Environmental and Climate Technologies
2024, vol. 28, no. 1, pp. 556–565
https://doi.org/10.2478/rtuect-2024-0043
https://content.sciendo.com

Biodegradable Waste Management in Georgia: Opportunities and Challenges

Ketevan TSKHAKAIA*

Akaki Tsereteli State University, 59 Tamar Mephe str., Kutaisi, Georgia

Received 30.03.2024; accepted 24.09.2024

***Abstract* – Georgia, as a developing country, faces challenges of biodegradable waste management. The promotion of the modern composting systems is the major problem for the country, given that the generation of municipal waste is characterized by increasing dynamics and, therefore, the amount of biodegradable waste is also increasing every year. By 2030, waste generation is expected to increase maximum to 1.2 % annually, which should be the cause of significant challenges for local municipalities whose duties include municipal waste management, including recycling/composting activities. According to the experience of the EU states and other developed countries, composting as one of the best approaches to recycling biodegradable waste, is still not properly developed in Georgia. The article provides an analysis of the current state of waste management, the main approaches of the existing national policy in this field, and the successful experience of centralized composting given on the example of the Kutaisi composting centre, the replication of which will significantly improve the state of biodegradable waste management in Georgia. In view of the critical analysis of existing approaches to composting and local characteristics, it is proposed to introduce models such as centralized composting and community and home composting.**

***Keywords* – Biodegradable waste; centralized composting; community composting; individual composting; green waste; recycling; separation; waste management.**

1. INTRODUCTION

Biodegradable waste management, and in particular the introduction and implementation of composting systems, are among the major problems for Georgia as well as for many other countries in the world, especially for developing countries. As a developing country, Georgia is characterized by an increase in the generation of municipal waste: therefore, the volume of biodegradable waste generated is also increasing. In accordance with the National Waste Management Strategy 2016–2030 of Georgia, the municipal waste generated in 2021 amounted to 1105 thousand tons and increased compared to the figures for 2020 (1061 thousand tons). It is fact that 60–70 % of municipal waste generation comes from cities, and the rest comes from rural areas. So, for example, of the total municipal waste generated in 2021, 768 thousand tons (69.5 %) were generated in cities, and 337 thousand tons (30.5 %) in rural areas [23].

It is worth noting that the largest part of municipal waste is organic waste (54.7 %), while plastic waste is 13.8 %, paper and cardboard (10.6 %) and other waste (Fig. 1). According to various studies, by 2030, waste generation is expected to increase from 0.6 % to 1.2 % annually, which should be the cause of significant challenges for national and local

* Corresponding author.
E-mail address: ketevan.tskhakaia@atsu.edu.ge

authorities, especially local municipalities, whose duties include municipal waste collection and transportation as well as the implementation of separate waste collection systems [23].

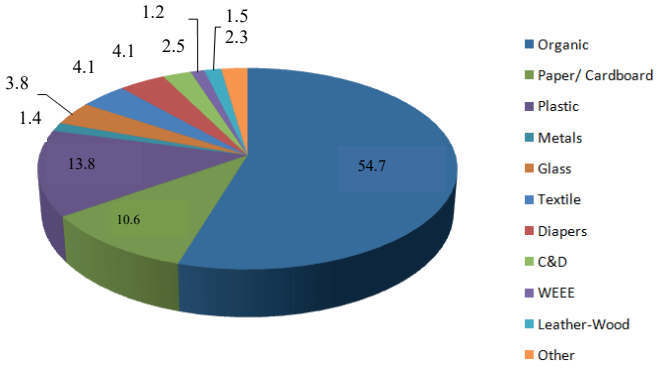

Fig. 1. Composition of solid municipal waste in Georgia, percentage, % [23].

The National Waste Management Strategy of Georgia 2016–2030, which was adopted in 2016 and updated in 2021, provides for the introduction of modern approaches to municipal waste management and the provision of waste prevention and recycling policies. Four new strategic objectives to address new challenges were added to the already existing ones of the National Waste Management Strategy of Georgia. One of the new strategic objectives is the creation and implementation of biodegradable waste collection and treatment systems.

The National Waste Management Strategy 2016–2030 also aims to introduce the best international experience when developing a waste management system in Georgia - through the step-by-step convergence with the main objectives of the European waste management policy.

Composting as a biodegradable waste processing technology is widely used in developed countries to reduce the negative environmental impacts caused by improper waste management. For example, 70 % of municipal bio-waste was sent for composting in the EU27 in 2022, with 30 % sent for anaerobic digestion, an amount equivalent to 17 % of the total municipal solid waste fraction [29]. The EU has set a target of 60 % for reuse and recycling (including composting) of municipal waste by 2030. Germany is the leading country in bio-waste management. Germany collects more than 14 million tons of bio-waste per year, followed by Italy with 6.5 million, and France with 4.6 million tons of bio-waste [29].

Unlike developed countries, most municipal waste in Georgia, including biodegradable waste, is disposed of at open dumping or landfill sites. The disposal of untreated biodegradable waste in open landfills has indisputable impacts at the environment. In this case composting of the biodegradable waste is one of the best options to reduce the amount of the waste being directly transported to the landfills.

The article discusses the potential of one of the important approaches to managing biodegradable waste – composting in Georgia – and the perspective of composting capacity development, based on the experience of developed countries, especially the European Union, and a critical analysis of the current situation in Georgia. For a country like Georgia, which is still characterized by mixed municipal waste collection and disposal at open landfills, rates of separate collection and recycling (including composting) are low [26]. Thus, it is critically important to implement modern waste management approaches, in particular, composting of biodegradable waste, taking into account local conditions and needs.

2. METHODS AND METHODOLOGY

A case study analysis of the experiences of some developed and developing countries on the introduction and implementation of biodegradable waste composting was used, in particular, in the composting of municipal waste generated in urban and rural areas. A comparative analysis of existing environmental, economic and social challenges made it possible to study different approaches and types of composting and the possibilities of their use, especially arising from the challenges of developing countries.

The article deals with the issues of composting biodegradable waste as their recycling. In this regard, the definition of such biodegradable waste is important, as well as the definition of terms such as municipal waste, bio-waste, etc., since there are certain features associated with the definitions of these terms in different countries. Municipal waste contains a large amount of biodegradable waste. Thus, the composition of municipal waste and the quantitative content of different fractions are important input for the management of municipal waste, including biodegradable waste, both at the national and local levels. Biodegradable waste, which is contained in municipal waste, is of specific interest in our case. For a country such as Georgia, which aspires to bring the field of waste management closer to the EU policy in this direction, it is relevant to identify and implement acceptable and effective approaches to biodegradable waste management.

For this purpose, the experience of EU member states and other developed countries, studies conducted by various institutions and authors have been studied. The study of the existing experience of biodegradable waste management in Georgia was also used. Based on comparisons and critical analysis, adequate conclusions were made, in particular, identification of acceptable methods of biodegradable waste management in the country and development of recommendations, the use of which will help increase the potential of biodegradable waste recycling/composting at the municipal level.

3. RESULTS

3.1. Definitions

Biodegradable waste is one of the components of municipal waste in Georgia. And, as shown below, biodegradable waste makes up the largest volume of municipal waste. Practically, the management of biodegradable wastes and the approaches used, largely determine the municipal waste management policy.

For adequate analysis and conclusions, it is necessary to define and compare the basic terms used in different documents, such as municipal waste, biodegradable waste, and bio-waste.

According to the Waste Management Code of Georgia, municipal waste is defined in the following way: “household waste, as well as other waste that are similar in characteristics and composition to household waste” [22]. The Waste Management Code does not provide more detailed information about the composition of municipal waste, which, we believe, in turn provides the possibility of inadequate representation, and is one of the important shortcomings of this document.

Usually, the municipal waste covers waste from “households, including bulky waste, similar waste from commerce and trade, office buildings, institutions, and small businesses, as well as yard and garden waste, street sweepings, the contents of litter containers, and market cleansing waste if managed as household waste” [18]. This definition is typical for the municipal waste generated in developing countries.

As a rule, municipal waste is defined as domestic, garden, commercial, and small-scale industrial waste by the different documents and authors [17]–[20].

In our opinion, the following definition of municipal waste, such as "waste produced by residential, commercial, and public services sectors that is collected by local authorities for treatment and/or disposal in a central location" [21], clearly describes the source of municipal waste and the entities responsible for its disposal.

Based on the comparisons and analysis, the definition of municipal waste, which complies with the Directive 2008/98/EC on waste [24], provides a complete representation of the sources of municipal waste generation and its composition. In particular, municipal waste includes all types of waste (paper and cardboard, glass, metals, plastics, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture) mixed or separately collected from households or from other sources. The Directive expressly states that "municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste" [24].

In our opinion, since the mentioned definition of household waste in the Waste Management Code of Georgia cannot give a complete picture of municipal waste, it is necessary to remove the definition of household waste from this document, where it is indicated that "household waste – waste generated by households", and use only the term "municipal waste" as it is accepted in the EU Directives.

According to the Waste Management Code of Georgia, biodegradable waste is waste that is subject to anaerobic or aerobic decomposition, including food/animal feed waste, garden/park waste, paper, and cardboard [22]. According to this definition, biodegradable waste includes organic waste and paper/cardboard.

"Biodegradable waste" according to the Directive on the landfill means any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard [19]. These two definitions are identical, which is due to the obligations under the EU-Georgia Association Agreement, which Georgia has committed to in 2014, which allows for adequate comparisons. It should be noted here that this gives an opportunity to learn about the experience of the European Union countries in the management of biodegradable waste and to introduce the best practices in Georgia.

In terms of waste composting, the definition of bio-waste is also important. It should be noted here that bio-waste is not defined in the Waste Management Code of Georgia and the National Waste Management Strategy. An adapted version of bio-waste new definitions according to Article 3 of Directive 2018/851 amending Directive 2008/98/EC are: "bio-waste" means biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers, and retail premises, and comparable waste from food processing plants" [24].

Bio-waste consists of two fractions of biodegradable waste, particularly park and garden waste (which we call green waste) and kitchen waste (food waste) (Table 1). As the analysis of existing sources shows, these two fractions of bio-waste represent the largest share of municipal waste [6], [11], [15], [16], [25]. The difference between biodegradable waste and bio-waste is that biodegradable waste also includes paper and paperboard and forestry residues (bark, wood residues). It should be noted here that such types of biodegradable wastes as waste from agriculture, wastes from the food and beverage industry, forestry residues do not belong to the category of municipal waste, although similar approaches to municipal wastes can be used for their recycling/composting.

TABLE 1. BIODEGRADABLE WASTE AND BIO-WASTE COMPARISON

Type of waste	Biodegradable waste	Bio-waste
Garden waste	Applicable	Applicable
Food and kitchen waste	Applicable	Applicable
Paper and paperboard	Applicable	N/A
Commercial food waste (waste from markets, catering waste) [25]	Applicable	Applicable
Forestry residues (bark, wood residues) [25]	Applicable	N/A
Waste from agriculture [25]	Applicable	Applicable
Wastes from the food and beverage industry [25]	Applicable	Applicable

3.2. Current State of Biodegradable Waste Management and Composting in Georgia

In general, waste management, including biodegradable waste management, is one of the challenges for Georgia as a developing country. In relation to the waste management sector, the country has made a number of commitments under the EU-Georgia Association Agreement. One of the commitments was also the development of a biodegradable waste management strategy for 2019, instead of which a new Objective 12 "Creation and implementation of biodegradable waste collection and processing systems" was added to the National Waste Management Strategy in 2021 [23]. Regarding biodegradable waste management, the country's goal is to reduce the landfilling of biodegradable waste.

It is also worth noting the challenges that exist in the management of biodegradable waste in Georgia [23]:

- Establishing and implementing modern systems of biodegradable waste management in the country;
- Adoption of biodegradable waste collection, composting, and energy recuperation technologies;
- Capacity-building of the country's biodegradable waste management.

According to the National Waste Management Strategy 2016–2030 of Georgia, biodegradable waste makes up about 65 % of municipal waste (54.7 % organic waste and 10.6 % paper and cardboard). So far, the largest share of biodegradable waste generated in the country is still placed in landfills, which, in turn, is a source of gas emissions from landfills. It should be noted that in 2015, emissions from municipal waste disposal accounted for 67 % of the Waste Management sector's greenhouse emissions. The waste management sector accounted for approximately 8 % of the country's total greenhouse emissions in 2015 [27].

Georgia is facing certain challenges related to climate change. In particular, Georgia undertakes an unconditional commitment to reduce its national greenhouse gas emissions to 35 % below the 1990 level by 2030. Georgia's long-term vision for the waste sector related to climate change strongly focuses on waste reduction and recycling, including the composting of the biodegradable waste [27]. It is estimated that emissions from the waste sector will be reduced by approximately 150 $GgCO_2e$ by 2030, which should be achieved by introducing and implementing composting activities.

Even from the analysis of the composition of municipal waste, it can be seen that Georgia has a large composting potential. The municipalities of the country need to introduce proven systems of composting biodegradable waste, as indicated by various studies [28]. Today, only two composting enterprises operate in the country, one of the most successful of them is the Kutaisi Composting Centre. The second composting plant is located in eastern Georgia, in

the Marneuli municipality. Home (individual) composting has not yet received sufficient distribution in the country. Although each household generates a large amount of food waste, which is biodegradable and subject to composting, only a small portion of the population is aware of composting. One of the reasons for this is insufficient public awareness of the benefits and methods of composting. For example, according to the results of one of the surveys [28], 27% of respondents are willing to start composting if they have information about the approaches of the home (individual) composting.

3.3. Green Waste Composting in Kutaisi, Georgia

In 2021, the Kutaisi composting centre, intended for composting green waste generated in the city, was put into operation. The composting area and auxiliary warehouses are located in a closed-type building with an area of 3024 m^2. The building parameters are 84.00×36.00×10.76 m. The building consists of the following areas: green waste reception – shredding area, compost storage area (including screening operation), composting area, and directly for the composting process, which includes aerobic composting in windrows. The length of each windrow is 64 m, and the width is 3 m. The composting centre is equipped with devices such as: a shredder, a turner (with a tractor), a screen, and so on. The projected production capacity of the Kutaisi composting centre is 2000 tons of ready compost per year. The establishment of the Kutaisi composting centre was made possible thanks to the support of the EU JOP Black Sea Basin within the framework of the Waste Free Rivers for a Clean Black Sea project.

Fig. 2. Kutaisi composting centre for green waste.

The Kutaisi Composting Centre is one of the first and large-scale composting enterprises in Georgia, where green waste (tree branches, grass, leaves) is processed/composted. As a result of the functioning of the Kutaisi Composting Centre, the amount of municipal waste disposed of at landfill decreased. In particular, in 2022, approximately 15 % less municipal waste was placed at landfill than in 2020 Fig. 3, which is due to the commissioning of the composting centre in 2021.

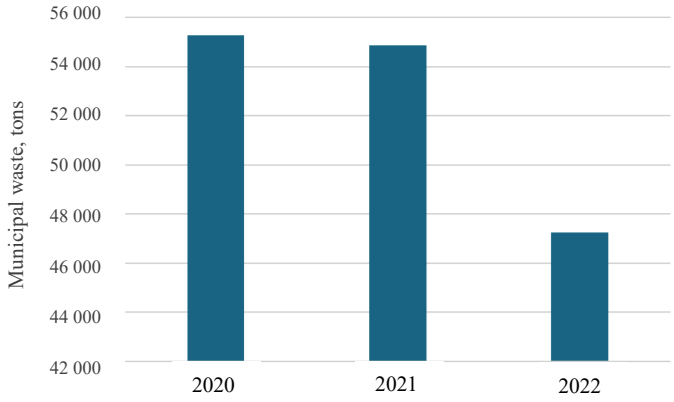

Fig. 3. Municipal waste collection and disposal in 2020-2022, Kutaisi, Georgia.

3.4. Composting Models

Composting is seen as a means to achieve the ambitious targets of the European Union for recycling and landfilling of municipal waste by 2025 and 2035 [7]. Composting is among the most acceptable methods in biodegradable waste management practice [1]–[6], [12]–[14], especially for developing countries where composting systems have not yet been properly established. Thus, it is necessary to focus on those models of composting that have already been tested in other countries. In particular, these are: centralized composting, home (or individual) composting, and community composting [10], [11]. The features and applications of each of these models are listed in Table 2**.**

TABLE 2. COMPOSTING MODELS AND CHALLENGES

Type of composting	**Centralized composting**	**Community composting**	**Home composting**
Compostable biodegradable waste	Food waste, garden waste, wood chips and, to some extent paper	Food waste, yard and garden waste, vegetable waste	Kitchen waste, yard waste
Applicable to	Municipalities, cities	Schools, universities, community gardens, farms, parks, and other spaces in urban and rural areas	Households
Benefits	Significant reduction of municipal waste sent to landfill sites. Reduction of municipal costs for waste transportation and disposal. Reduction in negative impact on the environment. Reduction in greenhouse emissions The production of compost	Reduction of household waste. Reduction of environmental pollution. Community engagement. The production of compost, which is used for community needs.	Reduction of municipal waste. The production of compost, which is used for own needs.

Centralized composting is effective in urban or rural areas where large amounts of biodegradable waste are generated [8], [9]. For example, in Georgia, the centralized

composting model is applicable for large cities, where the generation of municipal waste exceeds 40 thousand tons per year. Centralized composting can also be used if the resources of several municipalities are combined. The example of a successful experience of centralized composting is the Kutaisi Composting Centre, which was noted above.

Community composting can be applicable to rural, large-scale farms, that produce vegetables and fruits in large quantities. As is known, the production of agricultural products generates a large amount of bio-waste, which in many cases ends up in landfills, having a negative impact on the environment and climate.

Home composting is the cheapest and most effective method that can be used individually without much effort [5], [6]. In Georgia, home composting is not popular.

4. CONCLUSION

Georgia has committed itself [23], [27] to contributing to the introduction of modern systems in biodegradable waste management, such as composting.

The study shows that composting, as one of the best approaches to recycling biodegradable waste, is still not properly developed in Georgia. It is possible to name only one successful experience of municipal green waste composting, such as Kutaisi Composting Centre, which was established within the framework of the EU JOP "Black Sea Basin" in Georgia.

By implementing composting, it is possible to significantly reduce the quantity of municipal waste disposed of at landfills, with its environmental, social, and economic benefits.

The benefits of composting as one of the proven methods of recycling biodegradable waste are as follows:

- reducing the volume of landfilled waste;
- reduction of greenhouse gas emissions;
- obtaining humus-like material (compost), which, according to its characteristics, is used in agriculture, landscaping works, etc.

Using compost as an end product of the composting process also provides significant benefits. In particular, the use of compost usually improves the physical, biological, and chemical properties of soil, which is an important factor for crop production.

Among the biodegradable waste composting approaches, it is recommended to use systems such as: centralized composting, community composting, and home (individual) composting.

A centralized composting method can be used in municipalities where a large amount of biodegradable waste is generated. It is especially favourable in regions where the agricultural sector is developed and large amounts of green waste are generated. The Kutaisi Composting Centre is a good example of a centralized composting system. As practice shows, such large-scale composting is particularly effective for green waste composting. The experience of the Kutaisi Composting Centre can be successfully used by municipalities and villages where not only green waste, but also the so-called food waste is generated in large quantities. Similar composting centres should be recommended for all municipalities of Georgia, taking into account that climatic conditions and the field of economic activity (mostly agribusiness) create favourable factors for the introduction and implementation of centralized composting.

Along with centralized composting approaches, for a country like Georgia, it is promising to use decentralized approaches such as community composting and home (individual) composting.

It is promising for Georgia to introduce community composting approaches that offer an optimal scheme for communities to get the maximum benefits of their potential. Community composting should be actively used in small villages and populated areas. It would be

beneficial to use such approaches in agricultural farms, where a large volume of plant waste is generated as a result of the production of vegetables and greens. For example, only in Tskaltubo municipality (Georgia), there are more than 1000 agricultural farms that produce vegetables and greens for domestic and foreign markets. The own compost production will not only reduce the waste disposal costs, but the resulting compost can be used as a natural fertilizer, taking into account all the available benefits.

Home composting is an approach that requires minimal effort from households. However, the use of individual composting methods requires certain knowledge and skills of good composting practice.

Composting is an approach used in the field of biodegradable waste management that has the greatest potential in Georgia and can make a significant contribution to both economic development and the protection of the social and natural environment. By implementing different approaches to composting in the country, it will be possible to reduce 40–50 % of waste placed in landfills, and simultaneously, waste management costs will be effectively spent and, what is important, the product obtained from composting will be used for the production of new products, which will be a tangible benefit in the circular economy.

REFERENCES

[1] Álvarez-Alonso C., Pérez-Murcia M. D., Sánchez-Méndez S., Martínez-Sabater E., Irigoyen I., López M., Nogués I., Paredes C., Orden L., García-Rández A., Bustamante M. A. Municipal Solid Waste Management in a Decentralized Composting Scenario: Assessment of the Process Reproducibility and Quality of the Obtained Composts. *Agronomy* 2024:14(1):54. https://doi.org/10.3390/agronomy14010054

[2] Hassan N. Y. I., Badawi E. Y. M., Mostafa D. E. A. S. Composting: an eco-friendly solution for organic waste management to mitigate the effects of climate change. *Innovare Journal of Social Sciences* 2023:11(4):1–7. https://doi.org/10.22159/ijss.2023.v11i4.48529

[3] Ahmad A., Sur S. Biodegradable solid waste management by microorganism: Challenge and potential for composting. *International Journal of Recycling of Organic Waste in Agriculture* 2023:12:735–745. https://doi.org/10.30486/IJROWA.2023.1958655.1465

[4] Cao X., Williams P. N., Zhan Y., Coughlin S. A., McGrath J. W., Chin J. P., Xu Y. Municipal solid waste compost: Global trends and biogeochemical cycling. *Soil & Environmental Health* 2023:1(4):100038. https://doi.org/10.1016/j.seh.2023.100038

[5] Margaritis M., Dimos V., Malamis D., Loizidou M. An experimental investigation of the composting process in an innovative home composting System: The influence of additives. *Cleaner Materials* 2023:8:100185. https://doi.org/10.1016/j.clema.2023.100185

[6] Rao J. N., Parsai T. A comprehensive review on the decentralized composting systems for household biodegradable waste management. *Journal of Environmental Management* 2023:345:118824. https://doi.org/10.1016/j.jenvman.2023.118824

[7] Oliverı L. M., Arfò S., Matarazzo A., D'Urso D., Chıacchıo F. Improving the composting process of a treatment facility via an Industry 4.0 monitoring and control solution: Performance and economic feasibility assessment. *Journal of Environmental Management* 2023:345:118776. https://doi.org/10.1016/j.jenvman.2023.118776

[8] Tansengco M. L., Herrera D. L., Tejano J. C., Esguerra R. L. Development of a Small-Scale composter and its Application in Composting of Biodegradable Waste Generated from a Government Institution. *Asian Journal of Biological and Life Science* 2016:5(1):21–27.

[9] Stejskál B. Bio-waste composting as a part of rural development. *Infrastructure and Ecology of Rural Areas* 2010:11:5–13.

[10] Kawai K., Liu Ch., Gamaralalage P. J. D. CCET Guideline Series on Intermediate Municipal Solid Waste Treatment Technologies: Composting. UNEP 2020. [Online]. [Accessed 10.04.2024]. Available: https://wedocs.unep.org/20.500.11822/33737

[11] Sulewski P., Kais K., Goła´s M., Rawa G., Urba´nska,K., Was A. Home Bio-Waste Composting for the Circular Economy. *Energies* 2021:14(19):6164. https://doi.org/10.3390/en14196164

[12] Ayilara M. S., Olanrewaju O. S., Babalola O. O., Odeyemi O. Waste Management through Composting: Challenges and Potentials. *Sustainability* 2020:12(11):4456. https://doi.org/10.3390/su12114456

[13] Melnyk O., Scliar V., Sabadash S., Butova V. EU Municipal Organic Wastes Management and Its Implementation Prospects in Ukraine. *Environmental and Climate Technologies* 2021:25(1): 205–221. https://doi.org/10.2478/rtuect-2021-0014

[14] Khatiwada D., Golzar F., Mainali B., Devendran A. A. Circularity in the Management of Municipal Solid Waste – A Systematic Review. *Environmental and Climate Technologies* 2021:25(1):491–507. https://doi.org/10.2478/rtuect-2021-0036

[15] Giacomazzi M., Giavini M., Körner I., Leifert I., Walk S. Guidance on Separate Collection. The untapped potential and steps forward for separate collection of household food waste for high-quality recycling. European Compost Network, 2022. [Online]. [Accessed 10.04.2024]. Available: https://www.compostnetwork.info/download/ecn-guidance-on-separate-collection/

[16] Dubois M., Sims E., Moerman T., Watson D., Bauer B., Bel J.-B., Mehlhart G. Guidance for separate collection of municipal waste. Luxembourg: Publications Office of the European Union, 2020. https://doi.org/10.2779/691513

[17] Kushwaha A., Hans N., Badruddin I. J., Oh W.-G., Shukla R., Goswami L., Kim B. S. Polyhydroxyalkanoates production from biowastes: A route towards environmental sustainability. *Bio-Based Materials and Waste for Energy Generation and Resource Management*, Elsevier, 2023:5:143–182. https://doi.org/10.1016/B978-0-323-91149-8.00013-2

[18] Municipal waste (indicator). OECD 2024. https://doi.org/10.1787/89d5679a-en

[19] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste. *Official Journal of the European Union* L 182, 16/07/1999.

[20] Malinauskaite J., Jouhara H., Czajczyńska D., Stanchev P., Katsou E., Rostkowski P., Thorne R. J., Colón J., Ponsá S., Al-Mansour F., Anguilano L., Krzyżyńska R., López I. C., Vlasopoulos A., Spencer N. Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe. *Energy* 2017:141:2013–2044. https://doi.org/10.1016/j.energy.2017.11.128

[21] UN data. [Online]. [Accessed 10.04.2024]. Available: https://data.un.org/Glossary.aspx?q=Municipal+Wastes

[22] Waste Management Code of Georgia. [Online]. [Accessed 10.04.2024]. Available: https://matsne.gov.ge/en/document/view/2676416?impose=parallelEnRu&fullscreen=1&publication=8

[23] National Waste Management Strategy of Georgia 2016-2030 and National Waste Management Action Plan 2022-2026. [Online]. [Accessed 10.04.2024]. Available: https://rec-caucasus.org/wp-content/uploads/2022/12/National-Waste-Management.pdf

[24] Directive (EU) 2018/851 of the European Parliament and of the Council amending Directive 2008/98/EC on waste. *Official Journal of the European Union* 2018: L 150/109

[25] Saveyn H., Eder P. End-of-waste criteria for biodegradable waste subjected to biological treatment (compost & digestate): Technical proposals. Luxembourg: Publications Office of the European Union 2014:308.

[26] Chachkhiani M., Allesch A., Reichenbach J., Huber-Humer M. Formal and informal solid waste management in Kutaisi, Georgia: A status quo report based on material flow analysis. *Waste Management & Research: The Journal for a Sustainable Circular Economy* 2023:41(4):848–859. https://doi.org/10.1177/0734242X221135261

[27] Georgia's 2030 Climate Change Strategy (Mitigation), 2021. [Online]. [Accessed 10.04.2024]. Available: https://mepa.gov.ge/En/Files/ViewFile/50123

[28] A report on the current challenges and needs of separate waste collection in the municipalities of Imereti region. 2023:88. [Online]. [Accessed 10.04.2024]. Available: https://www.asocireba.ge/files/Speqtri_Waste_Separation_Imereti.pdf

[29] Gilbert J., Siebert S. ECN Data Report 2022. Composting and Digestate for a Circular Economy. Overview of Bio-waste Collection, Treatment & Markets Across Europe. European Compost Network, 2022. [Online]. [Accessed 10.04.2024]. Available: https://www.compostnetwork.info/wordpress/wp-content/uploads/ECN-rapport-2022.pdf