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ADVANCES IN MUNICIPAL ORGANIC FRACTION SOLID WASTE MANAGEMENT

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Introduction

The consistent increase in organic waste fraction in municipal solid waste (MSW) poses an urgent environmental concern. With the evolution of urbanization and consumer habits, more food scraps, yard waste and other biodegradable materials are ending up in landfills. This challenge has serious impacts, the main being the emission of greenhouse gases, resources depletion and environmental pollution.

The study of progress made toward municipal organic fraction solid waste management includes improvements in mechanical methods to separate organic wastes from other MSW components, advanced composting technologies that will allow a more efficient and higher quality product (compost), e.g. aerobic or anaerobic composter technology, breakthrough anaerobic digestion technology capable of converting organic waste to biogas (renewable energy) and high-quality digestate, transforming organic waste into a soil-building and carbon-negative inoculant to support healthy soils via pyrolysis.

Investigating these developments and possible uses of these advancements gives an understanding of the opportunities and challenges of the sustainable management of municipal organic fraction solid waste. This knowledge will help decisions-making regarding policies, and technologies development, as well as ways of involving the public effectively towards a more circular and resilient waste management system.

Materials and methods

In order to achieve a comprehensive assessment of the progress of existing systems for municipal organic fraction solid waste management, a multi-pronged approach was adopted. A systematic literature survey was conducted to search for pertinent articles, case studies, and policy documents. Data collection aimed at quantifying waste generation, recycling rates, and composting capacity. The gathered material was then analyzed. Optimal cases were found based on the analysis of the case studies in order to understand the circumstances for this success and possible failures. The results of the several sources were fused together in order to come up with a proper perspective including all new inventions, policy makers' initiatives and problems.

Results and conclusions

The field of municipal organic fraction solid waste management has come a long way with technological innovations, collaborative governance models and robust sustainability frameworks. These aim to improve environmental performance, economic viability and social acceptance of waste management systems.

Technological innovations have been key drivers in organic waste management. All-Component Resource Recovery (AcRR) a new sorting technology is a more sustainable and profitable alternative to incineration. IoT and computer vision have also improved waste classification accuracy so waste management is more efficient and effective.

Beyond technological innovations, governance and cooperation are key to sustainable waste management. Inter-municipal cooperation has shown to be successful in building regional collaboration and social capital. Circular economy models are gaining traction especially in developing countries, focusing on resource recovery and waste reduction.

Policy and regulatory frameworks also play a big role. The EU Landfill Directive has impacted waste management in Europe, reducing landfill and increasing recycling. Italy's efforts to align waste management with circular economy goals has resulted to reduced landfill use and increased waste-to-energy capacity.

Sustainability assessment tools like Life Cycle Sustainability Analysis (LCSA) provide valuable insights to the environmental and social impacts of waste management innovations. By applying LCSA and considering the UN Sustainable Development Goals, decision makers can find the best solutions and monitor the implementation.

While these are big steps forward, there are still challenges to achieve comprehensive and sustainable waste management systems. For example, the transition to circular economy models requires overcoming economic, sociocultural and technological barriers especially in developing countries. Inter-municipal cooperation can also be limited by competitive behaviours and the need for more inclusive governance structures.

Social acclimatization of organic waste disposal options is a multifaceted issue that includes perceptions, attitudes, and behaviors associated with the stakeholders in the society, namely, local residents, government officials, and business entities. The strategies are effective only if they are accepted by the majority of the public and the administration is successful in their fusion into the social and economic systems that are already existing.

Although the researches unveil various factors which are the barriers to social acceptance, environmental awareness and education also need to be taken into account. Elevating public knowledge on waste management strategies has the potential to be a means of growing opportunity and involvement. Furthermore, bringing social insights to the table into technical analysis can channel more productive tact and practice. The adverse side in this is that we have to find the right mix among economic, environmental, and social issues to be able to form such waste management solutions that are sustainable and generally adopted.

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