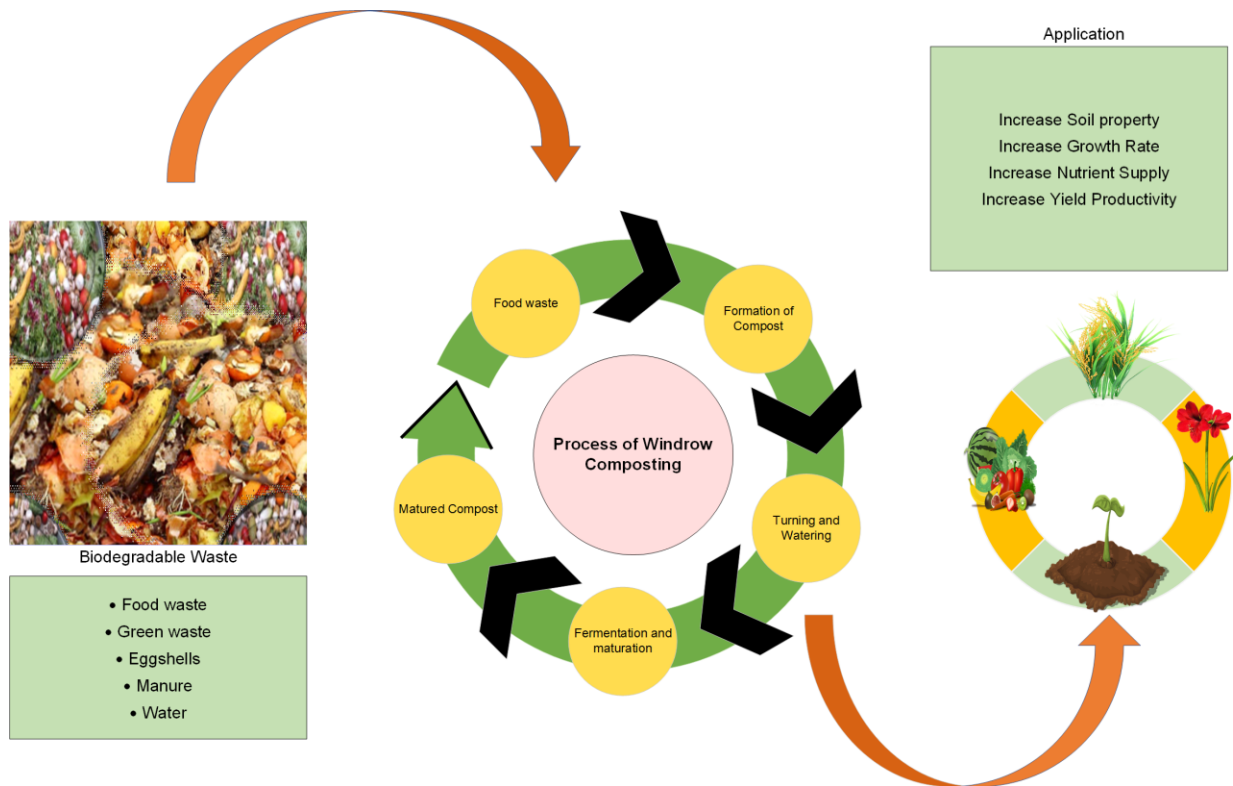


Figure: Life cycle assessment model

This research aims to evaluate the environmental and economic performances of food waste compost (FWC) production from municipal mixed waste, green waste, eggshells, and manure in Lahore city, Pakistan. A case study was conducted that encompasses raw materials, Energy,

transportation, and manufacturing processes by using combined methods of life cycle assessment (LCA) and life cycle cost (LCC) analysis, particular approach based on ReCiPe 2016 Midpoint (H) database. The results determined that the energy stage is the key contributor (over 65 %) with total environmental impact. Followed by manufacturing and transportation stages (less than 15%).

Grid mix energy is the key substance used as hotspot and substantially increases environmental burdens. In addition, manure and diesel consumption are also identified as dominant substances to contribute to environmental impacts. Environmental impact scores of Global warming potential, Marine water eutrophication potential, Terrestrial ecotoxicity potential, and Fossil depletion potential with higher impact values of 1.21×10^3 kg CO₂ Eq, 7.05×10^2 kg N Eq, 2.60×10^2 4-DB Eq, and 4.39×10^1 kg oil Eq, respectively. Future improvements to reduce environmental impacts should focus on the alternative use of grid mix and using another biowaste as substrates to improve compost quality and lower composting period.

Sensitivity analysis of FWC production results confirmed that pollution control by grid mix of energy, manure, and diesel should be a top priority for realizing environmental credibility. In addition, economic modeling showed that the life cycle cost of FWC was 24.97 \$/t. Equipment cost is calculated as the top contributor of LCC (over 45%). The estimated revenue was 29.2 \$/t and 2924.8 \$/day. According to the literature, the payback year was less than 1 year and was more economical. The outcomes of this research can be helpful for the relevant stakeholders and decision-makers in realizing environmentally friendly and economically feasible options to execute food waste compost productions.

Keywords: Sustainable development, bio-fertilizer, environmental impact, environmental analysis, economic analysis