Sustainable Management of Construction and Demolition Waste to Achieve Zero Waste and Circular Economy

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Abstract

The construction industry is one of the major industries contributing to the environment and economy. It consumes 50% of natural resources and generates 20% of greenhouse gas emissions worldwide (Gallego-Schmid et al., 2020). Rapid urbanization, population increase, and poor management are the major challenges hindering Pakistan's construction and Demolition (C&D) waste management. This study aims to recover resources that can replace new raw materials and reduce C&D waste quantity. A recycling plant for C&D waste in Lahore is proposed to contribute to the circular economy. ReUrban D5100 recycling plant was studied as a case study for Lahore city to recycle C&D waste.

Life cycle assessment (LCA) and life cycle costing (LCC) were used in this study to compare different scenarios; landfill, recycling with grid mix electricity, and recycling with solar electricity. This study was performed by applying ISO 14040 and ISO 14044 standards as attributional LCA modeling. The goal and scope of this study were to examine the best possible option for C&D waste management in Lahore city. Therefore, the entire life cycle of C&D waste management was included in the system boundary of this study. One ton of C&D waste as the functional unit was studied in both scenarios. This study's life cycle inventory analysis was based on primary and collected data from different platforms.

ReCiPe 2016 was used as life cycle impact assessment (LCIA) method to evaluate the sustainability of C&D waste recycling and various impacts from landfilling. There are two approaches in ReCiPe to calculate results: midpoint and endpoint assessment (Huijbregts et al., 2017). Eighteen midpoints and three endpoint categories were calculated in the LCIA. The endpoint approach gave the normalized results as a single score for easy understanding (Dong & Ng, 2014). In the LCC, internal and external costs were included to study the economic indicators and externalities of the study.

Quantitative results from these selected categories showed landfill scenarios as harmful practices for managing the C&D waste for the city. Transportation of C&D waste and landfill emissions gave the

most negative results in the landfill scenario. In the recycling scenario, transportation of C&D waste recycling process that included electricity and diesel consumption resulted as impactful factors. Transportation emissions declined in the recycling process because of less distance from the landfill. Avoided raw materials and landfilling impacts evaluated recycling as a promising and valuable C&D waste management technique.

This LCA study calculated that recycling has three times less impact than a landfill of C&D waste. C&D waste recycling can decrease the demand for new raw materials from extractions. Recycled aggregates from recycling can be used in road construction, low weight bearing construction, pavements, bricks, and tiles. These value-added products can contribute a lot to Pakistan's circular economy. Extraction and demand for raw materials can be reduced after substituting recycled material. Avoided landfilling of C&D waste and resource recovery will reduce environmental impacts. Policymakers in Pakistan should focus on C&D waste, as it can contribute to a sustainable future and circular economy.

Keywords: C&D waste, Circular economy, Sustainability, Waste Management, Resource recovery

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