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Recycling of municipal waste in Slovak cities

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Abstract. Among the most urgent topics within waste management policy is the gradual transition of the economy from a linear model towards a circular economy with a more sustainable way of using resources. The European Union has responded to these changes by passing new legislation and ambitious targets so that all member states can quickly work towards achieving a greener and more sustainable Europe. However, the starting position for achieving the desired goals differs significantly from one country to another. In this paper, we therefore looked at the position of Slovakia in relation to selected waste management indicators, and at the measures taken so far. Moreover, since waste management falls under one of the many public benefit services provided under the remit of local governments, we also monitored the specific contribution of Slovak cities to the newly established trend of waste management in the country.

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1. Introduction

Waste management is currently one of the most widely discussed topics in environmental policies, both globally and at the EU level. Every year, people burden the planet with about 2 billion tonnes of municipal waste, with the EU contributing about 250 million tonnes, which represents almost 0.5 tonnes of waste *per capita* (Eurostat). At the same time, the trends of a highly consumerist society are encouraging more and more waste production. Although this is not a recent problem – the issue of increasing amounts of waste first resonated in the early 1970s – international cooperation in this field intensified only in the 1990s (Alwaeli, 2010). This raises the question of effective waste management and, in particular, its recovery from the perspective of environmental sustainability and economic profitability. The response to today's most serious challenges (including the unsustainability of prevailing patterns of production, consumption and waste generation) is suggested by a series of legislation, documents, programmes and strategies that summarise commitments and ambitious goals (e.g. *Agenda 2030 for Sustainable Development, EU Circular Economy Action Plan, Sustainable Europe by 2030, Environmental Action Plans and Strategies of the Member States*, and others). The EU stands out for its recycling targets (among others), which require a recycling rate in EU member states of two thirds by 2035.

It is obvious, however, that the starting point for achieving these ambitious goals differs significantly from one country to another. It is therefore appropriate to speculate whether and when all these milestones will be achieved (if at all). In addition, even within the member states, different approaches and effects of waste management can be observed across regions, municipalities and cities. In this paper, we aim to evaluate the position of Slovakia with respect to recent waste management challenges, and provide a further detailed look at the level of recycling of municipal waste in cities.

We focus our attention on:

a) the rate of recycling of municipal waste in Slovakia in relation to the newest EU recycling targets;

b) the current level of recycling in Slovak cities, as well as the measures taken and their consequences.

2. Materials and research methods

The growing demand for efficient waste management has also stimulated an increase in interest across the scientific spectrum. On the one hand, we can find research dealing with the theoretical concept of waste management and new emerging trends in this respect, such as zero-waste or circular economy (Zaman, 2016; Korhonen et al., 2018; Grdic et al., 2020). Attention is also paid to: the evaluation of individual countries in relation to the fulfilment of waste management objectives (Alwaeli, 2010; Končálová, Dubcová, 2010; da Cruz et al., 2014; Struk, 2017; Rusko, Hrabčák, 2014; Štofová, 2017; Stričík et al., 2019); case studies reflecting on existing waste management schemes (Bohm et al. 2010; Bosák, 2017; Ferronato et al. 2019); and the design of new optimisation models of waste management, from both an economic and environmental point of view (Beigl et al., 2008; Anghinolfi et al., 2013; Anagnostopoulos et al., 2015; Rigamonti et al., 2016; Kolekar et al., 2017). Using the existing range of theoretical and methodological studies, we analysed the position of Slovakia, paying special attention to Slovak cities in terms of waste production and the recycling of municipal waste, the overall urban contribution to meeting EU recycling targets, and the streamlining of the waste management system in Slovakia.

In order to achieve this, it was necessary to obtain relevant data for waste management. For comparisons of individual EU countries and regions, the basic source of data is Eurostat – the statistical office of the EU, which is responsible for publishing high-quality pan-European statistics and indicators that allow comparisons between countries and regions. With respect to Slovakia, selected data on waste production at the national level are provided by the Statistical Office of the Slovak Republic. However, the availability of data at a lower level (e.g. municipal) was more difficult to obtain.

Until 2017, one of the partial monitoring systems of the Ministry of the Environment was the Partial Waste Monitoring System, which focused on the

collection and processing of data on waste generation and management, falling under the Regional Waste Information System (IS RISO). Although data on waste generation and management in this original IS RISO are publicly available, they only provide information on the situation at the NUTS1–NUTS3 and LAU1 levels up to 2017. Since 2017, the new Waste Management Information System (ISHO) has gradually been implemented with the aim of digitising the records of waste management and subsequently launching waste management control mechanisms (e.g. it is possible to link the records of those who take over the responsibilities of waste management with the records of those who hand them over). It also focuses on monitoring of the flow of waste from its generation to its treatment and disposal, and at the same time enables continuous monitoring of the fulfilment of the objectives set out in the Waste Management Plan of the Slovak Republic in connection with the objectives of the EU. Data on waste generation and management are registered in this new system at the level of district authorities or district offices in each regional capital, respectively. However, access to this data is limited to selected employees of these offices; therefore, they are not available for broader external analyses.

Thus, obtaining data for all 141 cities (LAU2) required the intervention of the authors, as well as analysis of generally binding waste regulations of cities in relation to recent legislative changes. Moreover, specific statistical data on waste production and its treatment were requested via individual communication with city mayors (based on *Act No. 211/2000* on free access to information). We further calculated these data on waste production *per capita*, as well as in relation to size categories and average values valid for Slovakia and the EU, and later interpreted them in connection with the EU context of changes in waste management.

3. Results

3.1. Rate of recycling of municipal waste in Slovakia in relation to newly applied EU recycling targets

While advanced Western economies have prioritised the field of waste management for several years and are considered nowadays to be leaders in this respect, the focus on waste management in Slovakia shifted only a few years ago from material treatment as its only priority, rather than waste prevention, and was aligned with the hierarchy of waste management in accordance with the *EU Waste Framework Directive 2008/98/EC* transposed into Slovak legislation (Fig. 1) (*Waste prevention programme in the Slovak Republic for the years 2019–2025*). In Slovakia, currently in force is the *Waste Act no. 79/2015* last amended at the end of 2019 as *Act no. 460/2019*, amending and supplementing *Act no. 79/2015 on Waste and on Amendments to Certain Acts, as amended*.

As declared by the Government's Programme Statement for the period 2020–24, waste management has once again become one of the priorities of the Ministry of the Environment, due to, among other things, the need to align our legislation with EU regulations and objectives, which focus primarily on reducing total amount of waste, and on maximising recycling and re-use. *The Waste Management Plan*

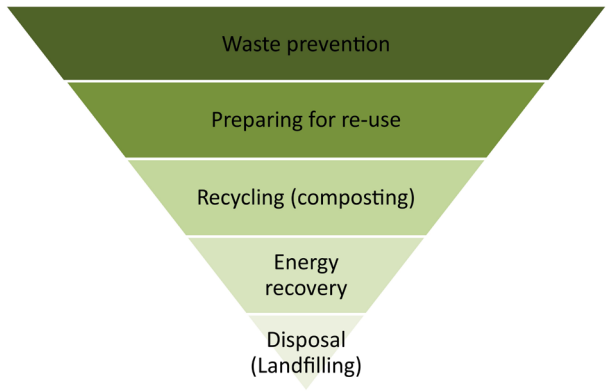

Fig. 1. Hierarchy of waste management
Source: Authors´ elaboration based on Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

of the Slovak Republic for the period 2021–2025 therefore set the following four priorities:

- reducing the amount of municipal waste deposited in landfills while at the same time tightening landfilling conditions;
- increasing the rate of preparation for re-use and the rate of recycling of municipal waste;
- increasing the weight targets for recycling for specific materials;
- and reducing the consumption of disposable plastics.

Back in 2018, the European Parliament approved ambitious recycling targets as part of new legislation on waste treatment aimed at the transition to a circular economy. In this respect, the EU is very active in pursuing sustainable development – since recycling not only reduces waste but also mitigates the depletion of natural resources from economic development (Bolaane, 2006; Bor et al., 2004). By 2025, at least 55% of municipal waste, including waste produced by households and small businesses, should be recycled. By 2030, the share of recycled waste should reach 60% and by 2035 as much as 65%. At least 65% of packaging waste should also be recycled by 2025, and this share should increase to 70% by 2030. The new legislation also sets separate targets for individual packaging materials, such as paper, cardboard, plastic, glass, metal and wood (European Parliament news, press release 18.4.2018). It has been shown in several studies that the production of municipal waste is directly dependent on socio-economic indicators, especially on the level of GDP (Porter, 2002; Štofová, 2007; Rusko, Hrabčák, 2014; Lewandowska & Szymańska, 2019). In this context, it is necessary to point out the fact that in comparison with other EU countries, Slovakia has one of the lowest annual production rates of municipal waste *per capita* (in 2018 it was 427 kg *per capita* in Slovakia compared to 489 kg *per capita* in the EU28). On the other hand, a long-term, unsatisfactory situation still prevails in the area of its treatment, as well as the actual separation of its components and recycling (36%) compared to the EU28 countries (47%) (Eurostat). Although in the last two decades there has been a relatively significant 30% increase in the recycling rate, this is still no cause for celebration, since the amount of municipal waste produced has also increased along with the increase in recycling (Fig. 2).

The truth is that in recent years, although we are gradually approaching the EU average in terms of recycling, it is disputable whether we will in fact be able to meet the newly set EU targets (Fig. 3, Fig. 4),

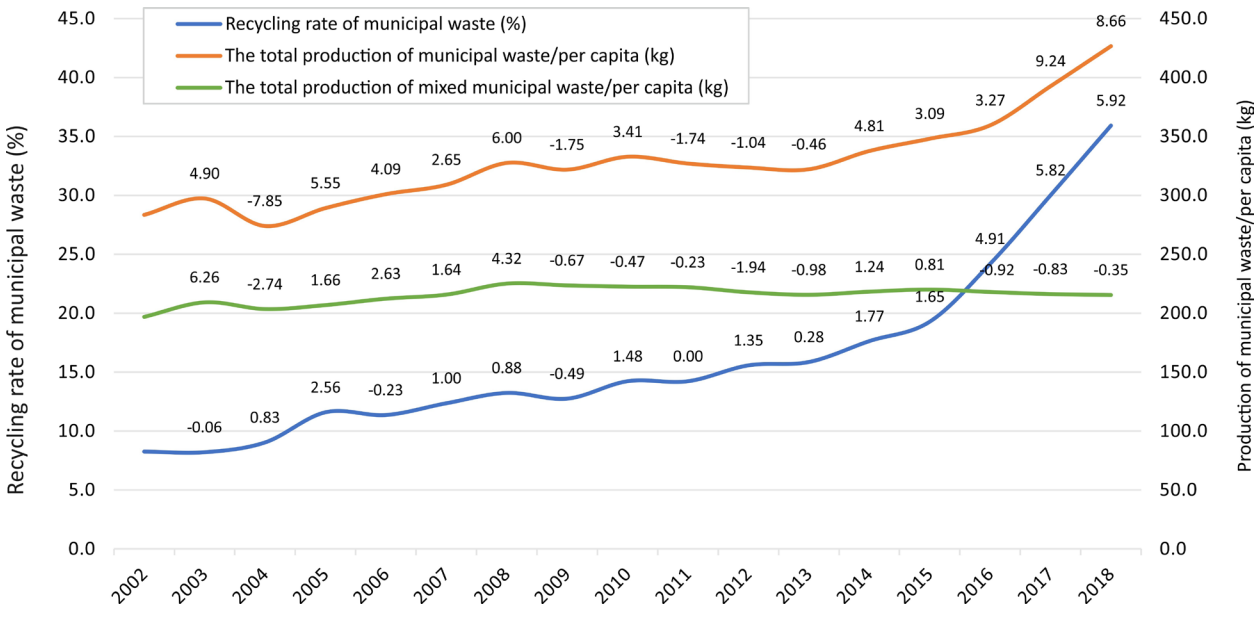

Fig. 2. Production and level of recycling of municipal waste in Slovakia in the years 2002–2018
Source: Authors´ elaboration based on Statistical Office of the Slovak Republic

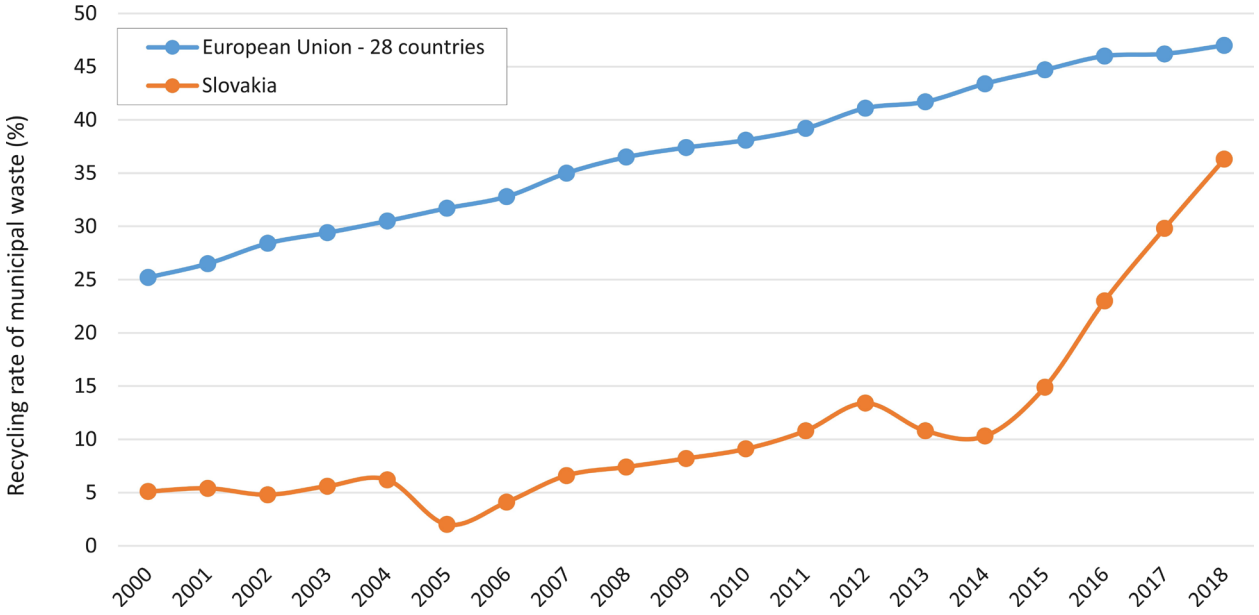

Fig. 3. Rate of municipal waste recycling in Slovakia in relation to EU average
Source: Eurostat, Directive (EU) 2018/851 of the European Parliament and of the council, Authors´ elaboration based on research

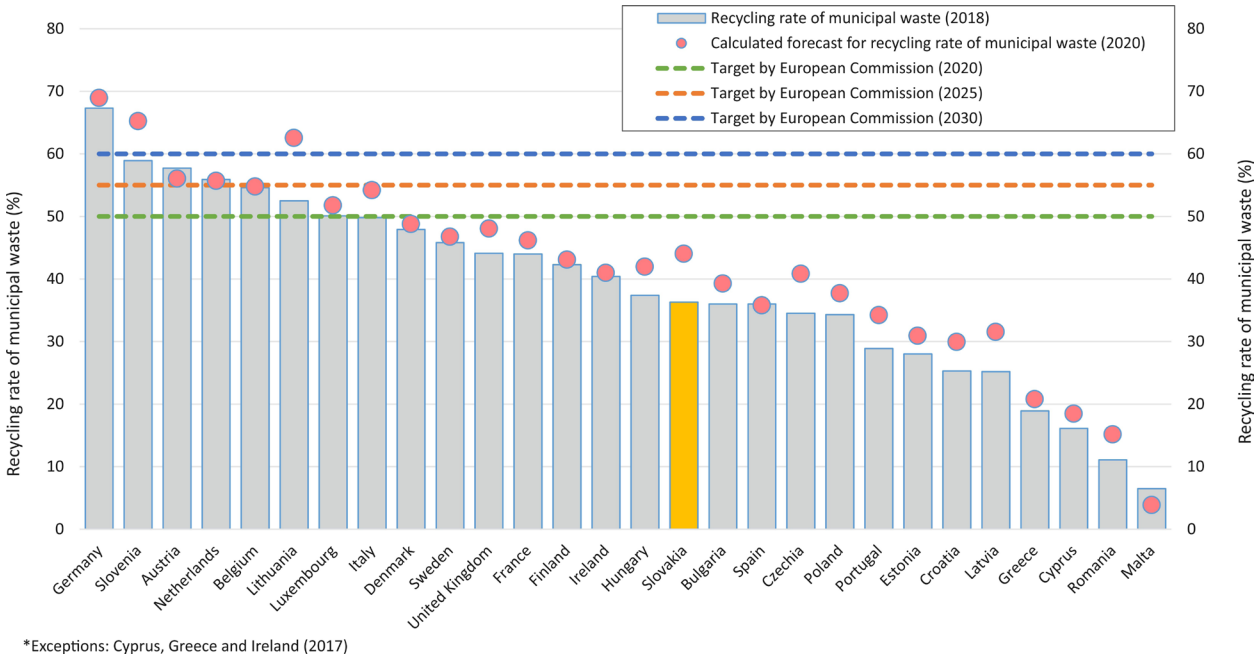

Fig. 4. EU Member States in relation to EU recycling targets
Source: Eurostat, Directive (EU) 2018/851 of the European Parliament and of the council, Authors´ elaboration based on research

which pose a challenge even for the current waste management leaders. That will depend not only on the legislative measures adopted at the national level, but especially on their implementation with respect to the conditions of regions and specific cities and municipalities. Therefore, we pay further attention to the level of recycling in the cities and the implications arising from it.

3.2. Current level of recycling in Slovak cities, measures taken and their consequences

Waste management is one of many public benefit services provided under the remit of local governments. In Slovakia, this represents a total of 141 cities and 2,749 rural municipalities. However,

data on the production and treatment of waste at the local level (LAU2) are not commonly available, and their acquisition requires considerable effort and time (and often largely depends on the willingness of local authorities to provide these data). We will therefore look at the contribution of Slovak cities, where approximately 54% of the population lives, to waste production in Slovakia.

In 2018, 1,523,911.80 tonnes of municipal waste were produced in Slovak cities. On average, it was 515 kg *per capita*, which is 88 kg more than the Slovak average, and 26 kg more than the EU average. It can therefore be expressed that the urban contribution to the production of municipal waste in Slovakia is at the level of 65%. It is interesting to note that in 2018, cities produced almost as many tonnes of municipal waste as were produced in 2002 in the entire country (Statistical office of the Slovak Republic).

Moreover, meeting the recycling targets can be considered an enormous challenge from the perspective of Slovak cities, since most of them dump large amounts of municipal waste into landfills (with the exception of Bratislava and Košice, the two largest cities, which have waste incinerators and can recover up to 60% of waste). The average recycling rate in cities is about 36%, which corresponds to the recycling rate for the entire country.

However, when taking a closer look at these statistics in terms of size categories of cities, no direct correlation can be determined between the size of the city and the amount of municipal waste produced. From the population size category 5,000+, it is possible to see a slight increase in waste production and recycling. One reason may be the fact that in larger cities the consumption of a separated amount of waste (plastics, paper, glass, etc.) has been increasing, and thus the production of total municipal waste has increased as well. Higher production of separated waste components thus implies a higher rate of municipal waste recycling (Fig. 5).

As a result of the current trend of waste management, as well as the effort to reduce the amount of municipal waste and increase the recycling rate, *Government Regulation No. 330/2018 Coll.* changed the fees for dumping municipal waste into landfills (Tab. 1).

The above-mentioned fees, which consist of two components: the landfill owner fee and the Environmental fund fee, was at the level of around 5 EUR·t^{-1} for several years until 2018. Since 2019, the rate has gradually increased and is currently

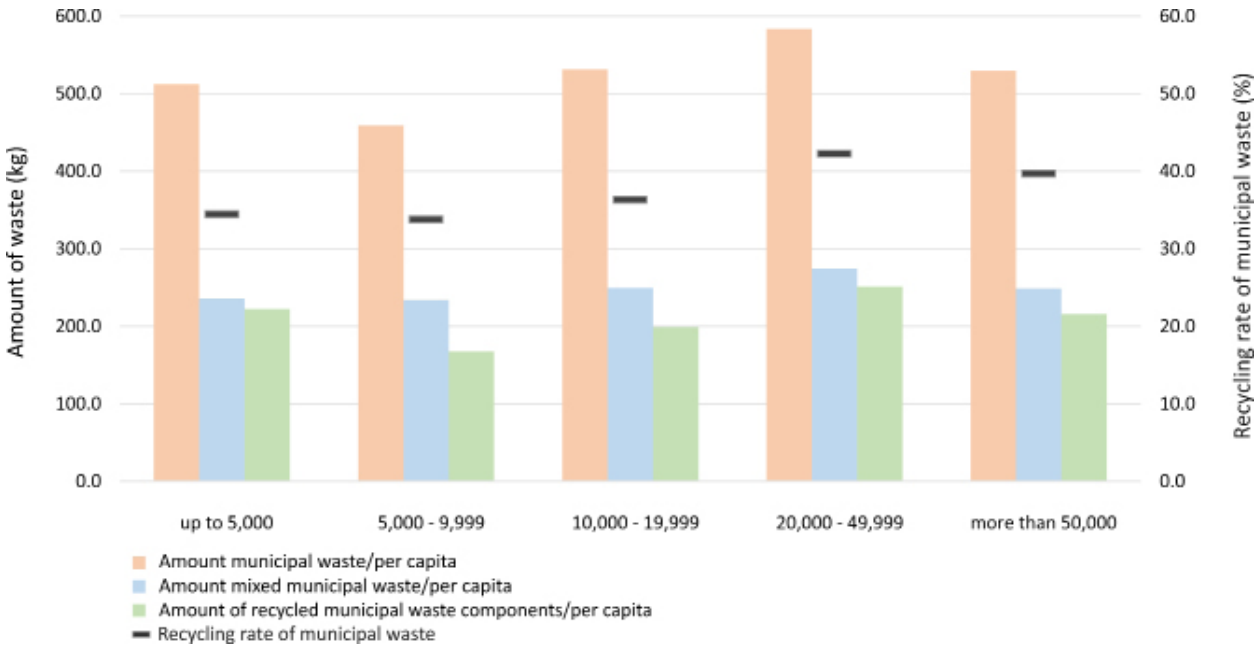

Fig. 5. Municipal waste production and level of recycling in Slovak cities in 2018
Source: Authors´ elaboration

Table 1. Fees for landfilling of mixed municipal waste (20 03 01) and bulky waste (20 03 07) Eur.t.-1

	Slope	Absolute term	R^2 coefficient of determination
Value	413	974	0.93
Student's t-test	-3.17	20.59	---
F-Test	---	---	611.82
Statistical significance	1.90×10^{-27}	0.0003	1.90×10^{-27}
Significance level α	0.01	0.01	0.01

Source: Regulation of the Government of the SR no. 330/2018 Coll., which establishes fee rates

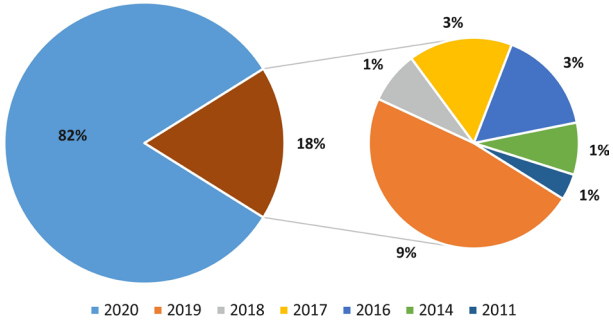

Fig. 6. Changes in generally binding regulations on waste in Slovak cities
Source: Authors´ elaboration

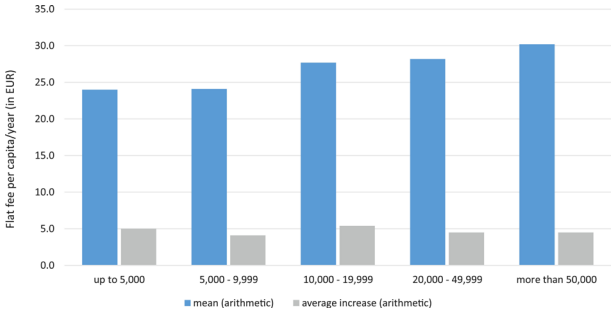

Fig. 7. Average amount of municipal waste fee by size category of cities in relation to the previous general binding regulation on waste
Source: Authors´ elaboration

in the amount of 8–26 EUR·t^{-1}. And so, a new incentive has arisen: the more municipalities are able to separate waste, the less they pay to landfills. At the same time, most cities (up to 82%) have already managed to prepare for these changes and have updated their generally binding regulation on waste management. Subsequently, this legislative change was also reflected in the adjustment of the flat fee for municipal waste (Fig. 6). In 2018, the average flat fee for municipal waste in Slovak cities was EUR 26.1 *per capita*/year, while it was true that the average fee increased with the size of the city. Following the implementation of the new fee schedule, these fees increased by an average of EUR 5 *per capita*/year (Fig. 7).

When taking into account not only the amount of the flat fee and the size of the city, but also the recycling rate, it is clear that only a fraction of cities did not reflect the announced legislative changes in increasing the fee for municipal waste (only 18 out of 141, which means 12%). The majority of cities adjusted the amount of the fee only minimally (in 15 cities, the increase was up to EUR 2.5 *per capita*/year; in 44 cities it was up to EUR 5 *per capita*/year); however, there were also seven cities where the fee increased by more than EUR 10 *per capita*/year (Fig. 8 and Fig. 9).

Finally, it should be noted that even though some cities had a relatively "high" rate of municipal waste recycling compared to other cities in Slovakia, local authorities adjusted the amount of the flat fee. Thus, cities appear to anticipate the challenges that await them as a result of announced increases in the rates for dumping mixed and bulky municipal waste into landfills in a relatively short period of time (Fig. 6). For instance, cities that had a recycling rate of 25% in 2019 and paid EUR 10 *per capita*/year would have to reach a recycling rate of 60% in order to pay a relatively equal amount in 2021,

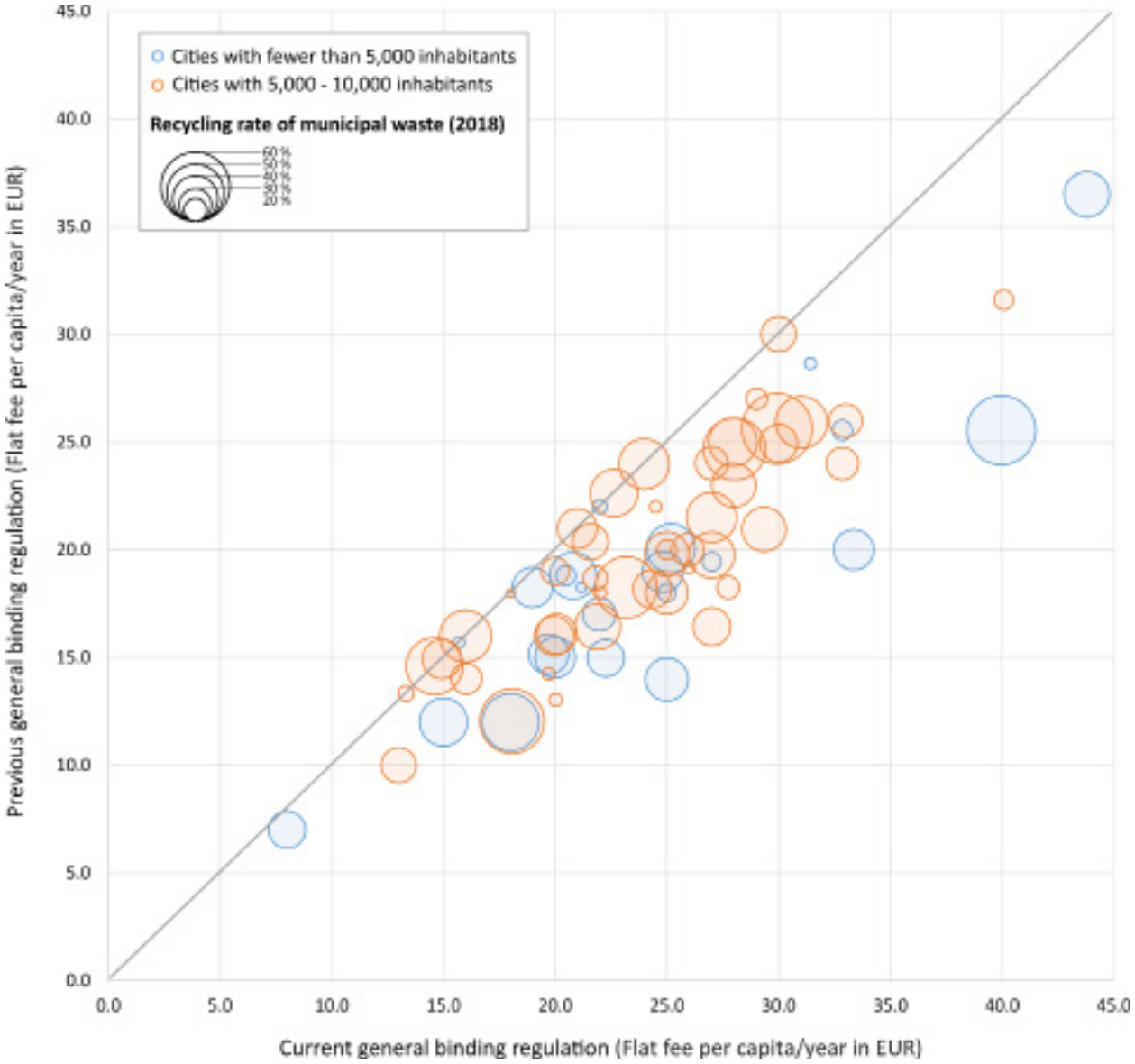

Fig. 8. Development of fees for municipal waste in relation to the recycling rate in cities with fewer than 10,000 inhabitants
Source: Authors´ elaboration

which is rather unrealistic to accomplish in such a short period of time.

4. Discussion

Waste management is a complex system that is influenced by many external factors. As stated by P. Šimurka, Director of the Department of Waste Management and Integrated Prevention of the Ministry of the Environment of the Slovak Republic, the direction of waste management is currently at a crossroads; not only in the Slovak Republic, but in the entire EU as well. The EU's ambitious waste management targets thus pose a challenge not only for countries whose waste management system is lagging behind in some areas, but also for current European leaders. Their fulfilment will require strategic planning, which will be ensured in the Slovak Republic by the new strategic document W*aste Management Plan of the Slovak Republic for 2021–2025,* which is currently in the environmental impact assessment process (Šimurka, 2020). The persistent pandemic of the new coronavirus COVID-19 also presents a particular challenge in

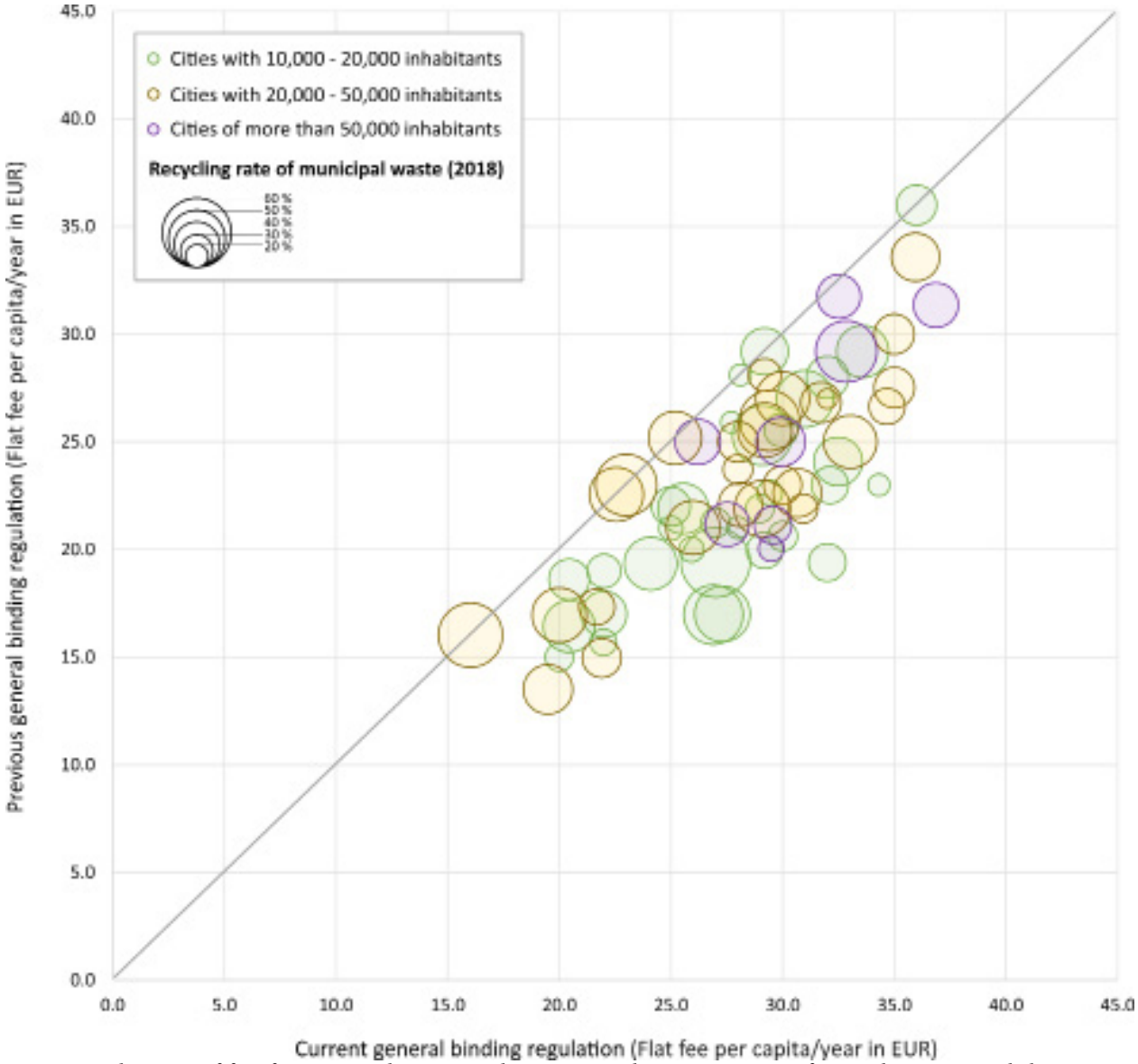

Fig. 9. Development of fees for municipal waste in relation to recycling rate in cities of more than 10,000 inhabitants
Source: Authors´ elaboration

the context of an enormous increase in disposable plastic, as well as with measures in connection with the collection and disposal of potentially hazardous waste. As a result of the threat of the spread of the disease, a massive shutdown of separation and recycling facilities is also taking place across the EU (Green Magazine 4th year 1/2020).

From the local level perspective (LAU 2), with a special focus on cities, the effort to meet the ambitious recycling targets set by the EU has so far been most pronounced in the area of changing legislation and adjusting the tariffs for the municipal waste fee upwards. However, it was emphasised by Rusko and Hrabčák (2014) that although the economy of waste management in the Slovak Republic is in deficit, and the cost per tonne of waste exceeds the income in many cities and municipalities, the recipe for a balanced budget should entail not only an increase in fees from citizens, but also more efficient management. This means reducing specific expenditures and increasing other revenue. On the other hand, increasing landfill fees is an appropriate incentive to separate waste, prevent waste and create pressure to increase recycling. As a result, the higher fee gradually reduces the landfill rate, however, it must be suitably supplemented by other measures

(*Strategy of the Environmental Policy of the Slovak Republic until 2030*).

Thus, many local governments have responded to the announced increase in landfill fees in their generally binding regulations. Despite the fact that the newly set tariff contains a motivating factor for local governments (the more they recycle, the less they pay to landfills), many of them face the problem of reporting the level of recycling. The reason is that this tariff only considers the level of recycling and does not take into account the amount of municipal waste produced. In other words, if the local government produces less municipal waste compared to the previous year, this "progress" will not be taken into account in the level of fees for municipal waste (Pitoňáková, 2020). This situation occurs mainly in connection with the production and recovery of biodegradable waste, which, for example, is not disposed of in municipal waste during domestic composting, thus reducing the total amount of waste (however, this is the case especially for rural communities or smaller cities due to domestic composters and their use in family houses). Here, we finally get back to the waste hierarchy itself, where waste prevention is of the utmost importance. Yet the question remains: should this fact no longer be taken into account when setting the municipal waste tariff?

On the other hand, there is the question of motivating inhabitants themselves to consume more consciously, and consequently to manage waste more efficiently. As several studies have previously confirmed, the introduction of support programmes, financial rewards or economic savings increases the motivation of citizens to sort their waste, thereby increasing the recycling rate itself (Končálová, Dubcová, 2010; da Cruz et al., 2014; Struk, 2017). One inspiration in this respect may be, for example, the creation of systems based on the principle of PAYT – pay as much as you throw away. The PAYT toolkit was developed by the Italian municipality of Prato as part of the EU's urban agenda entitled "partnership for the circular economy", which enables European cities to set up systems that set fees for the exact amount of waste collected. This set of tools provides municipalities with a comprehensive process for implementing PAYT: assessing the current situation in waste management, creating appropriate IT systems, empowering citizens, and much more (Pay-as-you-throw Toolkit for European Cities). For example, the PAYT system has proved its worth in a certain form in the Czech Republic, where municipalities that have applied this approach have managed to reduce the fee for municipal waste by up to 70% (Struk, 2017). In Slovakia, some municipalities are also introducing an electronic waste registration system and trying to collect data and motivate households to reduce waste production and increase recycling. This type of system of setting waste fees rewards all households that produce as little municipal waste as possible, thereby increasing household recycling.

The Strategy of the Environmental Policy of the Slovak Republic is considering a similar solution using motivation quantity waste collection by 2030. Based on this, all municipalities will gradually introduce one of the forms of collection by volume (different size of bags or containers, collection frequency, regular monitoring of waste production, etc.). While this model is relatively well-established outside the Slovak Republic, collection by volume is still used to a lesser extent within the country. In municipalities where a certain form of collection by volume is implemented, a clear benefit can already be seen in the form of a higher rate of municipal waste recycling, as well as improvement of the economics of waste management in individual municipalities (Stričík et al., 2019). However, as Alwaeli (2010) emphasised, any well-established waste recovery system will not work without society realising its benefits; from not only an economic but especially an environmental point of view. Even the results of the research by Stričík et al. (2019) in the conditions of Slovakia confirmed that it is primarily the internal motivation of local governments and individuals (60.2%) and later the financial effects (30.4%) that are the most common motivating reasons for the waste recycling. As Haško (2010) further emphasises, the long-term unsustainable covering of deficits in waste management in Slovakia is one of the main obstacles to citizens' sense of responsibility for the waste produced by each of us, as well as for the ecological and economic impacts that follow. The development of environmental awareness for waste management throughout the population therefore plays a key role here.

5. Conclusions

With the growing population and increasing living standards, the amount of municipal waste produced is growing rapidly as well. The currently prevailing linear model of the economy based on growing production and consumption, as well as resulting amount of waste, can be perceived as highly inefficient, both in terms of economic profitability (due to the enormous use of resources and the inability to fully utilise most of the waste produced), and in terms of environmental sustainability. The EU's efforts for a gradual transition to a circular model of the economy can therefore be seen as a positive shift. We are seeing these efforts not only in terms of a redefinition of the waste management hierarchy in the *EU Waste Framework Directive 2008/98/EC*, but also in terms of ambitiously defined targets regarding waste generation and treatment for the coming years or even decades.

The issue of the circular economy is resonating increasingly intensely in Slovakia as well, and it is also supported by the Ministry of the Environment. Like the other Member States, Slovakia has followed the direction of the EU and implemented the new direction of waste management in its development of documents and objectives. Although the country's starting position in meeting the new targets is not the worst (Slovakia has long been recording low-waste production compared to other EU countries), there is still room for improvement in its overall approach to waste management, since the rate of efficient treatment is still relatively low.

One of the challenges will be the setting up of a functioning waste management system and its implementation. Under current conditions, the adopted legislative changes associated with the increase in fees for municipal waste, which have a direct impact on the functioning of waste management at the level of local governments, have resonated the most so far. The measures already in place (along with a number of other measures aimed at developing environmental awareness and education) may ultimately have a positive impact on reducing the deficit of waste management at the local level, while at the same time reducing the total amount of waste management and increasing its level of recycling.

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