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FROM ORGANIC WASTE TO AGRICULTURAL FERTILIZER: A MEASUREMENT OF THE LEVEL OF CIRCULARITY AND AN ASSESSMENT OF ECONOMIC FEASIBILITY

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Abstract

Rapid population growth is generating a dual challenge: growing pressure on agricultural land to meet global food demands and increasing complexity in managing organic waste. This study investigates the environmental, social, and governance (ESG) circularity of a composting plant as a case study to determine whether the circular economy can positively influence business performance in the composting sector by improving cost efficiency and identifying higher-value markets. Unlike most previous studies, which have mainly focused on technological innovations for process optimization, this research quantifies circularity through the UNI/TS 11820:2022 standard, an emerging methodological framework that integrates environmental, social, and economic dimensions to measure the transition from linear to circular systems. The composting plant analyzed, located in Sicily, achieved a Circularity Level (CL) of 65.5% in 2023, demonstrating strong adherence to circular principles across six groups of indicators. The highest score (96%) was obtained for waste and emissions management, confirming the company's strong environmental commitment, while the lowest score (38.8%) was registered for energy and water resources, highlighting potential for improvement through renewable energy adoption and resource efficiency measures. Despite achieving high circularity, the plant's economic analysis revealed structural weaknesses, mainly due to high residue disposal costs and the limited market value of compost (currently €0.10 per ton). The findings emphasize that circularity can act as both an operational and strategic asset, supporting the market repositioning of organic fertilizers as premium products. By integrating circular performance metrics into business strategies and communicating results transparently, composting enterprises can strengthen competitiveness, enhance profitability, and align with the European Green Deal objectives. The research demonstrates that measuring circularity provides not only an environmental indicator but also a managerial tool for driving sustainable growth and resilience within the bio-waste valorization sector.

Key words: circular economy, composting plant, organic fertilizer, sustainability

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