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EVALUATING THE SUSTAINABILITY OF MUNICIPAL WASTE MANAGEMENT IN ROMANIA

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ABSTRACT

The study examines the municipal waste generation per capita trends in Romania from 1995 to 2022 compared to other EU countries using Eurostat data. The analysis divides the period into two phases: pre-accession (1995-2008) and post-accession (2008-2022). In the first period, Romania maintained a low and stable waste generation rate, below 300 kg per capita per year, due to low consumption levels, incomplete waste collection, and limited waste management capacity. After joining the EU, there was a slight increase in waste generation, accompanied by improved data reporting and infrastructure, but Romania still had one of the lowest waste generation rates in the EU. Challenges remained in waste monitoring, rural collection, and public awareness. By contrasting Romania's data with high waste generating countries like Denmark and Germany, the study suggests that factors such as waste monitoring and public awareness contribute to lower waste per capita figures.

KEYWORDS: waste management, recycling rate, waste generation, sustainable development, Romania

1. Introduction

Municipal waste generation serves as a key indicator of both consumption levels and the efficiency of waste management systems within a society. In the European context, the European Union closely monitors this metric, considering its environmental impact, as well as its relevance to circular economy and sustainability objectives [1].

Between 1995 and 2018, the average amount of municipal waste generated per capita in EU Member States consistently exceeded 500 kg per person per year.

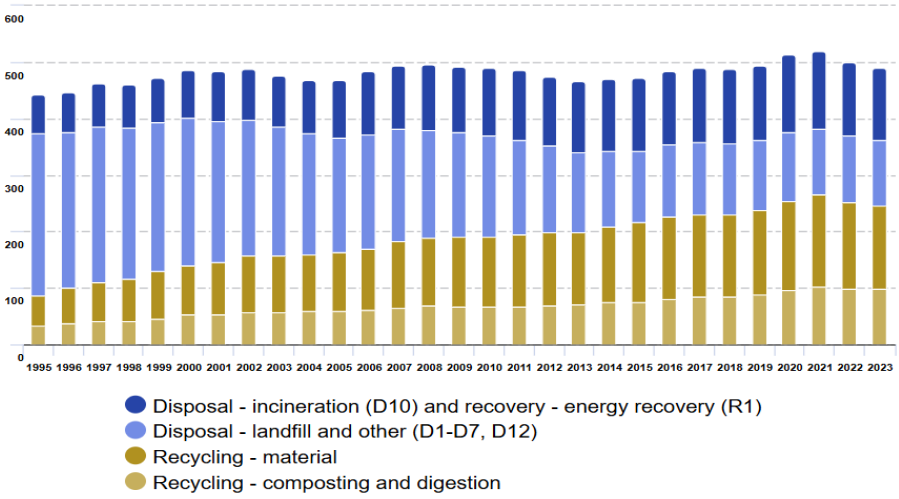

Fig. 1. *Municipal waste treatment, 1995-2023 (kg/capita) Sourse Eurostat* [2]

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Significantly higher values were recorded in countries such as Denmark, Germany, and Austria, where figures often surpassed 700–800 kg per capita [2].

In contrast, Romania has persistently ranked among the lowest in the EU, with reported averages below 300 kg per capita, according to official Eurostat data [2].

However, this seemingly favourable performance requires cautious interpretation. The low level of reported waste generation in Romania reflects, to a considerable extent, structural issues such as inadequate collection infrastructure—particularly in rural areas—systemic underreporting of actual waste quantities, and the prevalence of informal disposal practices [3].

Therefore, a comparative and context-sensitive analysis is essential to understand not only the quantity of municipal waste generated but also the underlying mechanisms behind its generation and management in Romania, in comparison with other European countries.

2. Methodology

The data analysed in this study are provided by Eurostat and published at the national level by the National Statistical Institute. The indicator ECC301A reflects the recycling rate of municipal waste, expressed in percentages, while ECC302A measures the amount of waste generated per capita in a calendar year, expressed in kilograms. Both datasets follow a standardized European methodology, ensuring comparability across countries and over time.

3. Results and discussion

3.1. Municipal waste recycling rate municipal

Waste management has become a central element in the transition to a circular and sustainable economy, and the analysis of the two main indicators—the recycling rate and the amount of waste generated per capita—offers valuable insights into Romania's performance in this area [1].

The municipal waste recycling rate, defined as the proportion of the quantity of waste recycled to the total generated, reflects not only the efficiency of waste management infrastructure but also the level of public engagement. The targets set at the European level are ambitious: a recycling rate of 55% by 2025 and 60% by 2030 [2].

Romania, as a member state of the European Union, has committed to these goals, but available data suggest that progress remains insufficient. In many regions, material recycling is still limited, and composting or anaerobic digestion of biowaste is rarely implemented on a large scale [5].

One of the main obstacles to increasing the recycling rate is the lack of adequate infrastructure for separate collection, particularly in rural areas and disadvantaged communities. Additionally, the low level of environmental awareness and education among the population frequently leads to contamination of recycling streams, significantly reducing the efficiency of recycling process. Moreover, informal or non-compliant collection, alongside the absence of incentive systems for households, hinders the full potential of recycling in Romania [3].

The impact of recycling is not only ecological although this is the most visible aspect, as recycling contributes to pollution reduction, conservation of natural resources, and limitation of greenhouse gas emissions. However, the benefits are also economic and social: the development of the recycling sector can generate green jobs, encourage entrepreneurship, and strengthen the circular economy, while active citizen participation in collection and sorting fosters civic responsibility and community involvement [1].

3.2. Municipal waste generated per capita

The amount of waste generated per capita is a key indicator of consumption behavior and the effectiveness of prevention measures. Although Romania records one of the lowest per capita figures in the EU, this value may be indicative of deficiencies in formal collection systems [2].

Changing consumption models, reducing packaging, and promoting reusable products are necessary solutions to decrease this indicator.

According to the hierarchy established by the Waste Framework Directive, waste prevention takes priority over recycling, reuse, or disposal [8].

Reducing the amount of waste produced per inhabitant is often seen as a sign of a society's ecological maturity. This involves not only technical or legislative measures but also a profound change in individual behavior: purchasing durable goods, avoiding unnecessary packaging, reusing products, and engaging in community waste reduction initiatives [6]. Furthermore, consumption models influenced by urban lifestyles or income growth can increase waste volumes in the absence of proactive policies for education and waste reduction.

It is important to note that Romania's lower per capita waste figures, compared to the European average, may in some cases conceal issues such as under-reporting or informal collection.

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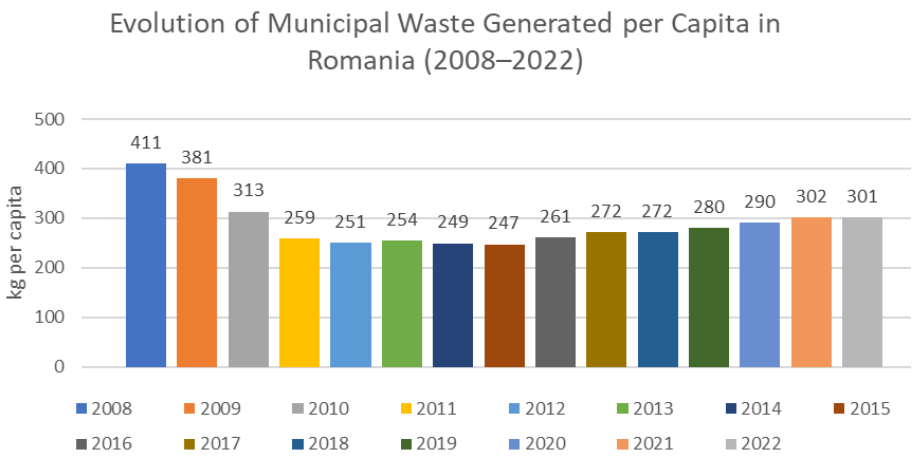

Fig. 2. *Evolution of municipal waste generated per capita in Romania (2008–2022) (source: https://insse.ro/)* [4]

These situations, which exclude waste from the official statistical circuit, do not necessarily reflect better performance but rather gaps in monitoring and control systems [5].

3.3. Interdependence between indicators

The interdependence between the two analysed indicators is particularly relevant: a smaller amount of waste generated facilitates efficient recycling, while a high recycling rate requires the existence of an effective collection and processing system. Together, these factors contribute to building a sustainable model of consumption and production where resources are maximized and environmental impact is minimized.

Between 2008 and 2021, Romania made significant progress in waste recycling, although not without challenges. In 2008, recycling was almost non-existent, with only 0.89% of waste managed through sustainable methods. In just a few years, notable progress was recorded.

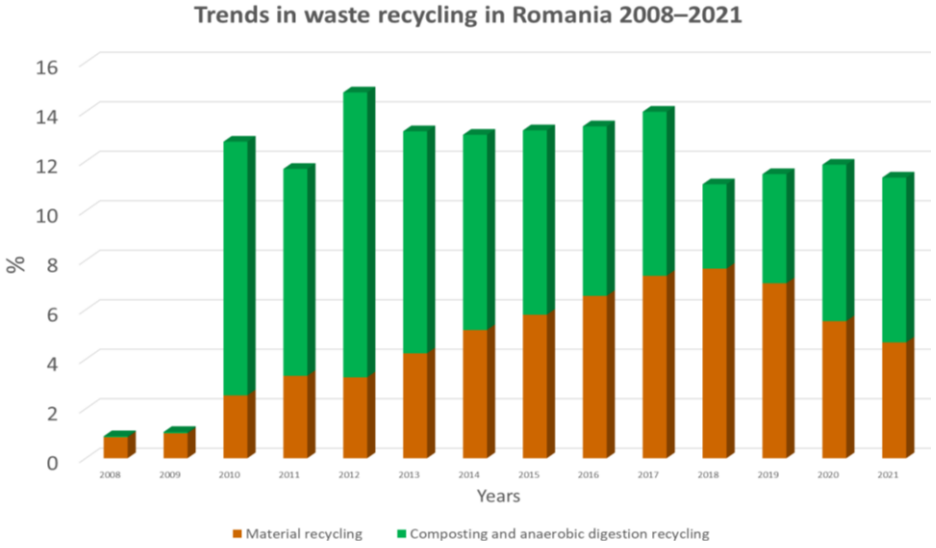

Fig. 3. *Trends in waste recycling in Romania 2008–2021 (source: https://insse.ro/)* [4]

This period of growth was especially supported by the development of biowaste treatment through composting and anaerobic digestion. In 2010, this type of recycling surged from negligible values to over 10%, suggesting the emergence of new facilities and systems dedicated to organic waste.

At the same time, traditional material recycling—such as that of plastic, metal, or paper—increased more slowly but steadily, peaking in 2018

at 7.66%. This indicates that citizens and authorities began adapting to and adopting more sustainable habits, most likely following awareness campaigns and the introduction of separate collection systems in several cities [3].

However, after 2018, this positive trend reversed. The total recycling rate began to decline slightly, and material recycling experienced a more pronounced decrease. In 2021, only 4.68% of waste was recycled as material—a significant drop compared to previous years. At the same time, composting and anaerobic digestion fluctuated, suggesting a lack of a stable strategy for managing organic waste.

This stagnation and partial regression can be attributed to several factors: depletion of European funds, lack of continuity in public policies, inadequate infrastructure, and the 2020 health crisis, which disrupted waste collection and recycling services [5].

Romania's progress in recycling shows an encouraging initial phase followed, unfortunately, by a period of stagnation and decline. To ensure that these initial gains are not lost, it is essential to implement coherent public policies, secure long-term investment and strengthen institutional capacities dedicated to sustainable waste management.

4. Conclusions

The analysis of Romania's performance in municipal waste management between 2008 and 2021 reveals a complex and uneven trajectory. While notable progress has been made - particularly in the first years after EU accession - Romania continues to face structural and systemic challenges that prevent sustained improvement.

The recycling rate in Romania has seen a significant increase, particularly between 2008 and 2012, driven in part by the implementation of EU-aligned waste policies and an increased focus on the treatment of biodegradable waste through composting and anaerobic digestion. However, this upward trend did not persist after 2018, as both material recycling and processing of organic waste declined, suggesting a lack of long-term strategic planning and continued investment.

Romania reports one of the lowest municipal waste generation rates per capita in the European Union, but this is largely due to underdeveloped collection infrastructure and informal waste disposal practices rather than environmental efficiency. The interdependence between recycling rates and the amount of waste generated highlights the need for robust collection, separation and processing systems to facilitate efficient recycling. In Romania, limited recycling infrastructure and inconsistent implementation of separate waste streams have hindered the country's ability to maximize this synergy.

Moreover, public participation remains insufficient, reflecting gaps in environmental education, limited awareness, and insufficient economic incentives. A stronger civic engagement in waste sorting, reuse, and reduction efforts is essential for the transition to a more circular economy.

In conclusion, Romania's current situation reflects a mix of initial policy-driven momentum and subsequent stagnation. In order to meet the EU's recycling targets for 2025 and 2030, Romania must prioritize the expansion of separate collection systems, ensure transparency and accuracy in reporting, and invest in local waste treatment capacities. A shift from reactive to proactive strategies—anchored in education, infrastructure, and enforcement—is critical to transform short-term gains into long-term environmental stewardship.

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