# MUNICIPAL WASTE MANAGEMENT IN THE CONTEXT OF THE CIRCULAR ECONOMY: A COMPARISON BETWEEN ROMANIA AND THE EUROPEAN UNION

**Lucia-Monica SCORȚAR**
*Babeș-Bolyai University of Cluj-Napoca, 400084, Romania*
*lucia.scortar@ubbcluj.ro*
**Alexandru CHIȘ**
*Babeș-Bolyai University of Cluj-Napoca, 400084, Romania*
*alexandru.chis@ubbcluj.ro*
**Maria-Zoica-Eugenia BALABAN**
*Babeș-Bolyai University of Cluj-Napoca, 400084, Romania*
*maria.balaban@ubbcluj.ro*

**Abstract**
*This article analyzes trends in key indicators of municipal waste management and the circular economy in Romania, compared to the European Union average, as well as the relationship between economic development, municipal waste management, and the circular economy, using official Eurostat data and data reported by the National Institute of Statistics for the period 2005–2024.*
*Descriptive statistical analysis and the Pearson correlation matrix, performed in IBM SPSS Statistics, highlighted the relationships between GDP per capita, environmental indicators, and material circularity. The results indicate a positive and significant correlation between GDP per capita and municipal waste recycling, suggesting that economic development has favored investments in recycling infrastructure. In contrast, the relationship between GDP and the rate of circular material use is negative, indicating the prevalence of a predominantly linear economic model in Romania.*
*The study found a strong association between waste generated and waste landfilled, highlighting Romania's high reliance on landfilling. Therefore, the results indicate the need to strengthen measures to integrate recycled materials into the economy to accelerate the transition to a circular economy.*

**Key words:** *circular economy; municipal waste; recycling; sustainability; waste management.*

**JEL Classification:** *Q01, Q53*

## I. INTRODUCTION

In the current context, waste management has become a major challenge for society, because of population growth and increased consumption. The European Union's strategy proposes the adoption of waste management measures to reduce the amount of waste sent to landfills, improve the quality of recycling, encourage composting, and recover energy from waste.

Municipal waste consists of all households and similar waste generated in urban and rural areas from households, institutions, commercial establishments, and businesses, as well as street waste collected from public spaces, streets, parks, and green spaces. Added to all this is construction and demolition waste resulting from interior renovations of homes, and its collection is carried out by sanitation operators.

In recent years, the European Union has implemented policies under the Circular Economy Action Plan and the European Green Deal, with the goal of achieving a circular economy by 2050. These policies include expanding eco-design requirements, promoting the right to repair, extended producer responsibility schemes, mandatory recycling targets, and measures to reduce waste from packaging and single-use plastics.

The transition to a circular economy depends directly on the efficiency of municipal waste management systems, which determines the extent to which resources are recycled and reused. In practical terms, the circular economy aims to minimize waste so that materials resulting at the end of a product's life cycle are reintegrated into the economy through recycling and reuse processes, generating added value repeatedly.

According to the National Strategy on the Circular Economy (2022), the circular economy is based on practices and solutions that encompass a wide range of strategies at various stages of the value chain. These can be grouped as follows:

- *Closing material loops*: replacing raw materials or new products with secondary materials and second-hand, repaired, or refurbished products or parts
- *Slowing material flows*: extending the durability of products through better design, maintenance, and repairs
- *Reducing material flow*: using fewer resources per product or fewer products to provide the same service to society.

A relevant example of the application of circular economy principles in Romania is the Deposit-Return System, officially launched on November 30, 2023. The deposit-return system is a mechanism used to collect and recycle reusable or recyclable packaging, designed to reduce environmental impact and encourage responsible behavior among consumers. (Scorțar, 2025, p.14)

## II. LITERATURE REVIEW

The increase in the volume of municipal waste generated across Europe has led to intensified research in this field. The literature offers numerous studies in the field of municipal waste management, which will be analyzed to identify the key factors influencing waste generation, analytical methods, and proposed solutions for its efficient management.

Thus, the study conducted by Gardinere et al. (2020) highlights a bidirectional relationship between economic growth and waste generation across EU regions, influenced also by energy consumption and R&D intensity. The authors show that traditional economic policies are insufficient for reducing waste. They emphasize economic instruments and eco-innovation that support the transition to a circular economy. In the same vein, the environmental impact of excessive consumption is analyzed by Krasulja et al. (2020). In the transition toward sustainable practices, the importance of consumer behavior - particularly that of younger generations, is highlighted; however, there are differing views regarding their actual ability to bring about the desired change without adequate environmental education.

Another important area of research in this field focuses on forecasting municipal waste generation; the study conducted by Johnima et al. (2022) highlights the key factors (population, income, and tourism) for estimating future waste volumes. The study shows that nonlinear artificial neural network (ANN) models offer higher accuracy than linear models. Building on this research, Inokon et al. (2022) demonstrate that the accuracy of the models depends on the selection of variables and waste streams. This study provides analytical tools that can support the implementation of the circular economy.

Regarding waste characterization and management, Ren et al. (2022) emphasize the need to improve existing models and conduct future research for more efficient landfill management. Along the same lines of analysis, Vaverková et al. (2026) examine the long-term impact of closed landfills, highlighting their potential for integration into green infrastructure. The approach to municipal waste composition is also found in the study conducted by Triassi et al. (2023), which highlights significant differences between types of areas with the possibility of applying differentiated management solutions.

From a sustainability perspective, Albizzati et al. (2024) criticize the EU's current circular economy indicators, which are based on recycled quantities, suggesting that they should be supplemented with economic assessments using methods such as LCA/LCC (life cycle assessment/life cycle costing). Their study reveals discrepancies in the reporting of municipal waste data. As a complement, the study by Nurzhan&co (2024) provides an overview of the use of life cycle assessment (LCA) in municipal waste management, highlighting the development of methodology and related software tools.

On the topic of sustainability, Jităreanu et al. (2023) compare the circular economy and the green economy, emphasizing the differences between them regarding resource management and the integration of environmental factors. They consider these concepts to be well-developed theoretically, but their practical application remains limited at the EU level for now. Regarding the importance of sustainability, Arp&co. (2018) analyze the contribution of tourism and aviation to the increase in plastic waste and emphasize the need for more economically efficient alternatives that reduce the negative environmental impact of this waste.

From a macroeconomic perspective, Gogonea et al. (2021) analyzes the link between sustainable development, resource efficiency, and waste generation in European countries. The cluster analysis indicates that waste generation levels vary significantly across countries, reflecting differences in consumption patterns and resource management. Building on this research, Medina-Mijangos et al. (2020) reviews scientific literature on the economic aspects of municipal waste management, particularly regarding waste-to-energy conversion.

We consider that the literature addresses the complexity of the municipal waste management system, with the system's efficiency requiring an integrated approach that applies economic and technological tools as well as environmental education for citizens.

## III. ANALYSIS OF EUROSTAT DATA: ROMANIA'S INDICATORS COMPARED TO THE EU'S

The analysis presented below aims to evaluate indicators related to municipal waste management (generation, recycling, and disposal of municipal waste), as well as to assess the material circularity indicator for Romania, compared to the European Union average. Through this analysis, we have highlighted existing gaps, as well as trends of convergence or divergence between Romania and EU member states.

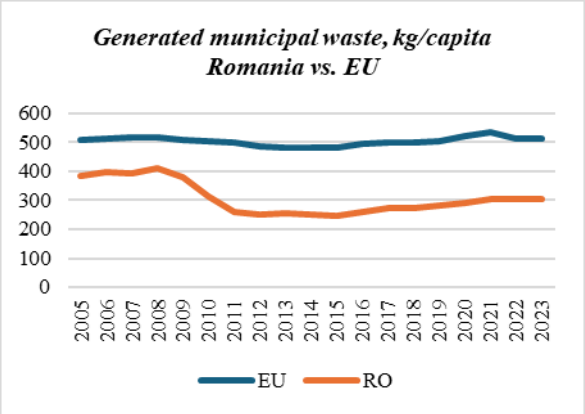


**Figure 1 – Trends in generated municipal waste (Eurostat, 2005-2023)**

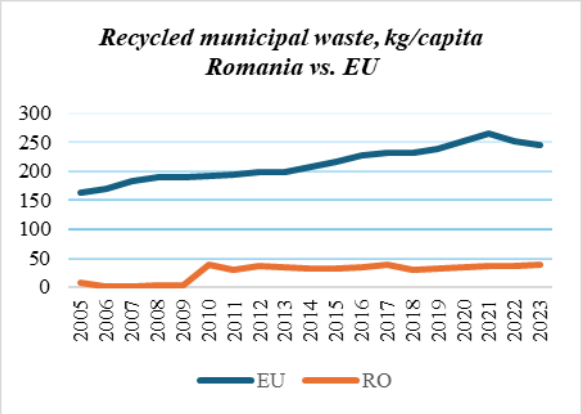


**Figure 2 – Trends in recycled municipal waste (Eurostat, 2005-2023)**

The indicator shown in Fig. 1 reflects the evolution of the amount of municipal waste generated per capita in Romania compared to the European Union average, for the period 2005-2023. In the case of the European Union, the level of waste generated is stable, ranging from 480-530 kg/capita, with a slight downward trend around 2012-2014. In contrast, the trend in Romania is more volatile. From the amount of waste generated of 380-410 kg per capita in 2005-2008, there was a sharp decline to 250 kg in 2011. After 2015, the increase becomes gradual, reaching approximately 300 kg per capita in 2023. Throughout the entire period analyzed, Romania remains significantly below the EU average, with a difference of 150-250 kg per capita.

Figure 2 analyzes the indicator reflecting the trend in the amount of municipal waste recycled per capita. It highlights a significant gap between Romania and the EU average in terms of municipal waste recycling. At the European Union level, an upward trend is observed, from 160-170 kg/capita in 2005 to over 260 kg around 2021, followed by a slight decline in recent years. This trend reflects the continuous improvement of selective collection systems and increasingly strict recycling requirements.

In Romania, the recycling rate is much lower and more unstable. In the early years (2005-2009), the figures are almost negligible, followed by an increase around 2010, when recycling reached approximately 40 kg per capita. Subsequently, the rate fluctuates between 25 and 40 kg, with a slight upward trend after 2018, reaching 35-40 kg per capita in 2023.

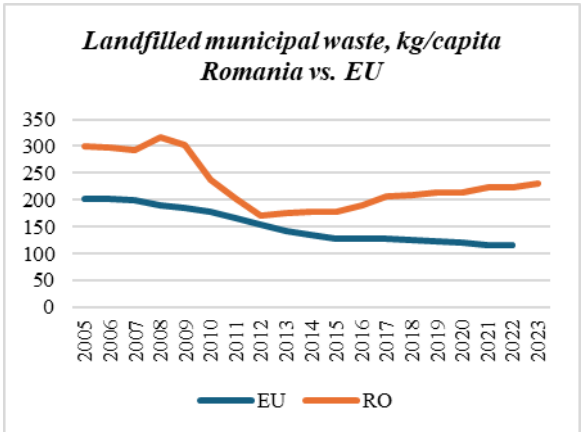


**Figure 3 – Trends in landfilled municipal waste (Eurostat, 2005-2023)**

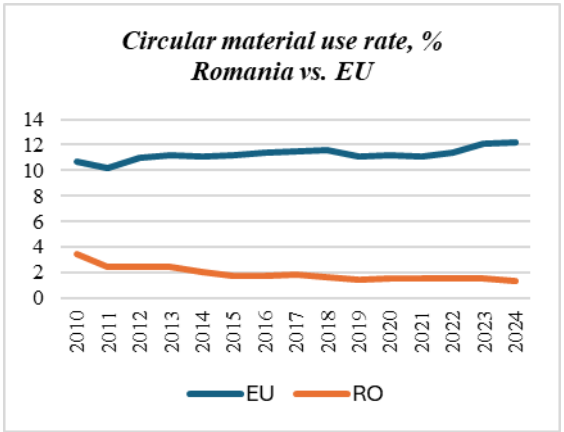


**Figure 4 – Trends in the circular material use rate (Eurostat, 2010-2024)**

The data in Fig. 3 highlight trends in municipal waste sent to landfills. The European Union has achieved visible results in reducing the amount of waste sent to landfills. However, Romania faces challenges in following a similar trajectory, requiring more effective measures in the areas of waste management and the circular economy. At the European Union level, the amount of landfilled waste is steadily decreasing from approximately 200 kg/capita in 2005 to about 120 kg/capita in 2023, reflecting the shift toward recycling. In Romania, the figures are initially much higher (290-320 kg per capita in 2005-2008), followed by a sharp decline through 2011-2012 (~170 kg per capita), only to exceed 220 kg per capita by 2023. The increase in the most recent years analyzed suggests difficulties in expanding recycling and other recovery methods, leading to a continued reliance on landfilling.

The "Circular Material Use Rate" indicator analyzed in Fig. 4 reflects the proportion of recycled materials reintroduced into the economy and serves as a key indicator of the level of circularity. An analysis of this indicator's trends reveals significant differences between Romania and the European Union average throughout the entire period analyzed, with reported data covering 2010-2024. Prior to 2010, no data for this indicator was reported for Romania.

In the case of the European Union, the values show a slight upward trend, ranging between 10.7% and 12.2%. This trend reflects moderate progress in the integration of recycled materials into the economy. In contrast, Romania records much lower values, ranging from 3.5% to 1.3%, which indicates a limited capacity to reintegrate recycled materials into economic processes, even though certain improvements have been made in the field of waste recycling.

Thus, the data analysis highlights that Romania falls below the European Union average in terms of the performance of the analyzed indicators, particularly in the circular economy, necessitating more effective strategies in the field of municipal waste management.

## IV. RESEARCH METHODOLOGY

The empirical analysis is based on statistical data for Romania, drawn from the Eurostat database, as well as data reported by the National Institute of Statistics for the period 2005-2024.

The analysis also has certain limitations. The unavailability of data for certain periods and indicators may affect the comparability between Romania and the member states of the European Union. The year 2005 was chosen as the starting point, as it is the first year for which data on Romania in this area are available.

The study uses indicators on the generation, recycling, and disposal of municipal waste (expressed in kg/capita), the circularity indicator known as the circular material use rate, and GDP per capita. Due to the varying availability of statistical series, the number of observations differs across indicators, with the analysis conducted based on the data available for each variable.

In the analysis, descriptive statistics were used to calculate the means and standard deviations for the variables (GDP per capita, municipal waste generated, recycled, and landfilled, expressed in kg/capita, as well as the material circularity rate expressed as a percentage).

Based on the Pearson correlation matrix generated in IBM SPSS Statistics, we examined the relationships between the economic indicator (GDP), environmental indicators (generated municipal waste, recycled municipal waste and landfilled municipal waste), and the circular economy indicator (circular material use rate) at the national level in Romania.

Through the correlation coefficients, one can observe the extent to which a change in one indicator is associated with a change in another indicator, highlighting both direct (positive) and inverse (negative) relationships.

## V. RESULTS AND INTERPRETATION

The descriptive analysis of economic and waste management indicators reflects important trends regarding both economic development and the performance of Romania's municipal waste management system.

The evolution of economic indicators reflects changes in the national economy (GDP growth, increased consumer spending, investment growth). At the same time, waste management indicators provide information on the system's performance (collection rate, waste recovery rate, and landfill rate).

Thus, the analysis of these indicators allows for an assessment of the relationship between economic development and environmental pressure over the period under review (2005–2024).

Using this statistical analysis, we can identify the level of data dispersion as well as the stability of the indicators over the analyzed period (2005-2024), thereby obtaining an overview of economic and environmental dynamics.

**Table 1: Descriptive analysis of indicators**

| Item | N | Minimum | Maximum | Mean | Standard deviation |
|---|---|---|---|---|---|
| *GDP_RON per capita* | 20 | 13,266 | 88,000 | 41,437.55 | 21,537.643 |
| *Generated municipal waste_kg/capita* | 19 | 247 | 411 | 306.3158 | 56.72257 |
| *Recycled municipal waste _kg/capita* | 19 | 2 | 40 | 26.7368 | 14.35596 |
| *Landfilled municipal waste_kg/capita* | 19 | 171 | 316 | 229.6316 | 48.36805 |
| *Circular material use rate (%)* | 15 | 1.30 | 3.50 | 1.9067 | .60411 |
| *Valid observations* | 14 | | | | |

Source: Own processing; SPSS data, based on Eurostat data for Romania (accessed in March 2026)

The descriptive analysis reveals the following results:

a. During the period analyzed, the average GDP per capita was 41,437 RON, ranging from 13,266 to 88,000 RON, with a standard deviation of approximately 21,537 RON, indicating significant variability in economic conditions. At the same time, the large gap between the minimum and maximum values suggests that economic development was not uniform throughout the period analyzed, highlighting the gradual transition of Romania toward a more developed economy.
b. Municipal waste generated amounted to 306.3 kg/capita/year (ranging from 247 to 411 kg, with a standard deviation of 56.7 kg), and this quantity reflects a high level of waste generation, influenced by the population's consumption patterns and economic growth in Romania. With regard to consumer habits, these refer to the way people purchase, use, and dispose of products, influencing consumption levels and the amount of generated waste.
c. Regarding waste recycling, the average amount of recycled waste was significantly lower, with an average of 26.7 kg per capita (ranging from 2 to 40 kg, with a standard deviation of 14.3 kg). However, the maximum values indicate an upward trend in recycling, reflecting a gradual improvement in recycling practices.
d. Waste disposal via landfilling remains, for the time being, the predominant method used as part of municipal waste management in Romania. The average amount of landfilled waste of 229.6 kg/capita (ranging from 171-316 kg/capita; SD: 48.3 kg) is a high figure indicating a waste management system with a high reliance on landfilling.
e. The low rate of circular use of materials averaged 1.9% (ranging from 1.3% to 3.5%; SD: 0.60%), indicating that only a small portion of materials is reused or recycled in the economy.
f. The valid number of observations for all variables was 14, as statistical data were incomplete for certain years, particularly for the circularity indicator.

Overall, these descriptive statistics suggest that, although Romania experienced economic growth during the period under review, municipal waste generation remained high, recycling showed a gradual increase, and the level of material circularity remains low. Despite these challenges, there are favorable prospects for optimizing the waste management system and strengthening the principles of the circular economy.

In our research, we propose the following hypotheses to explore the potential relationships between GDP per capita, the amount of municipal waste generated, recycled, and landfilled, as well as the relationship with the circularity indicator:

- $H_1$: There is a statistically significant relationship between GDP per capita, and the amount of generated municipal waste.
- $H_2$: There is a statistically significant positive relationship between GDP per capita, and the amount of recycled municipal waste per capita.
- $H_3$: There is a statistically significant relationship between GDP per capita, and the amount of landfilled municipal waste.
- $H_4$: There is a statistically significant negative relationship between GDP per capita and the material circularity rate.
- $H_5$: There is a statistically significant negative relationship between the amount of municipal waste generated and the amount of municipal waste recycled.
- $H_6$: There is a statistically significant positive relationship between the amount of municipal waste generated and the amount of municipal waste landfilled.
- $H_7$: There is a statistically significant negative relationship between the amount of recycled municipal waste and the amount of landfilled municipal waste.

To analyze the relationships between the indicators used in the study, we created a Pearson correlation matrix using SPSS. Correlation analysis helps to understand the interdependencies between municipal waste generation in Romania, recycling activities, waste disposal, and circular material use rate, illustrating the extent to which changes in one variable are associated with variations in another variable. Thus, both direct and inverse relationships between the analyzed indicators can be examined, as well as the strength of these associations over the period covered by the analysis.

**Table 2. Correlation matrix among the analyzed indicators**

| | | *GDP (RON per capita)* | *Generated municipal waste (kg/capita)* | *Recycled municipal waste (kg/capita)* | *Landfilled municipal waste (kg/capita)* | *Circular material use rate (%)* |
|---|---|---|---|---|---|---|
| *GDP (RON per capita)* | *Pearson Correlation* | 1 | -,403 | ,638** | -,389 | -,750** |
| | *Sig. (2-tailed)* | | ,087 | ,003 | ,099 | ,001 |
| | *N* | 20 | 19 | 19 | 19 | 15 |
| *Generated municipal waste (kg/capita)* | *Pearson Correlation* | -,403 | 1 | -,879** | ,990** | -,078 |
| | *Sig. (2-tailed)* | ,087 | | ,000 | ,000 | ,790 |
| | *N* | 19 | 19 | 19 | 19 | 14 |
| *Recycled municipal waste (kg/capita)* | *Pearson Correlation* | ,638** | -,879** | 1 | -,870** | ,231 |
| | *Sig. (2-tailed)* | ,003 | ,000 | | ,000 | ,428 |
| | *N* | 19 | 19 | 19 | 19 | 14 |
| *Landfilled municipal waste (kg/capita)* | *Pearson Correlation* | -,389 | ,990** | -,870** | 1 | -,105 |
| | *Sig. (2-tailed)* | ,099 | ,000 | ,000 | | ,721 |
| | *N* | 19 | 19 | 19 | 19 | 14 |
| *Circular material use rate (%)* | *Pearson Correlation* | -,750** | -,078 | ,231 | -,105 | 1 |
| | *Sig. (2-tailed)* | ,001 | ,790 | ,428 | ,721 | |
| | *N* | 15 | 14 | 14 | 14 | 15 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | |

Source: Own processing; SPSS data, based on Eurostat data for Romania (accessed in March 2026)

The results indicate a moderate negative correlation between GDP per capita, and the amount of municipal waste generated ($r = -0.403$; $p = 0.087$; $p > 0.05$). This result suggests that, as the level of economic development increases, the amount of municipal waste generated per capita tends to decrease slightly. In this case, no statistically significant relationship was identified between GDP per capita and the amount of municipal waste generated; therefore, hypothesis $H_1$ is not confirmed. Therefore, municipal waste generation does not depend exclusively on the level of economic development but may also be influenced by the population's consumption behavior, the degree of urbanization, the level of environmental education, or the efficiency of waste collection (expressed in terms of the coverage rate of waste management services, the amount of waste collected, and the costs associated with the collection process).

Regarding the relationship between GDP per capita and the amount of municipal waste recycled in Romania, the results show a moderately strong and statistically significant positive correlation ($r = 0.638$; $p = 0.003$; $p < 0.01$), which confirms Hypothesis $H_2$. Economic development is associated with higher amounts of recycled waste. We can conclude that Romania's economic growth trend has led to increased financial resources for investments in selective collection infrastructure, followed by investments in recycling technologies and environmental education programs for citizens to continuously improve this process.

The correlation between GDP per capita and the amount of landfilled waste is negative but statistically insignificant ($r = -0.389$; $p = 0.099$; $p > 0.05$); hypothesis H3 is not confirmed.

An important finding of the analysis is the strong negative correlation between GDP per capita and the material circularity rate ($r = -0.750$; $p = 0.001$; $p < 0.01$), which confirms Hypothesis $H_4$. This statistically significant relationship indicates that, during the period analyzed, increased economic development was associated with a decrease in the circular material use rate. This result may suggest that economic expansion was based primarily on the use of primary resources, and the integration of recycled materials into the economy did not grow at a rate like that of total material consumption. Thus, Romania's economy can be characterized by a linear model of resource use, meaning extraction, production, consumption, and disposal. This model generates economic losses through the waste of valuable resources and significant pressures on the environment, particularly through excessive landfilling, soil, and water pollution, as well as the intensive exploitation of non-renewable resources.

Regarding the relationships between waste management indicators (municipal waste generated/recycled/landfilled), the analysis highlights strong and statistically significant correlations, as follows:

- First, there is a strong negative correlation between the amount of waste generated and the amount of waste recycled ($r = -0.879$; $p < 0.001$), confirming Hypothesis $H_5$. The high value of the correlation coefficient highlights a strong inverse association between the two variables, suggesting that as the amount of waste generated increases, the level of recycled waste tends to decrease.

- The correlation between waste generated and waste landfilled is perfectly positive ($r = 0.990$; $p < 0.001$), confirming hypothesis $H_6$. This result indicates that, unfortunately, a large quantity of the waste generated in our country continues to be disposed of through landfilling.
- Similarly, the correlation between recycling and landfilling is negative and strong ($r = -0.870$; $p < 0.001$), confirming hypothesis $H_7$. This relationship reflects the logic of circular economy systems, in which recovered materials are reintroduced into the economic cycle, thereby reducing the need for disposal through landfilling. In the specific context of Romania, this relationship may reflect the gradual transition toward a more sustainable waste management system, in which recycling is beginning to gradually replace landfilling as the primary method of municipal waste treatment.

Regarding the relationship between the circular material use rate and municipal waste management indicators, the results do not reveal any statistically significant correlations:

- The correlation between the circular material use rate and generated municipal waste is very weak ($r = -0.078$; $p = 0.790$), indicating that variations in the circular material use rate are not associated with changes in the amount of waste generated per capita.
- The correlation between the circular material use rate and the amount of recycled waste is positive, but weak and statistically insignificant ($r = 0.231$; $p = 0.428$; $p > 0.05$). This result suggests that, during the period analyzed, the increase in municipal waste recycling was not accompanied by a clear increase in the rate of recycled material use in the economy.
- The relationship between the circular material use rate and the amount of landfilled waste is very weak and negative ($r = -0.105$; $p = 0.721$), indicating that the level of waste landfilling is not linked to the circularity of the economy, at least within the analyzed dataset.

Therefore, even though the recycling of municipal waste contributes to increased circularity, the effect on the overall level of circularity may be limited if the recycled materials are not reused in economic processes and do not replace new raw materials.

In practice, recycling alone does not guarantee a higher level of circular economy performance, unless the recovered materials are reused as secondary raw materials in industries. For example, materials collected for recycling may lose economic value due to poor sorting quality, insufficient recycling infrastructure, or limited market demand for recycled products. Some recycled waste may be incinerated or landfilled instead of being reintroduced into the production cycle. This highlights the fact that the rate of circular use of materials depends not only on the quantity of recycled waste, but also on the efficiency with which recycled materials replace raw materials within the economy.

## VI. CONCLUSIONS

An analysis of the statistical data shows that Romania has made some progress in terms of economic development and improvements in municipal waste recycling activities between 2005 and 2024, but the transition to a circular economy remains limited.

The statistical results show that economic development has contributed to an increase in the quantities of recycled waste and a trend toward reduced landfilling, but the economic model continues to rely on the use of primary resources and the disposal of waste through landfilling.

The correlations identified among the analyzed indicators confirm the existence of significant links between economic performance and waste management but also highlight the fact that recycling has not yet translated into a significant increase in the circular material use rate. This suggests difficulties in reintegrating recycled materials into the economic cycle and points to the need to strengthen public policies on the circular economy.

Therefore, to accelerate the transition to a sustainable economic model, Romania must invest more in recycling infrastructure, which involves expanding selective waste collection, efficient waste sorting, modern recycling facilities and technologies, developing infrastructure for the composting of biodegradable waste, as well as encouraging the use of secondary materials in the economy.

## VII. METHODOLOGICAL LIMITATION

One limitation of the study is the relatively small number of observations, which is due to the availability of statistical data reported by Eurostat. Some data series, particularly those related to material circularity, are available only for a limited number of years (2010–2024). For this reason, the results of the analysis should be interpreted with caution; however, they still provide useful insights into the relationships between economic development, municipal waste management, and the level of circularity in Romania's economy.

## VIII. REFERENCES

1. Albizzati, P.F., Foster, G., Gaudillat, P., Manfredi, S., Tonini, D. (2024) *A model to assess the environmental and economic impacts of municipal waste management in Europe*, Waste Management Journal, vol. 174, Pages 605-617 https://doi.org/10.1016/j.wasman.2023.12.029
2. Arp, A.K., Kiehne, J., Dünnweber, M., Marquardt, K., Murswiec R. (2018) *Waste management in aviation– recycling is not enough*, Ecoforum, Volume 7, Issue 2(15)
3. Departamentul pentru Dezvoltare Durabilă. Strategia Națională privind Economia Circulară, 2022. [online] Available at: https://dezvoltaredurabila.gov.ro/strategia-nationala-privind-economia-circulara-13409762
4. Eurostat 2026. Municipal waste by waste management operations [online] Available at: https://ec.europa.eu/eurostat/databrowser/view/env_wasmun__custom_20315869/default/table [Accessed 1 March 2026]
5. Eurostat 2026. Municipal waste by waste management operations [online] Available at: https://ec.europa.eu/eurostat/databrowser/view/env_wasmun__custom_20315919/default/table [Accessed 1 March 2026]
6. Eurostat 2026. Municipal waste by waste management operations [online] Available at: https://ec.europa.eu/eurostat/databrowser/view/env_wasmun__custom_20315968/default/table [Accessed 1 March 2026]
7. Gardiner, R., Hajek, P. (2020) *Municipal waste generation, R&D intensity, and economic growth nexus – A case of EU regions*, Waste Management Journal, vol. 114, Pages 124-135, https://doi.org/10.1016/j.wasman.2020.06.038
8. Gogonea, R.M., Zaharia, M., Bălăcescu, A. (2021) *Territorial disparities of waste generation and resource productivity in sustainable development*, ECOFORUM, Volume 10, Issue 2(25)
9. Inokon, A, Bitala, W., Johnima, A., Browndi I., (2022) *A Review on Prediction of Municipal Solid Waste Generation Models*, International Journal of System Management and Innovation Adoption, Volume 124.
10. Jităreanu, A.F. (2023) *Conceptual and practical differences between circular and green economy,* Ecoforum, Volume 12, Issue 2(31)
11. Johnima, A., Bitala, W., Inokon, A., Browndi I. (2022) *Improvement of a suitable model for predicting municipal solid waste production*, International Journal of Science and Information Technology Research, Volume 36.
12. Krasulja, N., Ilić, D., Marković, B. (2020) *Basic principles of circular economy with special focus on sustainable consumption "y" and "z" generation*, Ecoforum, Volume 9, Issue 2(22)
13. Medina-Mijangos, R., Seguí-Amórtegui, L. (2020) *Research Trends in the Economic Analysis of Municipal Solid Waste Management Systems: A Bibliometric Analysis from 1980 to 2019*, Sustainability Journal, 12(20), 8509; https://doi.org/10.3390/su12208509
14. Nurzhan, A.; Ruan, X.; Chen, D. (2025) *A Review of Life Cycle Assessment Application in Municipal Waste Management: Recent Advances, Limitations, and Solutions*. Sustainability, 17, 302. https:// doi.org/10.3390/su17010302
15. Scorțar, L.M., *Managementul deșeurilor. Concepte și studii de caz*, Ed. Presa Universitară Clujeană, 2025.
16. Triassi, M.; De Simone, B.; Montuori, P.; Russo, I.; De Rosa, E.; Di Duca, F.; Crivaro, C.; Cerullo, V.; Pontillo, P.; Díez, S. (2023) *Determination of Residual Municipal Solid Waste Composition from Rural and Urban Areas: A Step toward the Optimization of a Waste Management System for Efficient Material Recovery*, Sustainability, 15(18), 13378; https://doi.org/10.3390/su151813378
17. Vaverková, M.D., Koda, E., Podlasek, A., Winkler, J. (2026) *Reclamation of closed municipal solid waste landfills from the perspective of environmental risk and post-closure management: An international review*, Journal of Environmental Management, vol. 403, https://doi.org/10.1016/j.jenvman.2026.129213
18. Yinbang, R., Zhenying, Z., Man, H. (2022) *A review on settlement models of municipal solid waste landfills*, Waste Management Journal, vol. 149, Pages 79-95, https://doi.org/10.1016/j.wasman.2022.06.019