Landfilling as a Significant Environmental Burden in Slovakia

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Abstract. In order to improve the state of the environment, it is essential, that the issue of landfilling, as a significant environmental burden, becomes a priority, as well as activities leading to the removal of existing landfills and the prevention of new ones. The presented paper deals with landfilling as a significant environmental burden in Slovakia, in which we analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020. The paper uses descriptive statistics as research methods, specifically frequencies, percentages, minimum and maximum values, dispersion and averages. In the results, the paper states, that the amount of generated waste (without municipal waste) in Slovakia increased by approximately 14,5 % during the period 2005 – 2019. By analyzing the rate of landfilling, it was found, that it has been one of the dominant ways of dealing with municipal waste in Slovakia for several years, despite the fact, that its rate decreased by almost 30 % from 2005 to 2020. It is necessary, that the issue of landfilling becomes a priority in the future, and it is also necessary to develop activities leading to the removal of existing landfills and the prevention of the creation of new ones. In the coming years, Slovakia must proceed with significant structural changes in waste management. One of the possible solutions is to withdraw from the prevailing landfilling and transform to other forms of disposal of waste.

Keywords: environmental burden, landfill, environment, waste, Slovakia

JEL classification: *F18, F64, O13.*

1 Introduction

We live in a society, in which our desire for comfort leads us to increase consumption. We take our day-to-day responsibilities for granted and often do not even realize their impact on the environment. The already mentioned growth of population consumption subsequently causes the growth of waste, which we consider to be a significant

environmental burden, if they are not recovered in an efficient way. Environmental burdens are a much-discussed topic, due to possible impacts on animal health, human health, biodiversity and other impacts on the country. Due to the wide range of possible negative impacts, it is necessary to deal with this topic and find solutions to eliminate and remove it in the future, so as not to overburden the environment beyond its tolerable level. At present, both the European Union and the Slovak Republic are aware of the risk and significant impact of environmental burdens and therefore approach to legislative, methodological and economic procedures, the implementation of which improves the state of the environment.

Waste management is and will be one of the important topics in Slovakia, due to the environmental sustainability, economic growth and consumption. Slovakia is currently one of the countries in the European Union with the lowest recycling rate and the highest landfill rate [4]. New requirements for the transformation of the economy from linear to circulating and the related new environmental requirements lead to Slovakia having to embark on significant structural reforms in waste management in the coming years. As a result, Slovakia will have to withdraw from the predominant landfilling and switch to other forms of waste recovery and disposal. Changes, including the approach of all stakeholders, will be necessary in view of the environmental objectives to which the Slovak Republic has committed itself, to avoid permanent damage to the environment.

The increasing amount of waste produced in landfills is a current topic, that requires considerable attention. The presented paper deals with landfilling as a significant environmental burden in Slovakia, in which we analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020.

2 Landfilling as an environmental burden

At present, the issue of environmental burdens (hereinafter also EB) in Slovakia is affected by Act no. 569/2007 Coll. on geological works (Geological Act) [1] as amended. According to the Act no. 569/2007 Coll. on geological works, **environmental burden** is the pollution of an area caused by human activities, that poses a serious risk to human health or the rock environment, groundwater and soil, with the exception of environmental damage. The definition therefore says, that the environmental burden is the pollution of a territory caused by human activity, with the exception of environmental damage. The simplest definition characterize environmental burdens as a wide range of areas contaminated by military, mining, industrial, agricultural and transport activities, but also by inappropriate waste management, which was contaminated in the past, but whose effects persist to this day [6].

Landfilling can be considered the oldest, simplest and currently most widespread method of waste disposal. Landfills are the last link in the waste disposal chain. From a terminological point of view, they define the term landfill, resp. landfilling both

domestic and foreign authors, but also legislative standards. The legislation on landfilling in Slovakia itself is based on the revised directives adopted by the European Commission, so that Europe can gradually move from a linear economic model to a circular economy.

An important legislation of the landfilling at European Union level is Directive 1999/31/EC on the landfill of waste [5], which aims to ensure a gradual reduction of landfilling, in particular for waste, that is suitable for recycling or other waste recovery [3]. Directive 1999/31/EC on the landfilling [5] defines a landfill as a place for depositing waste on or in the soil, including internal places on waste disposal (i. e. landfills where the waste producer disposes of his own waste directly at the place of production) and permanent places (i. e. more than one year), that are used for temporary storage.

The landfill of waste is in accordance with the Act of the National Council of the Slovak Republic no. 79/2015 Coll. on waste [2] defined as a place with a waste disposal facility, where waste is permanently deposited on or in the ground. An internal landfill is also considered to be a landfill, where the waste producer disposes of his waste at the place of production, as well as a place, that has lasted, i. e. more than one year, used for the temporary storage of waste.

Landfill can be understood as waste disposal in a specially designated area, which in modern locations consists of a pre-built "cell" lined with an impermeable layer (artificial or natural) and with controls to minimize emissions [12]. The term landfill is used to describe a unit activity for the final disposal of municipal solid waste on land, that is designed and built to minimize environmental impact [15]. According to the OECD [11], a landfill refers to the final disposal of waste on or underground, in a controlled or uncontrolled manner, according to various hygiene, environmental and other safety requirements. According to the United States Environmental Protection Agency [16], landfills are a tool used to dispose of various types of waste in any industrialized society.

As already mentioned, the biggest problem of Slovak waste management is the disproportionately high rate of municipal waste landfilling. In Slovakia, an average of 446 kg of waste per person was produced in 2020. Of this amount, almost 44 % of waste was recycled and the share of municipal waste landfills was at the level of 48 % in 2020, while this share decreased by about 3 % year-on-year [8]. In an international comparison, Slovakia is in the unflattering top ten EU countries within landfilling [10].

Landfilling predominates, because it is the cheapest and least technologically demanding way of disposing of waste. However, there are many risks associated with landfilling. Every landfill has the potential to become an environmental burden. The operation of landfills burdens the environment with traffic, noise, odors, as well as environmental pollution by air raids. Fires are also a common problem in landfills, and even closed landfills pose environmental hazards in the future.

Following the above facts and the trend about high landfilling and low recycling rates in Slovakia, the European institutions agreed in 2019 on legislation, that would ban EU states landfilling recyclable waste from 2030. From 2035, the total landfilling of municipal waste can be a member state of EU to reach only 10 percent. According agreement between the European institutions, at least 55 percent waste from households

and small businesses should be recycled by 2025. By 2030, the share of recycled municipal waste should reach 60 percent and by 2035 at least 65 percent [8].

3 Methodology

Most of the data found in this article comes from publicly available sources, i. e. from the Statistical Office of the Slovak Republic. The data are measured in thousands of tonnes of waste produced, at constant prices and in percentages. The paper uses as research methods mainly descriptive statistics, especially frequencies, percentages, minimum and maximum values, spread and averages. In terms of time, the paper works with data within several years. The most common way of displaying is the annual results for the period 2015 to 2020. For a better historical comparison, we also use older data from 2005 and 2010. The last know period is 2020, eventually year 2019, because data from 2021 are not yet publicly available and are published usually in the months of July to August of the following year. From a territorial point of view, the paper monitors the data in question for only one territorial category, namely Slovakia.

Given the importance of the issue, the main goal of the presented paper is landfilling as a significant environmental burden in Slovakia, in which we also analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020. This main objective of the paper is divided into 2 sub-objectives. The first partial objective of the paper is to point out the overall development of waste production in general, for the period from 2005 to 2020 in Slovakia. Also within this partial objective, we compare the amount of waste produced with gross domestic product on the basis of recalculations in the form of an index. We follow the context in the period from 2005 to 2009. Following the first sub-objective, the second sub-objective is to examine the management of municipal waste generated in Slovakia in the period from 2011 to 2020. The second sub-objective in this context examines in particular the so-called landfilling trend in Slovakia during the years 2005 to 2020. As a result of the above main and sub-objectives is the research proposal of this paper to point out the importance of waste management issues in connection with increasing waste generation and inappropriate waste management in the form of landfilling. In order to meet the main and partial objectives of the presented paper, it was necessary in the first step to summarize data on the total production of waste in Slovakia. In the next step, we recalculated the data on the amount of waste produced in the form of an index and compared it with the gross domestic product expressed in constant prices. This was followed by a summary of data in connection with forms of waste management in Slovakia, and subsequently we focused only on the rate of municipal waste landfilling in Slovakia.

4 Current state of landfilling and waste management in Slovakia

Minimizing the negative effects resulting from the generation and management of waste on the environment and human health should be the main goal of waste management policy not only in Slovakia, but everywhere in the world. Waste

management policy itself should also focus on the use of natural resources, as many of them are currently limited, and apply a hierarchy of waste management, that is in line with the idea - ,,polluter pays". The main priority of waste management should be, in particular, the prevention of waste, its subsequent re-use, recycling and, finally, its energy recovery, of course, where appropriate and possible from an environmental, technical and economic point of view. Disposal of waste should be a last resort [10]. As a result of the above facts, in this part of the presented paper we will focus on the extent to which the Slovak Republic adheres to the above-mentioned waste hierarchy. We will point out the development of waste management in Slovakia, i. e. we will focus on the generation of waste in general, on the methods of its management, with the main focus on landfilling.

Based on the data of the Register of Environmental Burdens, we record a total of 1,793 environmental burdens in Slovakia as of April 30, 2022. Of this total, already confirmed environmental burdens represent 18 % (326 burdens) and the burdens, that we consider probable environmental burdens account for 49 % (876 burdens). Burdens, resp. location, that are or have already been reclaimed in some way reach a 33 % share (818 burdens). If we analyze the confirmed EB in terms of activities, that cause them, it can be stated, that the landfilling has the largest share in their creation, respectively created landfills for municipal and industrial waste. In numerical terms, landfills constitute the largest item with almost 25 % of all activities causing confirmed EB. Landfills represent 6 % of potential and already reclaimed EB. As a result of this fact, it is clear, that landfilling and created landfills in Slovakia represent significant environmental burdens, which need to be given considerable attention, but especially to eliminate their occurrence in the future and for those, that already exist to look for ways to eliminate them.

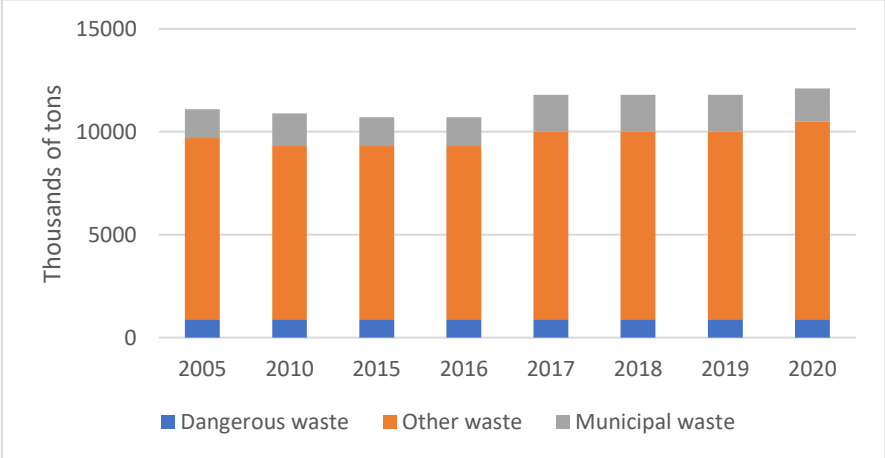

Fig. 1 Development of waste generation in Slovakia in the years 2005 to 2020.
Source: own processing, Statistical Office of SR.

In general, the waste produced is divided into three basic categories, i. e. municipal waste, hazardous waste and other waste. Based on fig. 1, we can state, that in the long

run, there has been a steady development in the overall generation of all types of waste since 2005. On the other side, if we look at waste from a medium-term perspective (since 2015), there has been an increase in total waste generation in Slovakia, which can be assessed as a negative. We recorded another negative in the last year-on-year change in the amount of all types of waste produced, as the increase in total waste generation is characterized. From fig. 1 we can also state, that the amount of generated waste (excluding municipal waste) for the period 2005 - 2019 increased by approximately 14,5 %. A year-on-year comparison of 2019 and 2020 showed an increase of 6,9 %. From 2005 to 2019, the amount of generated hazardous waste decreased by a significant 32,2 %. The largest producer of waste according to the classification of activities SK NACE was industrial production (especially other waste) in the whole time series, in 2020 with a share of the total amount of generated waste without municipal waste approximately 28 %. Behind the industrial production, follows transport and storage, with a share of more than ten percent.

Closely related to the level of economic activity of the country is the indicator of waste generation, which is also an indicator of the raw material consumption model. More waste tends to be produced by those countries, that are richer and less by waste to poorer ones. We often find, that developed countries reduce the total amount of waste produced as a sign of changes in the consumption of raw materials and increase the rate of recycling and reuse.

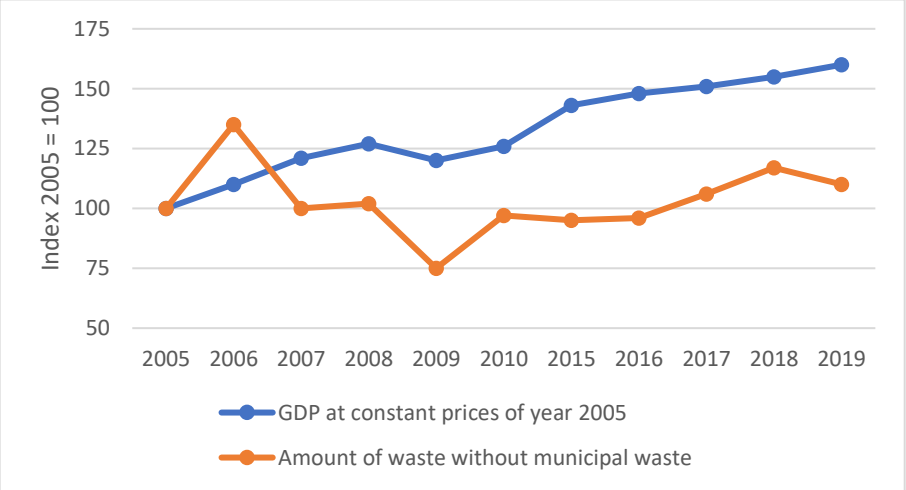

Fig. 2 Development of the amount of waste produced and GDP in Slovakia
Source: own processing, Statistical Office of SR.

In order to evaluate the development of waste generation, a comparison of waste production and economic development using the indicator of gross domestic product (hereinafter also GDP) is often used. In this regard, we consider it desirable, if the trend of GDP growth is faster, than the growth of waste generation. In the case of the Slovak Republic, we can state, that the trend of GDP growth is faster, than the growth of waste generation based on fig. 2, which can be considered positive.

As already mentioned, the dominant way of disposing of municipal waste in Slovakia has been landfilling for several years. In the long run, i. e. although the amount of waste deposited in landfills has decreased since 2005, but the high share of landfills still persists. However, the fact, that landfilling of waste without municipal waste, as well as municipal waste themselves, has decreased slightly since 2015. Specifically, if we see on rate of landfilling without municipal waste, it had a declining character in the period 2005 – 2020, while in percentage terms it decreased by more than 20 percentage points (fig. 3). Compared to 2019, a year-on-year decrease from 16,6 % to 10,8 % was recorded in landfilling without municipal waste in 2020, which can be assessed as positive. The rate of landfilling of municipal waste only had a positive declining character in the observed period since 2005. While in 2005 more than 78 % of municipal waste was landfilled, in 2020 it was only 48,4 %.

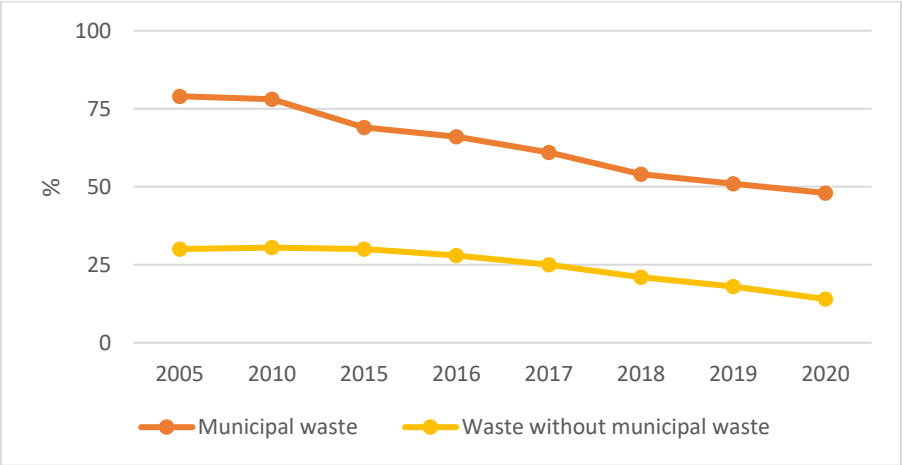

Fig. 3 Development of landfilling in Slovakia from 2005 to 2020
Source: own processing, Statistical Office of SR.

Although landfilling of municipal waste fell by almost 30 % between 2005 and 2020, the rate of decline is still insufficient and slow. This fact indicates the problem for Slovakia with meeting the goal set in the Environmental Strategy 2030, i. e. reduce the landfill rate of municipal waste to less than 25 % by 2035. Based on this fact and available data, the Slovak Republic must significantly intensify its efforts to reduce this indicator.

At present, 109 landfills are legally operated in Slovakia in a total of 101 areas and with a total amount of municipal waste of 1,2 million tonnes per year [4]. Most landfills are in the category for non-hazardous waste, which also includes landfills for municipal waste. Compared to 2013, the total number of landfills decreased by 15 landfills. From a territorial point of view, most landfills are located in the Banská Bystrica, Košice and Prešov regions, with landfills predominating for non-hazardous waste. On the contrary, the least landfills are located in the Bratislava region [9].

As we have already mentioned, the share of municipal waste landfills in total waste management was 48 % in 2020, which represented a year-on-year decrease of 3 %, but in an international comparison in the field of municipal waste landfills we are in the unflattering top ten EU countries. Countries such as Malta, Bulgaria and Cyprus have the highest landfill rates. On the contrary, the Netherlands, Belgium and Slovenia have the least landfill for municipal waste. However, the latest up-to-date data on landfill rates are only available in Eurostat [7] for year 2018.

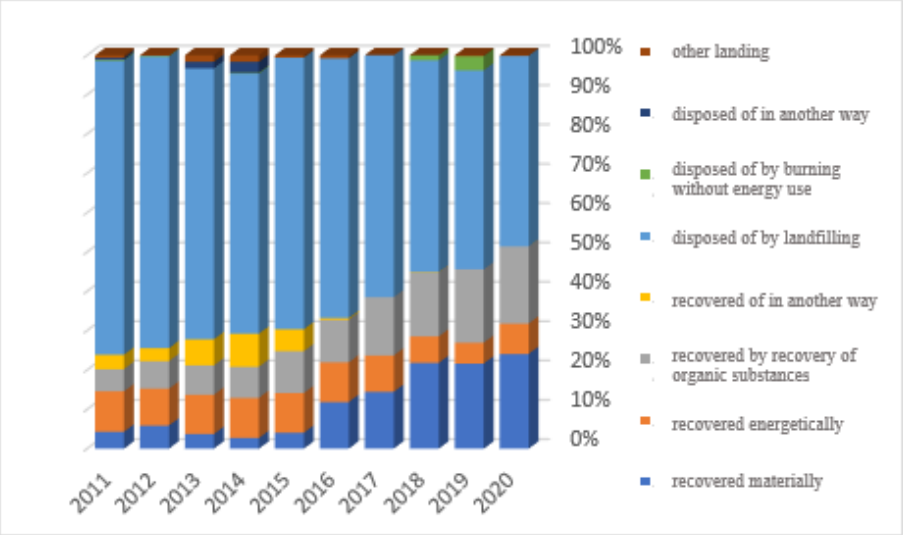

Fig. 4 Total municipal waste management in the Slovak Republic in the period 2011 to 2020
Source: own processing, Statistical Office of SR.

The fact, that in Slovakia municipal waste is mostly disposed in the form of landfills is also confirmed by fig. 4, which shows the overall management of municipal waste in Slovakia from 2011 to 2020. As we can see in fig. 4, since 2011 the disposal of municipal waste in the form of landfill has prevailed in Slovakia, although over time this trend is declining. The fact, that the rate of material recovery of municipal waste has been increasing in Slovakia since 2015 can be assessed positively. The same trend was observed by the recovery of waste by recovering organic substances. The energy recovery of municipal waste recorded relatively fluctuating values during the monitored period. Over time, the rate of this type of waste recovery has been slowly increasing, but in 2018 and 2019 it decreased. Waste disposal, whether without energy recovery or otherwise, was negligible in Slovakia. Despite the fact, that the recovery of municipal waste, whether material or energy has increased in the last five years, this situation is still considered insufficient and it is necessary to constantly intensify these forms of waste management in Slovakia, especially at the expense of landfilling.

5 Conclusion

The main goal of the presented paper is landfilling as a significant environmental burden in Slovakia, in which we also analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020. Based on the analysis, it can be concluded, that the amount of generated waste (without municipal waste) in Slovakia increased by approximately 14,5 % in the period 2005 – 2019. By analyzing the rate of landfilling, it was found, that it has been one of the dominant ways of dealing with municipal waste in Slovakia for several years, despite the fact, that its rate has dropped by almost 30 % from 2005 to 2020. The share of municipal waste landfilling in total waste management was 48 % in 2020, which represented a year-on-year decrease of 3 %, but in an international comparison, we are in the unflattering top ten EU countries in terms of municipal waste landfilling. The fact, that since 2015 the rate of material recovery of municipal waste has been increasing in Slovakia can be positively assessed. The same trend was observed in the recovery of waste by recovery of organic substances.

In order to improve the state of the environment, it is essential, that the issue of landfilling, as a significant environmental burden, becomes a priority, as well as activities leading to the removal of existing landfills and the prevention of new ones. As already mentioned, in the coming years Slovakia must undergo significant structural changes, respectively to waste management reforms. In particular, it will have to move away from the predominant landfilling and transform into other forms of waste management and disposal.

In recent years, the circular economy has become increasingly important, respectively circular economy, which emphasizes the efficient use of waste. Waste perceived as a raw material or a renewable energy source is currently considered a treasure, that hides valuables in the form of materials, energy or other reusable raw materials. This means, that most of the waste produced so far can be reused as a raw material. The application of material and energy recovery of waste absolutely minimizes the generation of waste, and thus landfills, which ultimately results in the production of electricity or heat, but also the return of materials back to industry in the form of secondary raw materials. At the same time, primary raw material and energy resources are being saved. It is the above facts represent the so-called medicine of landfilling, which is one of the dominant methods of waste management in Slovakia.

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