PRESSURES ON ENVIRONMENT AND HUMAN HEALTH GENERATED BY BIO-WASTE MANAGEMENT IN MARAMUREȘ COUNTY, ROMANIA

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Abstract: *Bio-waste represents the largest and most problematic category of municipal waste. Their particularity of decomposition and generation of leachate, respectively of greenhouse gases, imposed finding solutions to reduce and even stop the landfilling of this waste, encouraging the application of recycling measures. Like other developing countries, Romania has no unitary system for the separate collection of bio-waste. This leads to a very low rate of their recovery, on average 10.35% of the total biodegradable waste collected, the majority being disposed of by landfilling with an average annual rate of approx. 72.17%. The lack of a separate bio-waste collection infrastructure in Maramures County means that more than 50,000 tons of organic waste to end up in landfill dumps every year posing risks for environment factors and human health.*

1. INTRODUCTION

In Europe, bio-waste represents 30-40% of municipal waste. Between 118 and 138 million tonnes of bio-waste are generated annually [1], [2]. Bio-waste poses a risk for environmental factors, especially when landfilling, because of the leachate and methane released during the decomposition processes [3].

The European Directive 2008/98/EC set a recycling target of 65% till 2035 for municipal waste and bio-waste, implicit [4]. However, in the absence of certain legislative

obligations regarding the selective collection and valorization of bio-waste, some European countries, including Romania, have not yet created a functional infrastructure for selective collection, treatment, and valorization. Thus, a large part of the bio-waste ends up together with the residual waste in the municipal waste dumps where it generates leachate and landfill gases. This is predominantly in Europe, although there are countries such as Austria, Germany, Belgium, Holland, Italy, Slovenia, Estonia, and France that practice the selective collection and recovery of bio-waste for many years [1], [5]. The degree of valorization through composting or anaerobic digestion of bio-waste for the period 2018-2021 means an average for Europe of 92 kg/capita, and 103.75 kg/capita for France, 151.25 kg/capita for the Netherlands, 105.5 kg/capita for Lithuania, 129 kg/capita. Germany and Denmark recorded an average of 157.75 kg/capita [6]. There are some countries for which data of the year 2021 are not yet available so for the period 2018-2020, Austria had an average of 185 kg/capita, and Italy 109.33 kg/capita for the same period. Romania has fully registered an average for the period 2018-2021 of 13.25 kg/capita, while Bulgaria, for the period 2018-2020, had an average of 15.33 kg/capita. Compared to Romania, Bulgaria recorded a slightly higher amount of recovered bio-waste than Romania for the period 2018-2020 [6].

The non-existence of a unitary action in all member states for the separate collection of bio-waste entails the inability to achieve a statistical representation in line with reality.

In order to protect the environment, some countries banned the storage of bio-waste many years ago without waiting for this measure to be legally imposed at the European level. In this sense, the following can be mentioned: Austria, which banned the storage of bio-waste starting in 2009, respectively Belgium [5].

The recovery of bio-waste, either through composting or through anaerobic digestion, has a significant contribution to the circular economy, since organic waste could return to the soil as a nutrient material, respectively it could provide biogas favoring the saving of natural resources and the protection of the atmosphere.

In Romania, of the total collected biodegradable waste, most of it is disposed of on landfill dumps, registering an average of 72.17% in the period 2016-2020, the highest share being in 2017 of 74.70% [7]. Not all the amount of bio-waste is eliminated, part of it is recovered through composting. In this sense, it can be mentioned an average for the period 2016-2020 of 10.35% with the highest valorization rate of 13.37% in 2016 and the lowest in 2018 of 6.42% [7]. According to statistical data, the bio-waste recovery trend is decreasing, therefore a unitary strategy for a selective collection and recovery infrastructure throughout the country is necessary [7]. Unlike the the data presented publicly in the national environmental report, for Maramures county there is no public report for reflecting the way bio-waste is managed, the achievement of the objectives established by the County Waste Management Plan or the achievement of the objectives provided by the specific legislation [8-12].

The objective of this study is the analysis of the current bio-waste management in Maramures county and the highlighting of its pressures on the environment and human health.

2. MATERIALS AND METHOD

The method of carrying out the study is based on the collection, processing, and statistical interpretation of data and information regarding the national and county management of bio-waste and the correlation of the got data and those provided by the legislation and specialized literature.

In the previous context, data and information were requested from the national and county authorities responsible for bio-waste management and public information.

Bio-waste management in Maramureș County is the responsibility of local public authorities and the intercommunity development association, regulatory authorities, sanitation operators, etc. In this respect, based on the legislative provisions and the history of specific activities, action plans, and strategies are made, and reports containing data about the management process, attributions, and results are issued.

3. RESULTS AND DISCUSSION

According to GEO 92/2021 [13], which transposes Directive 2008/98/EC [4], bio-waste is "biodegradable waste from gardens and parks, food and kitchen waste from households, offices, restaurants, wholesale warehouses, canteens, catering companies or shops retail and comparable waste from food processing plants" (*fig. 1*); This bio-waste is part of the municipal waste category.

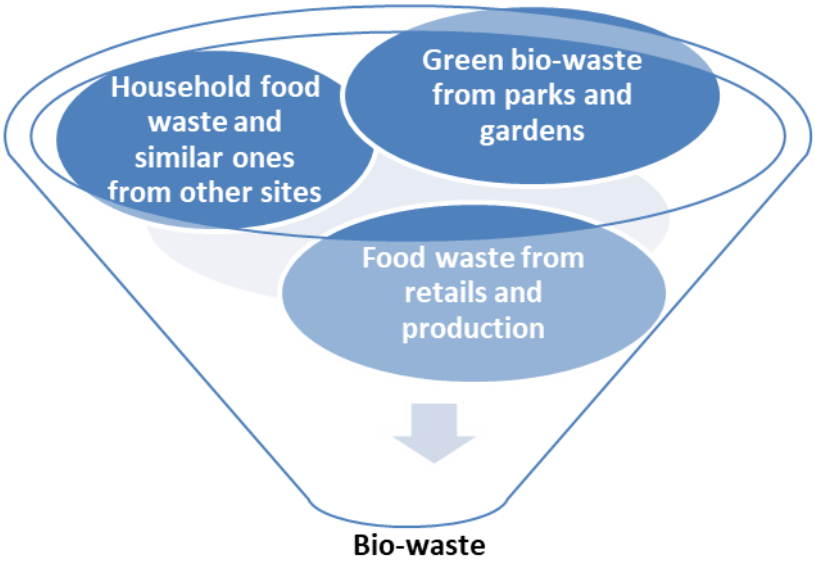

Fig. 1 Bio-waste components (according to GEO no. 92/2021 [13])

Starting in 2018, the amount of individually composted biodegradable waste was no longer considered recycled [14]. However, the data presented in the 2021 national environmental report indicate for the period 2017-2020 a decrease in biodegradable waste disposed of from 74.7% in 2017 to 69.3% in 2020. This indicates an emphasis on the recovery of this category of waste [14].

According to the National Waste Management Plan for 2020 the objective of reducing the amount of municipal biodegradable waste stored was set up to 35% of the total amount expressed gravimetrically to that one generated in 1995 [15], [16]. At the national level, this objective was not reached for the year 2020, being 43.3% [14]. To meet the target of 35% compared to 1995, Romania obtained a derogation setting the limit in 2024 [15], [17].

In Maramureș County, the data reported by the environmental protection authority do not refer to the achievement of the objective of reducing the amount of landfilled bio-waste compared to 1995, nor do they offer information on the degree of recovery or disposal thereof. Reference is made only to the quantities of bio-waste from municipal waste [8]. The graph in figure 2 expresses the dynamics of bio-waste content in municipal waste including bio-waste from household waste, and bio-waste from gardens, parks, green spaces, markets, and streets. To calculate the weight of bio-waste from gardens, parks, green spaces, and markets, respectively the streets, the quantities reported by the county authority for environmental protection were correlated with the percentages provided in PJGD MM [17].

As can be seen in *fig. 2* there is a tendency to increase the share of bio-waste in municipal waste. According to the projection from the PJGD, an 11% reduction in the amount of bio-waste generated in 2025 compared to 2020 is expected [17].

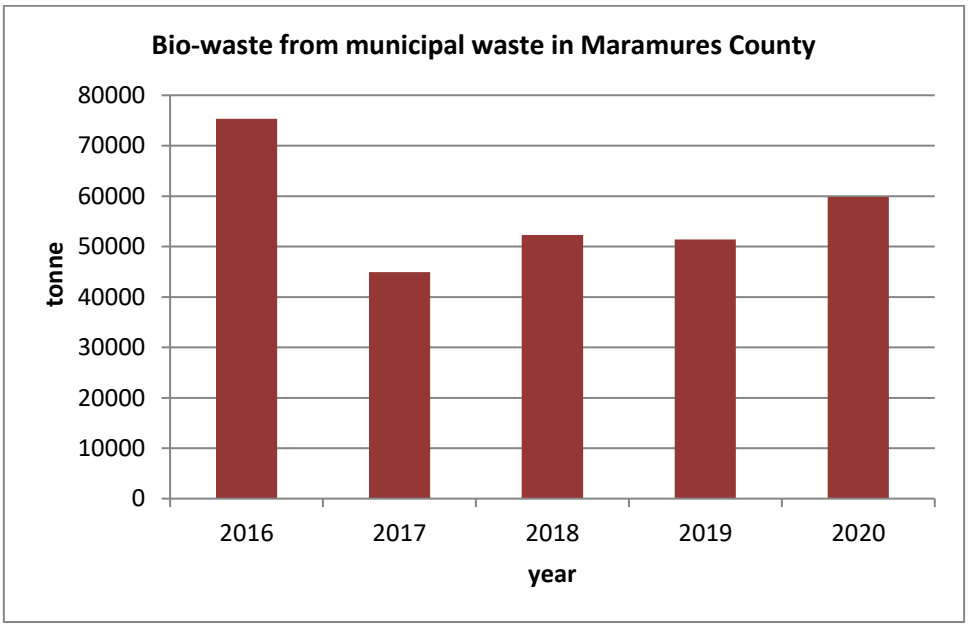

Fig. 2 Bio-waste from municipal waste in Maramures County [8])

From the data provided by CWMP MM [17], as well as by IDAIHWM MM [11], since 2010, several 82,785 composters with a volume of 400 liters each have been distributed to rural households. Thus, support is provided for the composting of bio-waste in households and implicitly a reduction in the quantities of bio-waste collected is expected. Biocomposting in households has both the advantage of reducing organic waste and obtaining compost which is a material rich in nutrients for the soil.

In Maramureș county, bio-waste is collected mixed with household waste, except in the municipality of Baia Mare where a special service belonging to City Hall collects and uses green bio-waste for composting [11] [8]. The rest of the bio-waste is collected and mixed with household waste by the sanitation operator.

Following the answers received from the authorities responsible for recording and management of bio-waste in Maramures county, some strengths, weaknesses, opportunities, and threats can be highlighted according to table 1. [7], [9-12].

Table 1 The SWOT analysis of bio-waste management in Maramures county

Strengths
• Legislative acts, strategies, and plans for waste (bio-waste) management; • Authorities and bodies responsible for the application of legislative provisions and waste (bio-waste) management; • The Integrated Waste Management System project;
Weaknesses
• Insufficient public information regarding the generation of bio-waste, the degree of its valorization or elimination, applied technologies, the achievement of performance objectives, and the reduction of the amount of landfilled bio-waste, etc; • Deficient collaboration between the authorities and responsible factors and fractured traceability of data; • Non-existence of a common, interactive, digital platform of the habilitated entities with attributions in the implementation of legislation and bio-waste management for storage information, and data reporting; • Non-existence of infrastructure for the selective collection of bio-waste from households and economic operators; the non-existence of a record of the generated bio-waste; • Collection of bio-waste mixed with residual household waste; • Non-existence of technical norms and a functional infrastructure for bio-waste recovery (composting platforms, anaerobic digestion facilities, mechanical-biological treatment facilities, etc.); • Lack of results on the efficiency of equipping households with biocomposters correlated with the situation before the application of this measure; • Non-existence of incentives for households composting;

• Non-functionality of the Integrated Waste Management Center in the Sîrbi area and implicitly of the mechano-biological waste treatment line.
Opportunities
• Financing of some projects for the infrastructure of valorization of the collected bio-waste (composting platforms, mechanical-biological treatment stations, biogas facilities, etc); • Supplementing the endowments with bio-composters for individual households in the urban areas; • Carrying out programs to educate and raise awareness among the population regarding the importance of bio-waste recycling and reducing the quantities that would be disposed of in landfills.
Threats
• Cumbersome and inefficient connections between waste generators, operators of sanitation services, and the County responsible authorities; • Lack of a common digital data platform that can serve in real-time the authorities with duties to monitor bio-waste management and the implementation of the provisions of the law; • Superficiality in providing information of public interest to citizens; • The failure of the infrastructure of separate collection and valorization of bio-waste implicitly could attract sanctions from European bodies.

3.1 Effects on the environment generated by bio-waste management

The management of bio-waste is an activity that includes several stages starting from its generation and up to its valorization or disposal. Currently, the infrastructure for the separate collection, treatment, and valorization of bio-waste is negatively affected by the lack of technical regulations [18].

According to directive 2008/98/EC [4], bio-waste must be collected separately from other categories of waste. For this, distinctly colored and labeled containers and a high frequency of picking them up are necessary because this waste decomposes easily and generates leachate and a bad smell.

As it appears both from the response received from the authorities and the environmental reports, in Maramureș county there is no infrastructure for the separate collection of bio-waste, and also not for its treatment and recovery [9-12]. A partial exception is the municipality of Baia Mare, which collects green bio-waste and uses it through composting on its platform [8], [19].

Bio-waste creates a certain discomfort right from the collection stage, because in a short time, they decompose, generating leachate and a bad smell. The same is true for final landfilling.

According to the data published in the EPA MM Environmental Report [8] corroborated with those from CWMP MM [17], over 50,000 tons of bio-waste are generated annually in Maramures county. Together with residual waste, they end up in municipal landfills where they generate leachate and greenhouse gases. The serious problem faced by Maramures county is both the non-existence of a separate bio-waste collection infrastructure and the lack of a landfill dump for storing the residual waste. This involves the temporary storage of bio-waste mixed with residual waste up to their transfer to landfilling dumps. Besides the olfactory discomfort, these bio-wastes can attract rodents, decomposing insects, or birds. By leachate, they can transfer into the aquatic environment organic matter and ammonia nitrogen compounds, and also compounds with heavy metals because leachate can constitute a corrosive and decomposition environment for certain materials with toxic contents [20]. On the other hand, landfill gas represented in particular by methane contributes to increasing the greenhouse effect and, implicitly, to climate change.

4. CONCLUSIONS

Bio-waste constitutes the largest part of the municipal waste category. It poses a risk to environmental factors and human health through its ability to decompose and generate leachate and greenhouse gases such as methane and carbon dioxide. Moreover, the presence of these organic wastes in municipal landfilling can create an environment conducive to the corrosion or decomposition of certain materials with toxic elements, facilitating their transfer into water, air, or soil deteriorating their quality, also biodiversity, and even human health.

In Maramureș County, a separate collection of bio-waste is not carried out. Only small fractions of the green bio-waste category are collected in Baia Mare city where they are composted. At the county level, there is no infrastructure for treating and valorizing bio-waste, although this had to be started given the deadline of 31st December 2023. The infrastructure involves not only the separate collection of this waste, but also recycling facilities, either through composting or anaerobic digestion. The measure proposed by the directive 2008/98/EC leads to an increase in the recovery rate of bio-waste and, implicitly, to a reduction in the amount of bio-waste that would be disposed of by landfilling. Moreover, these quantities must be lower than 35% since 2020 (2024) compared to the amount of bio-waste generated in 1995 [4]. Unfortunately, for Maramureș County, there is no database with the quantities of bio-waste generated and collected, nor with regard to the amounts of bio-waste recovered, or disposed of. There was only the mention that selective collection is not done and this waste is collected together with residual waste [8], [17]. In this case, in Maramures County, over 50,000 tons of bio-waste are disposed of yearly by landfilling with all the negative consequences for the environment and health that arise from this operation.

REFERENCES

[1] European Union, *The Bio-waste Management Challenge*, Interreg Europe, 2021.

[2] https://www.interregeurope.eu/sites/default/files/2022-04/Bio-waste%20challenge.pdf

[3] European Union (Maarten Dubois, Edward Sims, Tim Moerman, David Watson, Bjorn Bauer, Jean-Benoît Bel, Georg Mehlhart), *Guidance for separate collection of municipal waste*, 2020, EY, PlanMiljØ, ACR+, RWA and Öko-Institut

[4] https://op.europa.eu/en/publication-detail/-/publication/bb444830-94bf-11ea-aac4-01aa75ed71a1

[5] Victor Hugo Argentino de Morais Vieira and Dácio Roberto Matheus, *Environmental assessments of biological treatments of bio-waste in life cycle perspective: A critical review*, *2019*, Waste Management & Research, Vol. 37(12), pp. 1183–1198, 2019.

[6] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 *on waste and repealing certain Directives*, OJ L 312 22.11.2008, p. 3, 2008.

[7] Enzo Favoino & Michele Giavini, Scuola Agraria del Parco di Monza, *Bio-waste generation in the EU: Current capture levels and future potential, Bio-based Industries Consortium (BIC)*, 2020.

[8] https://zerowasteeurope.eu/wp-content/uploads/2020/07/2020_07_06_bic_zwe_report_bio_waste.pdf

[9] Eurostat, *Municipal waste by waste management operations, Recycling composting and digestion*, 2023.

[10] https://ec.europa.eu/eurostat/databrowser/view/ENV_WASMUN__custom_4805919/default/table?lang=en

[11] National Environment Protection Agency (NEPA), *Answer information no. 1/332/LAP/03.02.2023*, 2023.

[12] Environment Protection Agency of Maramures County (EPA MM), *Environmental Register for 2021*, 2022.

[13] Environment Protection Agency of Maramures County (EPA MM), *Answer information no. 12018/05.12.2022*, 2022.

[14] Maramures County Council (CC MM), *Answer information no. 27034/19.12.2022*, 2022.

[15] Intercommunity Development Association for Integrated Household Waste Management in Maramureș County (IDAIHWM MM), *Answer information no. 1965/20.12.2022*, 2022.

[16] Environment Protection Agency of Maramures County (APM MM), *Answer information no. 183/16.01.2023*, 2023.

[17] Government Emergency Ordinance (GEO) no. 92 of 19 August 2021 regarding the waste regime, M.Of. nr. 820/26 aug. 2021.

[18] National Environment Protection Agency (NEPA), *National Environment Report for 2021*, 2022.

[19] Government Decision no. 942 of 20 December 2017 regarding the approval of the National Waste Management Plan, (M.Of. no. 11/5 Jan. 2018.

[20] Government Ordinance no. 2 of 11 August 2021 on the landfill of waste, M.Of. no. 794/18 August 2021.

[21] Council Decision of Maramures County no. 119 of 29 June 2021 regarding the approval of the County Waste Management Plan of Maramureș.

[22] Law no. 181 of 19 August 2020 regarding the management of compostable non-hazardous waste, M.Of. no. 762/20 Aug. 2020.

[23] Council Decision of Baia Mare City. no. 95/2022 (Annex 3), *Regulation of the Organization and Operation of the Urban Environment Public Service, Baia Mare City*.

[24] https://www.baiamare.ro/Baiamare/Hotarari/2022/9%20martie/hot95_22_Anexa_3_2SPAU_ROF_2022_ACTUALIZAT.pdf

[25] Zhao Youcai, *Pollution Control Technology for Leachate from Municipal Solid Waste*, 2018.