Statistical Analysis Regarding Waste Generation and Treatment in Romania between 2016 and 2020

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Abstract

The generation and treatment of waste is a current issue, an idea reinforced by various policies and documents, such as the environmental policy of the European Union, the Paris Agreement on climate change from 2015, the European Green Deal, but also in the context of sustainable development objectives of the United Nations Organization.

The European Union aims to be as efficient as possible in terms of resources and to promote competitiveness in a circular economy. In terms of waste management, the European Union envisaged an order, prevention being preferred first. When the latter is not possible, it will go to reuse, recycling and recovery. The last place is assigned to sending waste to the landfill. Romania, as part of the European Union, will have to follow its provisions related to environmental issues in general and waste, in particular. The present article proposes a statistical analysis of the generation and treatment of waste in Romania during the period 2016-2020.

Key words: waste, waste generation, waste treatment, waste management
J.E.L. classification: Q53, Q58

1. Introduction

The EU legislative framework for waste management primarily includes Directive 2008/98/EC on waste and repealing certain directives. This directive established a hierarchy of waste, introduced, and confirmed principles related to responsibility in waste management, defined concepts such as "extended producer responsibility", "waste" and "by-products", but also established the competences of national authorities. European Union Directive 2018/851 is the one that modifies Directive 2008/98/EC, in the context of measures specific to the circular economy.

According to Directive 2008/98/EC, waste is defined in Article 3, paragraph 1 as "any substance/object which the holder throws away/has the intention or obligation to throw away". In this regard, a careful management of the waste problem is necessary, to differentiate hazardous from non-hazardous waste, separating materials and residual energy that can be reused later, with the intention of reducing the negative impact on the environment, to avoid polluting water, air or soil or making people sick. At the level of the European Union, the aim is to reduce the amount of waste generated or to reuse, recycle and dispose of unavoidable waste.

Waste is generated by both businesses and households. Thus, the generation of waste will concern both production and consumption activities, as the analyzes carried out by Eurostat also show. Regarding waste treatment, Directive 2008/98/EC includes among the treatment operations: recycling, energy recovery, incineration, landfill, or waste disposal.

The statistical data on waste flows are collected at the level of the European Union, to be able to follow the compliance with the Community legislation regarding the issue of waste. Pre-established quantitative objectives, recycling rates, but also the recovery of waste are considered. All of this is in line with the Sustainable Development Goals (SDGs), included in the resolution called Agenda 2030, but also with the European Union's goal of achieving a circular economy, respecting green principles.

2. Literature review

The studies on the issue of waste at the level of the European Union are varied, they deal with topics related to generation and treatment, management, existing waste flows between member countries, but also the analysis of specific waste such as batteries, municipal waste, packaging, electronic and electrical equipment, and others.

(López-Portillo *et al.,* 2021) considers that the average levels of waste treatment rates differ between the states of the European Union, depending on their economic characteristics. Thus, after dividing the states into 3 groups according to the real GDP per capita, investments in research and development, the period of membership in the EU or resource productivity, they concluded that if the states have an increased GDP/capita, but also important investments in research and development, then the waste treatment rates are also high. High rates of waste treatment are also observed in the case of states with more years of EU membership and with an increased productivity of resources.

Analyzing the situation of municipal waste generated and treated, (Angheluta *et al.,* 2020) notes that the consideration of waste management systems for the reuse and recycling of waste is favorable to the environment; the technologies and energy sources used in the production of various goods influence, finally, the composition of the waste.

(Vujic *et al.,* 2015) points out that waste management systems, especially municipal ones, are developed in many countries of the European Union and they have succeeded in reducing the amount of stored waste. At the same time, they concluded that there is an important link between the waste management variables and the gross domestic product of the states, thus municipal waste disposal rates are high when GDP levels are low and vice versa.

(Castillo-Giménez *et al*., 2019a) analyzing the degree of convergence of municipal waste treatment in the EU, shows that the highest performances are recorded in the member states located in Central and Northern Europe, and the lowest performances are recorded in the Europe of East, referring especially to those that joined after the year 2000. The authors mention that an increased convergence was noted with the adoption of the Waste Framework Directive in 2008. On the other hand (Castillo-Giménez *et al*., 2019b) shows that high-income EU countries treat larger amounts of waste per capita per capita, through recycling, composting and digestion, while poorer countries deal with smaller amounts of waste per capita, through landfilling.

When we approach the issue of waste prevention and reuse or material recovery, we must also discuss the management of waste electrical and electronic equipment (WEEE), as a specific category of waste. The regulation of WEEE quantities at the level of the European Union is primarily based on Directive 2012/19/EU on waste electrical and electronic equipment (European Parliament and Council of the European Union, 2012). (Cesaro *et al.,* 2018) believes that the recovery of metals from WEEE must be a central pillar of waste management strategies, considering the various precious metals and rare earth elements that they contain.

Among the socio-economic factors that can influence the electrical waste collection rates, (Marinescu *et al.,* 2016) found that variables such as a person's age and the unemployment rate have the greatest impact. The authors consider that education or the minimum salary level do not have significant influences on WEEE collection rates. Instead, (López Malest and Gabor, 2022) considers that at the EU level, good macroeconomic predictors of the e-waste recycling rate are indicators such as the population at risk of poverty and public spending on environmental protection. A second conclusion of the two authors' study refers to Romania's position. This does not follow the European model regarding macroeconomic predictors, in its case, the population by education level (N 0-2) stands out, as a direct effect, and the other factors have an indirect influence.

3. Research methodology

The generation and treatment of waste is a current and extremely important topic for Romania, in the context of the need to comply with the environmental policies of the European Union, but also with the aim of moving from a traditional economy to a circular, modern, more efficient, and environmentally friendly economy.

To guarantee the fulfillment of the objectives and directions established at the level of the European Union, the national policy in the field of waste management pursues the interests of the European policy regarding the reduction of the resources used, of the prevention of generated waste, but also of waste classification. For this, the National Waste Management Plan was developed, considering the provisions of the Framework Directive on waste (Directive 2008/98/EC), but also the strategic objectives included in the National Waste Management Strategy.

The qualitative research of the work is based on the specialized studies on the theoretical and practical aspects in the field of waste. The knowledge of the subject treated, and its research assumed the method of economic analysis, the use of synthesis and comparison. Quantitative research completed this paper, through a statistical analysis of waste generation and treatment in Romania during 2016-2020, for which the most recent data provided by Eurostat were used.

Thus, the statistical analysis included the following points:
- ✓ The amount of waste generated in Romania (tons and kilograms per capita) in the period 2016-2020, but also compared to the average of the European Union
- ✓ The share of waste generated according to the criterion of economic activities
- ✓ The amount of waste treated in Romania (percentages and kilograms per capita) during 2016-2020
- ✓ The main waste treatment operations in Romania and compared to the European Union

4. Findings

In Romania, according to data provided by Eurostat, over 177.5 million tons of waste were generated in 2016, over 203 million tons of waste in 2018 and over 141.3 million tons of waste in 2020. More than 99% of the amount of waste generated was non-hazardous.

As can be seen in figure no.1, waste generation in Romania is far above the European Union average, being among the largest generators of waste expressed in kilograms per capita. In 2016, in Romania, 9,012 kg of waste were generated per capita (representing over 177.6% compared to the EU average), in 2018, 10,425 kg of waste were generated per capita (representing over 199.1% compared to EU average) and in 2020, 7,338 kg of waste were generated per capita (representing over 152.6% compared to the EU average).

Figure no. 1. Waste generation in Romania compared to the EU average in the period 2016-2020 (kg/capita)
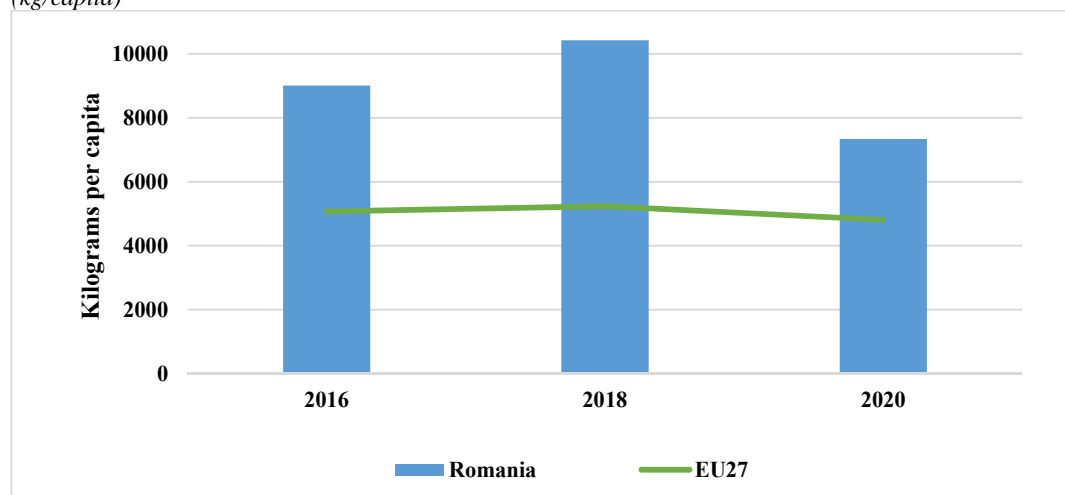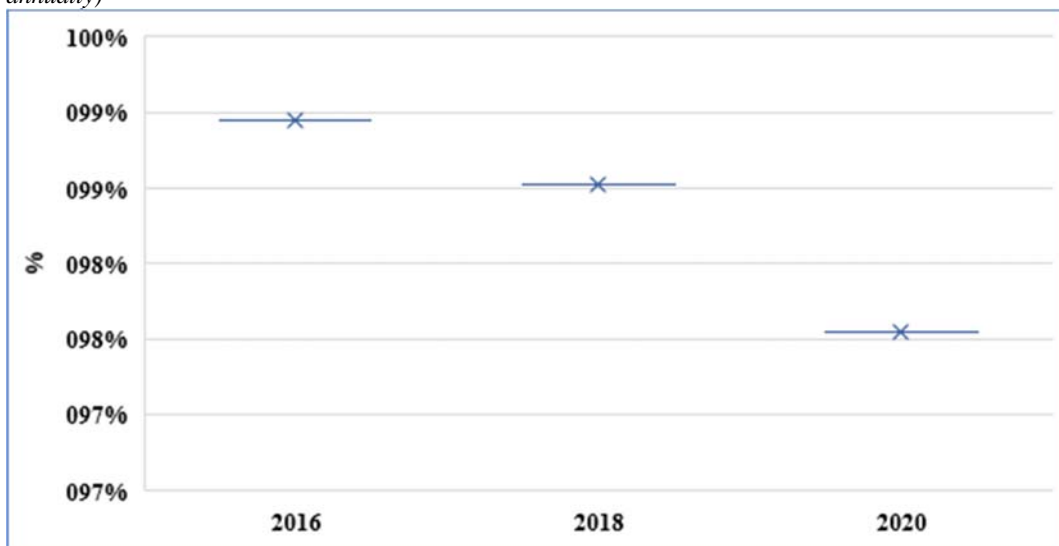

Source: Data processed by the author based on information provided by Eurostat

Based on the criterion of economic activities, according to the data provided by Eurostat, in Romania most of the waste generated was attributed to mining and quarrying (over 84.3% of the total waste generated), production (4.6% of the total waste generated) and energy (3.1% of the total waste generated). Households generate only 3% of total waste. Other economic activities represent 2.2% of the total waste generated, waste and water services have a share of 2% and constructions and

demolitions represent 0.9%.

During the analyzed period, waste treatment had significant proportions, but slightly decreasing, as can be seen in figure no. 2. Thus, if in 2016 the percentage of waste treatment was 98.95% of the total waste generated (corresponding to 8 918 kg per capita), in 2018 the share was 98.52% (corresponding to 10 272 kg per capita) and in 2020 it decreased to 97.55% (corresponding to 7 158 kg per capita).

Figure no. 2. Waste treatment in Romania in the period 2016-2020 (% of the total waste generated annually)
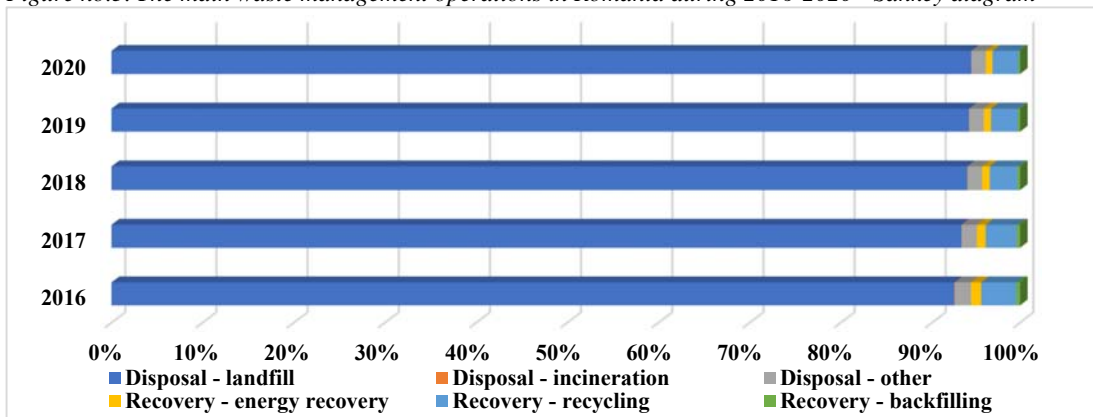

Source: Data processed by the author

At the level of 2020, most of the waste treatment operations in Romania targeted their disposal through landfill (124.5 million tons), followed by recovery through recycling (7.1 million tons) and other disposal operations (3 million tons). This means that a share of 92.45% of waste in Romania is eliminated through landfill and other specific disposal operations (such as biodegradation of waste in the soil, deep injection, release into water, etc.). In the same year, waste recovery through energy recovery (using waste as a fuel or energy generator) reached almost 2 million tons.

Comparatively, in the European Union the largest part of waste treatment operations concerned recovery through recycling (796.2 million tons), followed by disposal of waste through landfill (635 million tons) and recovery of waste through backfilling (285, 4 million tons). So, overall, at the level of the European Union, recovery and backfilling exceed the amount of waste disposed of through landfill and other disposal operations.

Figure no.3. The main waste management operations in Romania during 2016-2020 - Sankey diagram

Source: Data processed by the author based on information provided by Eurostat

According to the data provided by Eurostat, the main waste management operation in Romania based on the Sankey Diagram was landfill disposal throughout the analyzed period. At the same time, it has an increasing trend (as can be seen in figure no. 3). Disposal by incineration had a constant level, while other waste disposal operations registered slight increases. Recovery (through energy recovery, recycling, and backfilling) occupies a small part of waste management and has recorded a steady decline between 2016 and 2020.

5. Conclusions

Considering all that is mentioned in this article, we can summarize the following aspects regarding the current situation of waste generation and treatment in Romania:

- ➢ The national policy in the field of waste management must follow the directions and interests of the European policy, as constant measures are needed to reduce the consumption of resources and prevent the generation of waste.
- ➢ In 2020, more than 141.3 million tons of waste were generated, and 99% of the generated waste was non-hazardous.
- ➢ Waste generation at the national level is far above the European Union average, Romania being among the largest generators of waste expressed in kilograms per capita. Thus, 9,012 kg of waste were generated per capita in 2016 (representing over 177.6% compared to the EU average), 10,425 kg of waste per capita in 2018 (representing over 199.1% compared to the EU average) and 7,338 kg of waste per capita in 2020 (representing more than 152.6% compared to the EU average).
- ➢ Most of the generated waste was attributed to mining and quarrying (over 84.3% of the total generated waste), compared to the European Union average which placed constructions and demolitions on the first place of waste origin.
- ➢ Waste treatment had significant proportions, but slightly decreasing, from a share of 98.95% of total waste generated (corresponding to 8,918 kg per capita) in 2016 to a share of 97.55% (corresponding to 7,158 kg per capita) in 2020.
- ➢ A share of over 92% of the waste is landfilled or disposed of through specific operations (biodegradation of waste in the soil, deep injection, release into water). Comparatively, in the European Union more than 60% of waste is treated through recovery operations (recycling, backfilling, energy recovery).
- ➢ Recovery (energy recovery, recycling, and backfilling) occupies a small part of waste management and saw a steady decline between 2016 and 2020.

In conclusion, given the analysis undertaken and the observation of the evolution of the quantities of waste generated and treated, we believe that more attention is needed in this regard, by running campaigns to involve citizens and economic agents, but also by attracting greater investments in projects related to the ranking of waste, so that Romania can meet the specific objectives established by the European Union and to ensure better waste management.

In carrying out this study, we faced a series of limitations related, mainly, to the lack of more recent statistical data, but also to the lack of detailed data on the generation and treatment of waste in Romania. Future research directions may include the analysis of waste generation and treatment in certain specific areas of economic activity, of certain age categories, but also an approach to the urban-rural situation.

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