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MUNICIPAL WASTE MANAGEMENT IN THE CONTEXT OF ECONOMIC AND ORGANISATIONAL CONDITIONS AT THE LOCAL LEVEL IN POLAND

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ABSTRACT: The article addresses the challenge of municipal waste management in Poland, which is a problem at the local level. Various aspects of municipal waste management are pointed out. Addresses the role of national and regional policies in the context of municipal waste management and the importance of implementing effective strategies and programmes that reflect local circumstances. The main objective of the study is to evaluate municipal waste management in the municipal management process. In order to implement it, a survey, a SWOT/TOWS analysis and an assessment of the relationship between the elements of the waste management system and the factors influencing the municipal management process were carried out. The district of Częstochowa was chosen for the study because of its largest area and, as well as the municipality of Częstochowa, which is the second most populous city with district rights in the Silesian Voivodship.

KEYWORDS: management, municipalities, municipal waste management, SWOT/TOWS

Introduction

In today's world, protecting the environment requires proper management of waste, which is an essential part of this process (European Environment Agency, 2018). In Poland, municipal waste management is a key task in the municipal management process (Ministry of the Environment, 2016). An effective waste management system should take into account many factors, such as economic and organisational conditions at the local level (Ministry of the Environment, 2016). The implementation of municipal waste management tasks requires the use of appropriate strategies and operational measures (Wozniak, 2011). It is also important to take into account the individual technical, technological, financial, demographic and geographical trends of the municipality (Borys, 1996). The article presents the challenges facing municipal waste management at the local level in Poland and notes the need to introduce measures to improve the efficiency of the waste management system (Nowakowski & Kowalski, 2015). A waste management system is a comprehensive process that aims to minimise the negative impact of waste on the environment (McDougall et al., 2001). In 2020, 122.6 million tons of waste were generated in Poland, of which approximately 10% was municipal waste (346 kg per person compared to the average of 505 kg per person in the European Union). The main principles of waste management include activities in the area of prevention (Dziawgo, 2022). A properly functioning waste management system is not only a priority for large companies but also an important element of municipal management. At the local level, the municipality focuses mainly on the management of municipal waste, which is the primary type of waste generated in the territorial unit (Act, 1996). Therefore, municipalities must have a waste management strategy that takes into account the conditions and requirements arising from the European Conventions and Polish law (Directive, 2008). The municipal management process focuses on the result and the implementation of planned activities, while waste management is one of the key activities (Kozłowski & Kozłowski, 2012). As part of this process, municipalities should plan and organise a municipal waste management system that covers all property owners in the unit's area and that takes into account the principles of reasonable waste management in line with environmental protection requirements (Gajewska, 2012).

Literature review in the aspect of municipal waste management

Municipal waste management (Alzamora & Barros, 2020; Wang et al., 2021) is a key aspect when it comes to municipal management, which has been noted by many authors, both Polish and foreign ones. According to Andelman and Haastrup (2019), municipal waste management is essential for public health, environmental protection and sustainability (Andelman & Haastrup, 2019). Polish researchers, on the other hand, like Michalak (2017), indicate that effective municipal waste management is key to improving the quality of life of residents (Michalak, 2017).

The creation of a waste management (Zhang et al., 2021) plan is an important part of this process, which has been noted by many researchers. If we were to cite Dąbrowska (2020), she argues that the waste management plan is one of the most important tools to anticipate and respond to possible problems (Dąbrowska, 2020). Similarly, Fatta-Kassinos et al. (2016) emphasise that planning is key in municipal waste management and its absence can lead to serious environmental and public health consequences (Fatta-Kassinos et al., 2016).

The organisation of the waste management system is another key element that is often underlined in literature. According to Ciesielski (2021), effective organisation of waste management is essential to achieve positive results in this area (Ciesielski, 2021). Other researchers, like Wilson et al. (2015), also emphasise that an appropriate organisational structure is crucial for effective waste management (Wilson et al., 2015).

Finally, control and evaluation are essential for effective waste management. A Polish researcher, Świderska-Burek (2018), notes that regular monitoring and evaluation are key to maintaining high-quality waste management services (Świderska-Burek, 2018). Similarly, Hoornweg and Bhada-Tata (2012) argue that evaluation is a key element of waste management in adjusting strategies and approaches to improve efficiency (Hoornweg & Bhada-Tata, 2012).

The literature review underlines that municipal waste management is a complex process that requires effective planning, organisation and control (Batista et al., 2021). Appropriate waste man-

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agement is key to protecting the environment and promoting sustainable development, as Kijowski (2020) notes in the context of Polish waste management (Kijowski, 2020). On the other hand, other researchers such as Hoornweg et al. (2015) stress that waste management has a direct impact on residents' quality of life, public health and environmental protection (Hoornweg et al., 2015). It is also important to adequately carry out research on municipal waste management, as noted by Olszewski and Białecka (2019), who emphasise that research is important for identifying problems and opportunities, as well as for assessing the effectiveness of the solutions introduced (Olszewski & Białecka, 2019). Similarly, researchers, like Cherubini et al. (2019), indicate the importance of waste management research for optimising waste management strategies (Cherubini et al., 2019).

In Poland, municipal waste management constitutes a significant challenge at the local level, and it plays a key role in sustainable urban development (Kijewska & Kowalska, 2017). Municipal waste management in Poland is undergoing changes with the entry into force of EU legislation and growing public awareness, but challenges remain. Szpadt (2008) has analysed the development of municipal waste management in Poland, indicating the need for further actions to improve efficiency and sustainable waste management at the local level. Zielińska and Kulczycka (2016) assess the efficiency of municipal waste management systems in Poland, emphasising that the analysis of the efficiency of these systems is essential for the implementation of waste management strategies at the local level. Research shows that municipal waste management in Poland requires continuous monitoring and adaptation of strategies at both the local and national levels (Szpadt, 2008; Zielińska & Kulczycka, 2016). Cities, perceived as evolving organic entities, have expanded rapidly and haphazardly, not just in terms of density and size but also regarding their global complexity, engaging in numerous interactions through the implementation of circular economy strategies (Voukkali & Zorpas, 2022). In order to manage municipal waste more effectively at the local level, it is necessary to take into account various aspects such as environmental education, public participation, circular economy and technological innovation (Szpadt, 2008). At the same time, public participation, involving collaboration between local authorities, businesses and the community, can contribute to better waste management solutions. Implementing the concept of circular economy, which involves minimising waste and using it as a secondary raw material, can help to reduce the negative impact of waste management on the environment (Szpadt, 2008). The author also notes the need to support the development of technologies and innovations that enable more efficient use of waste and reduction of waste. A review of research by Zielińska and Kulczycka (2016) indicates that monitoring and evaluating the effectiveness of municipal waste management systems are key to identifying opportunities for improvement and adaptation to the changing needs. This allows municipalities to flexibly respond to the changing circumstances, introduce new technologies and waste management methods, and better cooperate with other territorial units as well as the private sector. Municipal waste management in Poland requires taking into account various aspects and further refinement of strategies at the local level (Szpadt, 2008; Zielińska & Kulczycka, 2016). Cooperation between science, local authorities and the community can contribute to more effective and sustainable waste management, which in turn will contribute to environmental protection and sustainable development of regions (Szpadt, 2008; Zielińska & Kulczycka, 2016). Investing in environmental education, promoting public participation, moving towards a circular economy and supporting technological innovation are the key aspects when it comes to achieving these goals (Szpadt, 2008). Also, the role of national and regional policies cannot be overestimated in the context of municipal waste management. The implementation of effective strategies and programmes at the national level that reflect local circumstances can support municipalities' pursuit of waste management and sustainable development goals (Szpadt, 2008; Zielińska & Kulczycka, 2016). In the long term, continuous monitoring and adaptation of municipal waste management systems, both at the local and national levels, will be key to achieving sustainable development and environmental protection (Szpadt, 2008; Zielińska & Kulczycka, 2016). Therefore, it is important to continue research, invest in innovation and develop cooperation between the various entities involved in municipal waste management.

According to Act (2012), municipal waste should be defined as 'waste generated by households, excluding end-of-life vehicles, as well as non-hazardous waste from other waste generators, which because of its nature or composition is similar to waste generated by households'.

The classification of municipal waste is based on various criteria, such as the origin, raw material, chemical composition, state of matter, toxicity, level of environmental risk or potential for further use

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(Adamska & Smol, 2018). Municipal waste is a mixture of different types of waste, such as biodegradable waste, packaging, green waste, hazardous waste or minerals (Brattebo & Bisaillon, 2018).

Municipal waste management is a key aspect of environmental protection and cleanliness in municipalities, which requires the use of adequate waste storage, collection and transport processes, as well as the introduction of innovative technological solutions that can have a positive impact on the quality of the environment, while contributing to reducing the amount of waste generated. According to Tchórzewska-Cieślak and Kardaś (2018), the methods in which municipal waste is managed at the global level vary and depend on many factors, including culture, politics, economics and technology. For example, some countries prioritise recycling and the recovery of recyclable materials, while others focus on waste incineration and energy generation. Nevertheless, in all cases, it is important to use the best available technology to minimise the negative effects of waste generation on both the environment and human health.

In Poland, similarly to the rest of the world, there are various municipal waste management systems. The effectiveness of these systems is determined by many factors, including the availability of resources, the state of the infrastructure or the culture and awareness of the population. Nevertheless, there has been a growing interest in environmental and waste management issues in Poland in recent years, which has had a positive impact on the sector.

One of the key measures taken in Poland to improve municipal waste management is to increase the share of recycling and recovery of secondary raw materials and to modernise infrastructure and technology. Despite the above, many municipalities in Poland still face problems of inefficient waste management, including improper waste storage, collection and transport.

In a global context, municipal waste management is a popular problem that requires efficient processes and innovative technological solutions. An important element of improving the situation in this area is raising awareness among the population and working together locally and globally to achieve sustainable development and environmental protection.

The process of waste management at the global level is very similar to the process of waste management at the local or municipal level. The basis for effective municipal waste management is the use of the three key processes: storage, collection and transport of waste. Storage is the process of preparing waste for transport to disposal and recycling sites, which involves concentrating discarded materials in containers and holding them temporarily at an intermediate point (Kaźmierczak & Smolinski, 2019). Storage is the first process in waste management and should take place as close as possible to the point of generation. Waste collection, on the other hand, is the process of collecting already stored waste and transporting it through further links of the management system, carried out by entities specialising in this field (Rada et al., 2021).

Research has shown that the efficient functioning of the municipal waste management system relies on effective planning of the routes of waste collection vehicles. The planning is complex and depends on many factors, such as the topography of the area, population, type and amount of waste, and the availability of roads. The results of a study conducted by Daszak et al. (2018) indicate that effective route planning has a positive impact on the environment and improves the quality of life for residents. On the other hand, according to a study by Kumar et al. (2020), the use of modern technologies such as the Internet of Things can increase the efficiency of the waste collection route planning process and reduce the negative impact on the environment.

The classification of waste on the basis of different criteria enables proper waste management, including recovery and processing into secondary raw materials. The use of innovative technologies, such as thermal waste treatment technology, can help to reduce waste and improve environmental quality. Research by Cao et al. (2019) shows the effectiveness of thermal waste treatment technology in reducing waste and greenhouse gas emissions.

Current state of knowledge about waste management

The current state of knowledge on waste management focuses on the use of modern technologies, such as the Internet of Things (IoT), to improve the processes of segregation, collection, and recycling of waste. Practices include automation and remote monitoring of waste management systems, which allows for better control and efficiency. Strategies include an integrated approach to

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urban waste management, emphasising the importance of sustainable development and intelligent solutions in the context of smart cities. The urban management process highlights the need for innovative systems to optimise waste collection and processing (Bondar et al., 2022). The current state of knowledge on waste management focuses on the challenges and strategies related to municipal waste management in cities, taking into account economic, technological, and legal aspects. Waste management includes processes of generating and managing waste, including their collection, transport, and processing. A key aspect is the waste management hierarchy, which recommends prioritising actions according to the following order: waste prevention, preparation for reuse, recycling, other recovery methods (e.g., energy recovery), and waste disposal. Technical aspects of the municipal waste management system include activities such as collecting, transporting, and processing waste. Processing may generate additional wastes that require further management. It is crucial to ensure the proper operation of facilities dealing with municipal waste processing and to conduct environmental controls of potential emissions from these facilities. Mechanical and Biological Treatment (MBT) technology developed in Germany in the 1990s includes both mechanical processes (such as grinding, sieving, and sorting) and biological ones (e.g., composting). MBT systems can be simple or more developed, preparing waste not only for landfilling but also for incineration or use as materials. Landfilling concerns the permanent removal of waste that has not been otherwise utilised in designated places in a manner safe for people and the environment. Modern landfills must meet high technical requirements, including systems to protect groundwater and surface water from the impact of waste, as well as drainage and biogas management systems. The waste incineration process enables energy recovery and a significant reduction of waste volume. Incineration is the process of oxidising organic matter of waste with heat generation. Incineration of municipal and industrial wastes, especially hazardous ones, has become an essential method of their disposal. In summary, waste management in modern cities encompasses a wide range of activities from prevention, through collection and transport, to advanced processing processes such as recycling, composting, incineration, and landfilling. It is important that these processes are carried out in a sustainable and safe manner for the environment. This requires both advanced technologies and close cooperation between various waste management entities, as well as compliance with legal regulations and environmental standards (Wąsowicz et al., 2020). In conclusion, the current state of knowledge on municipal waste management is based on an integrated waste management system that includes selective collection, processing, and waste control. Practices include advanced selective collection of waste in various fractions, supervision and control of the system, and the use of modern facilities for processing and recycling waste. Strategies focus on increasing recycling efficiency and striving for a closed-loop economy, with minimising landfilling of waste and maximising their recovery. The urban management process emphasises the integration of technology and intersectoral cooperation to achieve sustainable development goals and better environmental protection (Jabłońska & Piorunowska-Kokoszko, 2023). The United Nations General Assembly adopted the 2030 Agenda for Sustainable Development, defining seventeen Sustainable Development Goals (SDGs), creating a development strategy for the entire world. The goal is to find a balance between civilisational and technological development with concern for the future of subsequent generations. In the context of waste management, effectively implemented changes contribute to the increase in value of companies, as suppliers, municipal institutions, and ecologically aware customers appreciate the actions taken, which increases trust in the company (Sagan, 2021; Sielicka et al., 2018; Hordyńska, 2021; Gralak, 2021). International law focuses on effective waste economy and citizen education (Mosnegutu et al., 2020). Ecological solutions, such as cooperation with recycling companies, optimisation of production processes, and the introduction of a closed-loop raw material system, lead to cost reduction and a positive environmental impact (Nowaczek et al., 2019; Dziawgo, 2022; Dacko et al., 2019).

In conclusion, municipal waste management is a global issue that requires effective solutions at both local and global levels (Smith & Jones, 2022). To achieve efficient waste management, appropriate waste storage, collection and transportation processes should be used (Chen et al., 2021), as well as innovative waste treatment technologies should be used to reduce waste and improve environmental quality (Liu & Wang, 2023). A review of the literature shows that municipal waste management is a complex process that requires effective planning, organisation, control and research (Gupta & Sharma, 2022). Appropriate waste management is key when it comes to protecting the environment, improving the quality of life for residents and promoting sustainability (Wilson, 2023).

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Based on the presented literature, the following hypotheses and research questions were formulated:

Research hypotheses:

1. Factors affecting the functioning of the municipality determine the performance of the municipal waste management system.
2. Including waste management activities in the municipal management process contributes to improving the performance of the waste collection system as well as increasing recycling and reducing municipal waste.

Research questions:

1. Do municipalities carrying out an annual analysis of the state of waste management achieve the officially required levels of recycling and preparation for reuse of waste in the municipal management process?
2. In rural municipalities, are the measures taken in the waste management process impacted by the needs of the local community?
3. In urban or urban-rural municipalities, are the measures taken in the waste management process impacted by consumerism?
4. In municipalities where the state of the environment strongly impacts the measures taken in the waste management process, is the level of recycling and preparation for reuse of the municipal waste fractions, i.e. paper, metals, plastics and glass, a strength?
5. Is the strength of the municipalities supervising municipal waste management the collection system for used electrical and electronic equipment and large-size waste?
6. In municipalities where waste prevention measures are taken in the management process, is there no problem with wild dumps?

In order to confirm or refute the hypotheses presented and to answer the research questions, an empirical study based on the analysis of survey data of a selected group of municipalities in Poland was carried out. This approach will provide a broad spectrum of information and ensure a better understanding of municipal waste management issues at the local level.

Material and methods

The research was carried out based on an analysis of empirical data obtained through a questionnaire interview in the offices of the municipality of Częstochowa and the municipalities of the district of Częstochowa, which were serviced by Częstochowskie Przedsiębiorstwo Komunalne (Częstochowa Municipal Entity). A questionnaire interview was conducted in April/June 2021 among those responsible for managing the waste management system in the municipality. The objective of the study was to obtain information on how this system functions in the municipalities of the Częstochowa district, how it is managed and how it could be developed. The data obtained from the survey made it possible to assess how the waste management system is managed in the municipalities. It should be noted that 15 unitstook part in the study, i.e.: Kamienica Polska, Janów, Blachownia, Dąbrowa Zielona, Koniecpol, Konopiska, Kruszyna, Lelów, Mstów, Mykanów, Olsztyn, Przyrów, Starcza, Kłomnice, Częstochowa. Two municipalities refused to participate in the survey, i.e. the municipalities of Rędziny and Poczesna. The survey questionnaire consisted of 27 questions. The study conducted made it possible to present the functioning of the waste management system in the municipalities under study. They also provided the basis for further research, including a SWOT/TOWS analysis identifying the strategy and the internal and external factors affecting the waste management system in the municipal management process. On the basis of the survey material collected, the relationship between the elements of the waste management system and the factors influencing the municipal management process was also assessed. Fisher's exact test was used to test the relationship between the nominal data. Fisher's test is one type of statistical test to verify hypotheses about the value of variance in a population. It is also referred to as the F. Fisher's test, and it is recommended for small samples. It is the equivalent of the chi-square test (Magiera, 2018). Additionally, the study presents the values of the

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V-Cramer coefficient, which is the force of the effect and allows the measurement of the relationship between two variables (it takes values from 0 to 1; the closer to 1, the greater the strength of the relationship between variables). The study was carried out in the R statistical package (significance level adopted $\alpha = 0.05$).

Results

Synthetic evaluation of the results of surveys on the functioning of the municipal waste management system in the municipal management process

In the questionnaire survey, addressed to the municipal offices of the Częstochowa district and the City of Częstochowa, the largest group of respondents were rural municipalities (n = 12; 80%). Blachownia and Koniecpol represented urban-rural municipalities (n = 2; 13.3%), while Częstochowa represented urban municipalities (n = 1; 6.7%). The research indicated that most municipalities do not have waste management plans (n = 12; 80%). The creation of the above documents as indicated by the municipalities of Blachownia, Konopiska and Olsztyn (n = 3; 20%). A waste management plan is a document aiming to coordinate the activities of municipalities to create waste management systems. At the local government level, provincial waste management plans are developed; however, in the authors' opinion, municipalities should develop separate municipal waste management plans, as these would be tailored to the specifics of the individual unit and would affect the efficiency of the tasks in its management process. Action plans aimed at achieving waste management goals in the long term would constitute the manifestation of this efficiency. Of the municipalities that declared the creation of waste management plans, the units of Konopiska and Olsztyn indicated that the city/municipality plans waste management activities in a one-year perspective (n = 2; 66.7%). Planning in a 2-3 year perspective was indicated by the municipality of Blachownia (n = 1; 33.3%). In the authors' opinion, a long-term perspective should be taken into account when it comes to the municipal management process, as it determines the right decisions regarding the functioning of the waste management system in the municipality and will limit the possibility of unforeseen phenomena occurring in the future, which include the possibility of changes in national and EU regulations, changes in the economy, changes in consumer attitudes, reorganisation of production processes, demographic changes and technical and infrastructural changes.

In the next question, respondents were asked to provide information on the extent to which individual factors impact the waste management activities undertaken in the city/municipality. From the results obtained, it can be concluded that: The example of a bulleted list:

- national and legal regulations in ten municipalities influence the measures taken to a very high degree; five municipalities indicated that they have a strong influence on the waste management system,
- according to five units, EU legislation influences decision-making to a very high degree; four municipalities indicated a high impact of this factor on the waste management system, while in two units the impact was described as low; only the municipality of Starcza indicated that this factor does not influence decision-making,
- the needs of the local community in ten units, to a large extent, determine the decision-making regarding the waste management system; three municipalities indicated that the impact of this factor is very high, in the remaining municipalities, the needs of the local community impact the waste management activities to a medium or low degree,
- in most of the municipalities surveyed, the state of the environment impacts the waste management measures taken to a high or very high degree; only two municipalities described its impact as medium or low,
- six of the municipalities surveyed indicated that EU funds influence the waste management activities undertaken to a high degree; eight municipalities stated that this factor has no or little impact,
- ten municipalities stated that the type and characteristics of the municipality (e.g. type of development, terrain, degree of industrialisation, etc.) impact decision-making to a great or very great extent; while three do not notice the impact of this factor,
- in seven of the municipalities surveyed, demographic changes had a major impact on waste management activities, while seven surveyed units indicated that there was little or no impact,

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- in most of the municipalities surveyed, consumerism influences the waste management measures taken to a large extent; four municipalities, on the other hand, described this influence as low,
- eleven municipalities indicated that economic opportunities impact the waste management measures taken to a large or very large extent, while in three the impact is small or non-existent,
- in most of the municipalities surveyed, technical and organisational capacities influence the waste management measures taken to a great or very great extent.

The above data indicates that most of the listed factors have a significant impact on the municipal waste management activities undertaken. Taking them into account in the management process is therefore an essential element to enable managers to make the right decisions.

The questionnaire also asked, "Who in the unit is responsible for organising the waste management system?" In the majority of municipalities, a dedicated unit is responsible for this area (n = 13; 86.7%). In the other organisational units, this is the responsibility of the interdepartmental team in the municipality of Mstów (n = 1; 6.7%) and the Spatial Management and Environmental Protection Department in the municipality of Kłomnice (n = 1; 6.7%). According to the authors, it is important to entrust the organisation of the waste management system to an appropriate organisational unit. As this is an area of activity involving complex tasks and issues, the appointment of qualified staff is an essential part of the municipalities' organisational structure.

Another aspect addressed in the survey was the tasks carried out by the units responsible for organising the waste management system. The most common tasks carried out by those units include ensuring that all property owners in the municipality are covered by the municipal waste management system (n = 13; 86.7%) as well as supervising municipal waste management, including carrying out the tasks entrusted to entities collecting municipal waste from property owners (n = 13; 86.7%). The obligation to include all property owners in the municipality in the waste management system results from the legal regulations imposed on the local authority. Therefore, this is an action that is a priority for the municipality.

In the subsequent question, respondents were asked to indicate the most frequently used waste management tools. According to respondents, those include economic tools (n = 11; 73.3%), legislative tools (n = 10; 66.7%) and rationing tools (n = 7; 46.7.3%). Municipalities largely focus on the economic aspect (the availability of appropriate funding sources), which determines the establishment of a properly functioning waste management system. On the other hand, the method of determining the waste management fee most often depends on the number of residents living in a property (n = 13; 86.7%). In the municipality of Blachownia, the fees are based on the volume of water used (n = 1; 6.7%), while the municipality of Częstochowa has adopted a mixed system (n = 1; 6.7%). According to the authors, not all methods used by municipalities fully reflect the actual amount of waste generated by a given household. The amount of waste collected and the type of waste should be precisely controlled. According to the authors, this is achievable through the introduction of modern technologies for recording the waste collected from properties. Technology should be implemented to improve data reading and transmission, such as RFID (*Radio Frequency Identification*), which makes it possible to control the collection of waste from a property by monitoring municipal waste data (type, weight of waste). It may also be possible, particularly in multi-family buildings, to use smart waste bins equipped with a QR code reader to check the type and weight of waste handed in by a given household. Consequently, the activities of the municipal authorities should focus on collecting and communicating information on the amount and type of waste and its harmful impact on the environment, which would contribute to reducing the amount of waste and increasing the share of selective collection, resulting in a reduction in fees in the long term.

In the significant majority of municipalities, the collection of municipal waste from property owners is carried out through external operators (n = 12; 80%). In the case of the Janów and Przyrów municipalities, this is the responsibility of the municipal organisational unit (n = 2; 13.3%), and in the case of the municipality of Koniecpol – of the municipal company (n = 1; 6.7%). In the authors' view, it makes sense to outsource these tasks. These organisations specialise in the area of waste collection. Additionally, there are a number of waste management companies operating on the market and therefore, municipalities can choose the most favourable offer in terms of price.

All survey participants confirmed that there is a PSZOK (selective collection point for municipal waste) functioning in their municipality/city (n = 15; 100%), 1 stationary PSZOK (n = 15; 100%). This

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is beneficial in terms of increasing the level of separate waste collection, as well as improving the waste transport system. This is primarily due to the size of the municipalities analysed, where the number of such points is sufficient to cover the needs of residents in terms of municipal waste management. A PSZOK is most often operated by the municipality itself (*n* = 11; 73.3%), while in the Koniecpol municipality this task was assigned to the Municipal Company (n = 1; 6.7%); in the Janów municipality by means of an external entity selected by tender (*n* = 1; 6.7%); in the Częstochowa municipality by means of a commercial company (n = 1; 6.7%); in the Mstów municipality by means of its own budgetary establishment (*n* = 1; 6.7%).

The surveys also indicated that wild dumps are present in more than 50% of the municipalities (*n* = 8; 53.3%). In the remaining units, no prevalence of this type of landfill was found (*n* = 7; 46.7%). According to the authors, municipalities should focus on solving the problem of wild dumps as this is a phenomenon that has a very negative impact on the municipal environment. In municipalities where 'wild dumps' were present, one (*n* = 2; 25%), or two (*n* = 2; 25%) such sites were most commonly found. Three wild dumps were analysed in the municipality of Dąbrowa Zielona, while four were analysed in the municipality of Blachownia. This means that these municipalities should focus their efforts on their removal and increase control activities in areas where there is a tendency for communities to leave waste behind.

In most municipalities, an analysis of the state of waste management is carried out annually (*n* = 13; 86.7%). This type of explication is not carried out in the municipalities of Dąbrowa Zielona and Częstochowa (*n* = 2; 13.3%). The authors are of the opinion that all municipalities should analyse the state of waste management on an annual basis, as this makes it possible to introduce measures that aim at improving it.

The required levels of recycling and preparation for reuse of waste were achieved in the following municipalities: Janów, Blachownia, Koniecpol, Konopiska, Lelów, Olsztyn, Starcza, Częstochowa (57.1%). In the remaining municipalities under study, those levels were not achieved (*n* = 6; 42.9%). According to the authors, the fact that more than 40% of municipalities have not reached the required levels of recycling and preparation for the reuse of waste is to be assessed negatively. It should be a priority for the authorities of these units to take measures to achieve this goal, i.e. to educate society on the proper waste segregation and to implement measures to mobilise property owners to ensure selective waste collection (e.g. through a system of reduction in management fees). It is important to raise awareness among residents of the harmful impact of waste on the environment and also on the lives of future generations.

The largest proportion of the municipalities under study found it difficult to clearly address the impact of the waste management status analysis on performance management (*n* = 6; 42.9%). In the municipalities of Blachownia and Olsztyn, the analysis of the state of the economy has a decisive impact on the actions to be taken. The municipalities of Konopiska, Mykanów, Przyrów and Kłomnice were found to be indirectly impacted by the study. In the municipality of Janów, on the other hand, they are not impacted at all by the analysis, and in the municipality of Mstów, they are only slightly impacted. According to the authors, an analysis of the state of waste management should be carried out in municipalities, as it reflects the actual situation and makes it possible to focus the measures taken towards specific objectives.

Survey participants were asked to assess the strengths and weaknesses of the city/municipality. The results obtained are shown in Table 1.

Table 1. Strengths and weaknesses of the analysed municipalities in the area of municipal waste management

Variable	Number of responses N	Structure of responses n [%]
Degree of waste separation		
Strength	7	46.7%
Weakness	8	53.3%
Technical and road infrastructure		
Strength	11	73.3%
Weakness	4	26.7%

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Variable	Number of responses N	Structure of responses n [%]
Development of economic activities in the area of recycling		
Strength	4	26.7%
Weakness	11	73.3%
Staff		
Strength	13	86.7%
Weakness	2	13.3%
A system contributing to environmental education of the society and positive pressure among residents		
Strength	9	60.0%
Weakness	6	40.0%
Waste management fees		
Strength	9	60.0%
Weakness	6	40.0%
Scope of measures taken to prevent waste generation		
Strength	9	9 (60.0%)
Weakness	6	6 (40.0%)
Used electrical and electronic equipment collection system		
Strength	15	100.0%
Weakness	0	0%
Large size waste collection system		
Strength	15	100.0%
Weakness	0	0%
Level of reduction of biodegradable municipal waste transferred to landfills		
Strength	12	80.0%
Weakness	3	20.0%
Level of municipal waste generated in the city/municipality		
Strength	9	60.0%
Weakness	6	40.0%
Number of PSZOK (selective collection point for municipal waste)		
Strength	10	66.7%
Weakness	5	33.3%
Number of wild dumps		
Strength	9	60.0%
Weakness	6	40.0%
Level of recycling and preparation for reuse of municipal waste fractions: paper, metals, plastic and glass		
Strength	9	60.0%
Weakness	6	40.0%
Access to waste treatment systems		
Strength	4	26.7%
Weakness	11	73.3%
City/municipal budget		
Strength	3	20.0%
Weakness	12	80.0%
Level of technical and technological development of the city/municipality		

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Variable	Number of responses N	Structure of responses n [%]
Strength	5	33.3%
Weakness	10	66.7%

All the municipalities analysed mentioned the large-size waste and used electrical and electronic equipment collection systems among their strengths. On the other hand, the most frequently mentioned weaknesses included the city's budget and access to waste treatment systems, as well as the development of recycling businesses.

Another issue raised in the survey was the opportunities for municipalities in specific areas. The results obtained are shown in Table 2.

Table 2. Opportunities for the municipalities analysed to manage the municipal waste management system

Variable	Number of responses N	Structure of responses n [%]
Expansion plan for waste treatment systems in the region		
Yes	2	2 (13.3%)
No	13	13 (86.7%)
Creating a sustainable waste management system based on the waste management hierarchy		
Yes	7	7 (46.7%)
No	8	8 (53.3%)
Functioning of EU programmes supporting the development of environmental infrastructure		
Yes	6	40.0%
No	9	60.0%
Implementation of new management technologies		
Yes	6	6 (40.0%)
No	9	9 (60.0%)
Available financial support for developing a waste management system		
Yes	9	60.0%
No	6	40.0%
Effective inter-city/inter-municipal cooperation in the region		
Yes	7	46.7%
No	8	53.3%
Increasing the number of waste recovery systems, including technology development		
Yes	6	40.0%
No	9	60.0%
Managing waste for energy purposes		
Yes	6	40.0%
No	9	60.0%
Implementation of new technologies (using the best available techniques), including in the area of environmental protection, which will result in a reduced amount of waste		
Yes	6	40.0%
No	9	60.0%
Increased awareness/environmental education of the society		
Yes	15	100.0%
No	0	0%
Development of technological infrastructure		
Yes	7	7 (46.7%)
No	8	8 (53.3%)

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Variable	Number of responses N	Structure of responses n [%]
Increase control of proper compliance with waste management regulations		
Yes	13	86.7%
No	2	13.3%

The results obtained for the variables, shown in Table 2, were presented in descending order:

- increased awareness/environmental education of the society: yes (n = 15; 100.0%),
- increase control of proper compliance with waste management regulations: yes (n = 13; 86.7%),
- available financial support for developing a waste management system: yes (n = 9; 60.0%),
- creating a sustainable waste management system based on the waste hierarchy: yes (n = 7; 46.7%),
- effective inter-city/inter-municipal cooperation in the region: yes (n = 7; 46.7%),
- development of technological infrastructure: yes (n = 7; 46.7%),
- functioning of EU programmes supporting the development of environmental infrastructure: yes (n = 6; 40.0%),
- implementation of new management technologies: yes (n = 6; 40.0%),
- increasing the number of waste recovery systems, including technology development: yes (n = 6; 40.0%),
- managing waste for energy purposes: yes (n = 6; 40.0%),
- implementing new technologies (using the best available techniques), including environmental protection, resulting in a reduction of waste: yes (n = 6; 40.0%),
- plan for expansion of waste treatment facilities in the region: yes (n = 2; 13.3%).

The opinions of respondents on the risks of the cities/municipalities in each aspect are presented in Table 3 below.

Table 3. Percentage distribution of responses to the question on the risks of the surveyed municipalities relating to the management of the municipal waste management system

Variable	Number of responses N	Structure of responses n [%]
Small number of RIPOKs (Regional Municipal Waste Treatment Systems) leading to a lack of competition (monopolisation of prices)		
Yes	10	10 (66.7%)
No	5	5 (33.3%)
Waste incineration in domestic furnaces		
Yes	11	11 (73.3%)
No	4	4 (26.7%)
Increased level of obligations imposed on the city/municipality in the area of waste management		
Yes	14	93.3%
No	1	6.7%
Changes in the national and EU legislations		
Yes	10	66.7%
No	5	33.3%
Environment contamination by waste entering it in an uncontrolled manner, including illegal procedures for the collection of municipal waste as well as generation and management of waste generated in the course of business activities		
Yes	10	66.7%
No	5	33.3%
Failure to achieve indicators related to waste recovery and recycling		
Yes		86.7%
No		13.3%
Consumption level increase		
Yes	14	93.3%
No	1	6.7%

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Variable	Number of responses N	Structure of responses n [%]
Low environmental awareness of the society		
Yes	10	66.7%
No	5	33.3%
Lack of support for cities/municipalities with regard to the waste management system		
Yes	13	86.7%
No	2	13.3%
High costs of the waste management system operation		
Yes	15	100.0%
No	0	0%
Slow investment process when it comes to setting up separate collection points for municipal waste		
Yes	8	53.3%
No	8	46.7%
Shortage of funds		
Yes	14	93.3%
No	1	6.7%

In order to isolate the most frequently listed threats when it comes to the development of the waste management system in the region, the positive results obtained for the variables presented in Table 3 were arranged in descending order:

- high costs of the waste management system operation: yes (n = 15; 100.0%),
- increased level of obligations imposed on the city/municipality in the area of waste management: yes (n = 14; 93.3%),
- increased level of consumption: yes (n = 14; 93.3%),
- shortages of funds: yes (n = 14; 93.3%),
- failure to achieve indicators related to waste recovery and recycling: yes (n = 13; 86.7%),
- lack of support for cities/municipalities with regard to the waste management system: yes (n = 13; 86.7%),
- waste incineration in domestic furnaces: yes (n = 11; 73.3%),
- small number of RIPOKs (Regional Municipal Waste Treatment Systems) leading to a lack of competition (monopolisation of prices): yes (n = 10; 66.7%),
- changes in the national and EU legislations: yes (n = 10; 66.7%),
- environment contamination by waste entering it in an uncontrolled manner, including illegal procedures for the collection of municipal waste as well as generation and management of waste generated in the course of business activities: yes (n = 10; 66.7%),
- low environmental awareness of the society: yes (n = 10; 66.7%),
- slow investment process when it comes to setting up separate collection points for municipal waste: yes (n = 8; 53.3%).

The results obtained in the questions regarding the strengths and weaknesses of the municipality and the opportunities and threats, occurring in the internal and external environment of the municipality, and affecting the management process in terms of waste management, formed the basis for the SWOT/TOWS analysis carried out in the further section of the study.

The survey participants were also asked to indicate the frequency of problems associated with waste management in the city/municipality. The results obtained through the survey were listed in descending order:

- shortage of funds: very often (n = 6; 40.0%), on average (n = 5; 33.3%), often (n = 3; 20.0%), rarely (n = 1; 6.7%),
- difficulty in adapting to the requirements of national legislation: often (n = 6; 40.0%), on average (n = 4; 26.7%), very often (n = 2; 13.3%), rarely (n = 2; 13.3%), not at all (n = 1; 6.7%),
- difficulty in complying with EU regulations: often (n = 6; 40.0%), rarely (n = 4; 26.7%), on average (n = 3; 20.0%), very often (n = 1; 6.7%), not at all (n = 1; 6.7%),

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- low level of environmental awareness among residents: on average (*n* = 6; 40.0%), often (*n* = 5; 33.3%), very often (*n* = 2; 13.3%), rarely (n = 2; 13.3%),
- occurrence of wild dumps: rarely (*n* = 5; 33.3%), often (*n* = 4; 26.7%), very often (*n* = 2; 13.3%), on average (n = 2; 13.3%), not at all (*n* = 2; 13.3%),
- low level of waste segregation: very often (*n* = 6; 40.0%), on average (*n* = 5; 33.3%), often (*n* = 3; 20.0%), rarely (*n* = 1; 6.7%),
- lack of effective tools to enforce separate waste collection by residents: often (*n* = 6; 40.0%), on average (*n* = 4; 26.7%), rarely (*n* = 3; 20.0%), very often (*n* = 2; 13.3%),
- lack of adequate technical and road infrastructure: rarely (*n* = 7; 46.7%), not at all (*n* = 3; 20.0%), often (*n* = 2; 13.3%), on average (n = 2; 13.3%), very often (n = 1; 6.7%),
- lack of developed methods and tools to manage the waste management system: rarely (*n* = 7; 46.7%), on average (*n* = 4; 26.7%), very often (*n* = 2; 13.3%), often (*n* = 1; 6.7%), not at all *(n* = 1; 6.7%).

In all municipalities that participated in the study, information and education activities on proper waste management, including separate collection, were undertaken (*n* = 15; 100%). This represents a positive phenomenon, determining an increased awareness of the harmfulness of waste.

In the next questionnaire interview question, respondents were asked to answer what information and education measures on proper waste management, including separate collection among residents, were taken by the municipality. The question was descriptive in nature. The research has evidenced that municipalities use a variety of tools to carry out education and information activities on waste management. Both web-based activities and marketing materials, i.e. flyers and posters, as well as direct education in schools and kindergartens are used. Educational activities should be targeted individually to residents, taking into account their age groups. Due to environmental reasons, efforts should be made to minimise paper-based information flow in favour of electronic information flow. Modern forms of education, using online tools, make it possible to reach a wider audience. Innovative techniques for monitoring the volume of waste collected can also have a beneficial effect on the level of environmental awareness, which should make it possible to obtain individual data on each household, thus making residents aware of the scale of the waste management problem.

The majority of cities/municipalities do not plan any new investments related to waste collection, management, treatment and disposal (*n* = 13; 86.7%). Only the municipalities of Blachownia and Częstochowa indicated that such projects are planned in their city/municipality (*n* = 2; 13.3%). Units that confirmed the planning of investments related to waste collection, management, treatment and disposal were asked to identify them. Blachownia pointed to the expansion of the PSZOK, and Częstochowa indicated the creation of a recycling centre.

According to the authors, the activities of municipalities should focus more on the implementation of investments, related to waste management. Economic development contributes to increasing consumption, which determines the generation of more waste. Dynamic changes in this area obligate municipalities to continuously develop their waste management system, which they can do, according to the authors, through technical and infrastructural investments.

In the last questionnaire interview question, respondents were asked to indicate the waste management system management activities targeted by the city/municipality. In all the municipalities analysed, the most common activities implemented by the municipalities in terms of waste management system include: raising environmental awareness among the local society (*n* = 15; 100%) in the following municipalities: Kamienica Polska, Janów, Blachownia, Dąbrowa Zielona, Koniecpol, Kruszyna, Lelów, Olsztyn, Starcza, Częstochowa, and management aimed at implementing measures to increase the level of selective collection (*n* = 10; 100%) in the following municipalities: Kamienica Polska, Janów, Blachownia, Dąbrowa Zielona, Kruszyna, Mykanów, Starcza, Kłomnice and Częstochowa (*n* = 9; 100%). According to the authors, these measures are crucial for the proper operation of the waste management system in the municipality.

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Identification of strategies as well as internal and external factors impacting the waste management system in the municipal management process – SWOT/TOWS analysis

The strengths, weaknesses, opportunities and threats presented in Table 4 have been compared in terms of the strength of their mutual impact. SWOT/TOWS analysis allows you to answer questions about how its elements to be assessed (opportunities, threats, strengths, weaknesses) influence each other. Tables 5-14 present the identified groups of factors and assess their mutual influence. Strengths, weaknesses, opportunities, threats and interactions between them were specified. Conducting a TOWS/SWOT analysis consists of several stages. In stage I, answers are obtained to the question: "Will the identified strengths allow us to take advantage of the opportunities?" The next stage is to answer the question, "Will the identified strengths allow you to overcome the threats?" In stage III of the analysis, the answer to the question should be answered: "Will the identified weaknesses prevent the use of available opportunities?" The final, fourth stage of the analysis is to answer the question: "Will the identified weaknesses strengthen the impact of threats?" Tables 5-14 present relationships that enable determining the strength of impact and interaction of individual elements of the TOWS/SWOT analysis in the studied communes.

Table 4. Results of the SWOT analysis of municipalities in the aspect of managing the waste management system

SWOT analysis			
Strengths	**Scales**	**Weaknesses**	**Scales**
1. Bulky waste collection system	0.3	1. City/municipal budget	0.3
2. Collection system for waste electrical and electronic equipment	0.3	2. Access to waste processing installations	0.25
3. Staff	0.20	3. Development of business activities in the field of recycling	0.25
4. The level of reducing the mass of biodegradable municipal waste sent to landfills	0.15	4. Level of technical and technological development of the city/municipality	0.15
5. Technical and road infrastructure	0.05	5. Degree of waste segregation	0.05
total sum	*1*	*total sum*	*1*
Opportunities	**Scales**	**Threats**	**Scales**
1. Increasing ecological awareness of society/ecological education	0.3	1. High costs of operating the waste management system	0.3
2. Increasing control over proper compliance with waste management regulations	0.25	2. Increasing obligations imposed on the commune in the field of waste management	0.2
3. Available financial support for the development of the waste management system	0.2	3. Increase in the level of consumption	0.2
4. Creation of a waste management system consistent with the principle of sustainable development and based on a hierarchy of waste management methods	0.125	4. Shortages of financial resources	0.2
5. Effective intercity/intermunicipal cooperation in the region	0.125	5. Failure to achieve indicators related to waste recovery and recycling	0.1
total sum	*1*	*total sum*	*1*

A SWOT/TOWS analysis, which includes four steps and consists of identifying opportunities and threats and comparing them with the strengths and weaknesses of the municipalities under study, was conducted to determine the strategic position of the municipalities under study regarding municipal waste management. In the course of the study, a summary table was prepared, and the results of the SWOT/TOWS analysis are presented in Table 5.

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Table 5. Step 1 – SWOT analysis: Strengths/Opportunities

Strengths/ Opportunities		Strengths					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Opportunities	1	1	1	0	1	0	0.3	3	0.9	2
	2	1	1	1	1	1	0.25	5	1.25	1
	3	1	1	1	1	0	0.2	4	0.8	3
	4	1	1	1	1	1	0.125	5	0.625	4
	5	0	0	1	0	1	0.125	2	0.25	5
Weight		0.3	0.3	0.2	0.15	0.05				
Number of interactions		4	4	4	4	3				
Product of weights and interactions		1.2	1.2	0.8	0.6	0.15				
Rank		½	½	3	4	5				
The sum of interactions		38/2								
The sum of products		7.775								

Table 6. Step 1 – TOWS analysis: Opportunities/Strengths

Opportunities/Strengths		Opportunities					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Strengths	1	1	1	0	1	0	0.3	3	0.9	2/3
	2	1	1	0	1	0	0.3	3	0.9	2/3
	3	1	1	1	1	1	0.2	5	1	1
	4	1	1	1	1	1	0.15	5	0.75	4
	5	0	0	1	0	1	0.05	2	0.1	5
Weight		0.3	0.25	0.2	0.125	0.125				
Number of interactions		4	4	3	4	3				
Product of weights and interactions		1.2	1	0.6	0.5	0.375				
Rank		1	2	3	4	5				
The sum of interactions		36/2								
The sum of products		7.325								

Table 7. Step 2 – SWOT analysis: Strengths/Threats

Strengths/Threats		Strengths					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Threats	1	0	0	1	1	1	0.3	3	0.9	1
	2	0	0	0	0	0	0.2	0	0	5
	3	0	0	1	0	0	0.2	1	0.2	4
	4	0	0	1	1	0	0.2	2	0.4	3
	5	1	1	1	1	1	0.1	5	0.5	2
Weight		0.3	0.3	0.2	0.15	0.05				
Number of interactions		1	1	4	3	2				
Product of weights and interactions		0.3	0.3	0.8	0.45	0.1				
Rank		3/4	3/4	1	2	5				
The sum of interactions		22/2								
The sum of products		3.95								

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Table 8. Step 2 – TOWS analysis: Threats / Strengths

Threats / Strengths		Threats					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Strengths	1	1	1	1	1	1	0.3	5	1.5	1/2
	2	1	1	1	1	1	0.3	5	1.5	1/2
	3	0	1	0	1	0	0.2	2	0.4	4
	4	1	1	1	1	1	0.15	5	0.75	3
	5	1	0	0	1	0	0.05	2	0.1	5
Weight		0.3	0.2	0.2	0.2	0.1				
Number of interactions		4	4	3	5	3				
Product of weights and interactions		1.2	0.8	0.6	1	0.3				
Rank		1	3	4	2	5				
The sum of interactions		38/2								
The sum of products		8.15								

Table 9. Step 3 – SWOT analysis: Weaknesses/Opportunities

Weaknesses/Opportunities		Weaknesses					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Opportunities	1	0	1	1	1	1	0.3	4	1.2	1
	2	0	1	0	0	1	0.25	2	0.5	2/3/4
	3	0	0	0	0	1	0.2	1	0.2	5
	4	1	1	1	1	0	0.125	4	0.5	2/3/4
	5	0	1	1	1	0	0.125	4	0.5	2/3/4
Weight		0.3	0.2	0.2	0.2	0.1				
Number of interactions		1	4	3	3	3				
Product of weights and interactions		0.3	0.8	0.6	0.6	0.3				
Rank		4.5	1	2/3	2/3	4/5				
The sum of interactions		29/2								
The sum of products		5.5								

Table 10. Step 3 – TOWS analysis: Opportunities/Weaknesses

Weaknesses/Opportunities		Opportunities					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Weaknesses	1	0	0	1	0	0	0.3	1	0.3	4
	2	0	0	1	1	1	0.25	3	0.75	1
	3	0	0	1	1	0	0.25	2	0.5	2
	4	0	0	1	1	1	0.15	3	0.45	3
	5	1	1	1	1	0	0.05	4	0.2	5
Weight		0.3	0.25	0.2	0.125	0.125				
Number of interactions		1	1	5	4	2				
Product of weights and interactions		0.3	0.25	1	0.5	0.25				
Rank		3	4/5	1	2	4/5				
The sum of interactions		26/2								
The sum of products		4.5								

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Table 11. Step 4 – SWOT analysis: Weaknesses/Threats

Weaknesses/Opportunities		Weaknesses					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Threats	1	1	1	0	1	1	0.3	4	1.2	1
	2	0	0	0	0	1	0.2	1	0.2	4/5
	3	0	0	0	0	1	0.2	1	0.2	4/5
	4	1	0	0	1	0	0.2	2	0.4	2/3
	5	0	1	1	1	1	0.1	4	0.4	2/3
Weight		0.3	0.25	0.2	0.15	0.05				
Number of interactions		2	2	1	3	4				
Product of weights and interactions		0.6	0.5	0.2	0.45	0.2				
Rank		1	2	4/5	3	4/5				
The sum of interactions		24/2								
The sum of products		4.35								

Table 12. Step 4 – TOWS analysis: Threats /Weaknesses

Threats /Weaknesses		Opportunities					Weight	Number of interactions	Product of weights and interactions	Rank
		1	2	3	4	5				
Threats	1	1	1	0	1	1	0.3	4	1.2	1
	2	0	1	0	0	0	0.25	1	0.25	4/5
	3	1	1	1	1	0	0.2	4	0.8	2
	4	1	1	0	1	0	0.15	3	0.45	3
	5	1	1	1	1	1	0.05	5	0.25	4/5
Weight		0.3	0.2	0.2	0.2	0.1				
Number of interactions		4	5	2	4	2				
Product of weights and interactions		1.2	1	0.4	0.8	0.2				
Rank		1	2	4	3	5				
The sum of interactions		34/2								
The sum of products		6,55								

Table 13. Results of the SWOT/TOWS analysis for the analysed municipalities in the aspect of managing the waste management system

Combination	SWOT analysis result		TOWS analysis result		Collective summary for SWOT/TOWS	
	Sum of interactions	Sum of products	Sum of interactions	Sum of products	Sum of interactions	Sum of products
Strengths / Opportunities	38/2	7.775	36/2	7.325	74/2	15.1
Strengths / Threats	22/2	3.95	38/2	8.15	60/2	12.1
Weaknesses / Opportunities	29/2	5.5	26/2	4.5	55/2	10
Weaknesses / Threats	24/2	4.35	34/2	6.55	58/2	10.9

With the results of the survey, it was noted that both the sum of the interactions and the products were highest for the strengths/opportunities combination. Based on the presented results of the SWOT/TOWS analysis, a strategy matrix was drawn up and is presented in Table 14.

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Table 14. Strategy matrix for the analysed municipalitiesin terms of managing the waste management system

	Opportunities	Threats
Strengths	Aggressive strategy Number of interactions – 74/2 Weighted number of interactions – 15.1	Conservative strategy Number of interactions – 60/2 Weighted number of interactions – 12.1
Weaknesses	Competitive strategy Number of interactions – 55/2 Weighted number of interactions – 10	Defensive strategy Number of interactions – 58/2 Weighted number of interactions – 10.9

As a result of the analysis of the research presented, the authors identified the most favourable strategy for the municipalities under study in terms of managing the waste management system. As you can see from the data presented in Table 13, the analysed municipalities in the Częstochowa district should adopt an aggressive strategy when managing the waste management system. An aggressive strategy refers to strong expansion and growth using the advantage of strengths and opportunities. Its essence consists of an attempt to achieve synergies by maximising the strengths of the unit and capitalising on opportunities. In managing the waste management system, municipalities should take measures aimed at expansion and diversified development based on the strengths identified in the internal environment while taking advantage of emerging opportunities in the external environment. For the municipalities under study, aspects of a properly functioning collection system for large-size waste and used electrical and electronic equipment should be exploited, using proper models to further develop the system among the other waste fractions. The units analysed should also take advantage of the experience of the staff to develop further measures and make maximum use of their technical infrastructure. These activities should be closely linked to opportunities arising in the municipality's environment (use of financial support for the systematic development of the waste management system). In their activities aimed at developing the waste management system, municipalities should take advantage of the benefits determined by increasing the environmental awareness of the population and apply good practices stemming from the concept of sustainable development. In the management of the municipal waste management system, cooperation with other entities in the region is also an important factor, involving the exchange of experience and resources – including efficient technical and road infrastructure.

Studying the relationship between elements of the waste management system and factors influencing the municipal management process

There should be interdependencies between entities and elements of the municipal waste management system that affect its functioning. An appropriate relationship should provide social and financial benefits for the participants in the system, as well as correcting the problems that occur. This requires building appropriate institutional structures involving the municipality as well as external entities. They have diverse characteristics and are integrated into many areas of social and economic life.

This section of the study outlines the relationships affecting the waste management system in the municipal management process. A statistical and econometric study was carried out to verify 1) the research hypothesis: *The factors affecting the functioning of the municipality determine the operation of the municipal waste management system.* The proper functioning of the systemis identified with the coverage of all inhabitants by a waste management system that ensures continuous and smooth collection of waste from the municipalities and the achievement of the levels of recycling and preparation for reuse of waste required by law. Furthermore, the studymade it possible to isolate the factors impacting the management of the municipality and to present the relationship between them and the waste management system. Based on the study, the authors formulated conclusions relating to the municipal management process concerning the waste management system components.

Fisher's exact test was used to test the relationship between the nominal data. In addition, the study presents V-Cramer values. The study was carried out in the R statistical package (significance level adopted $\alpha = 0.05$).

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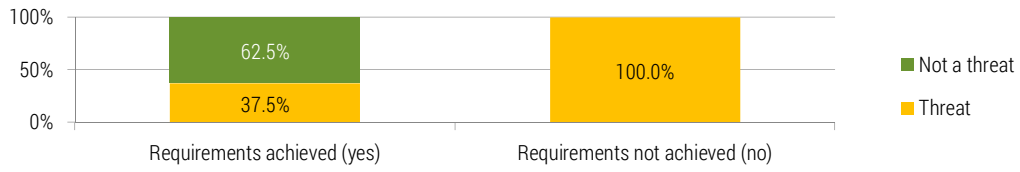
Firstly, the relationship between the achievement of the required recycling to reuse levels and changes in the national and European Union legislations (municipal risks) was assessed. The results are presented in Table 6. Of the municipalities that achieve the required levels of recycling and preparation for reuse of waste (Janów, Blachownia, Koniecpol, Konopiska, Lelów, Olsztyn, Starcza, Częstochowa), the municipalities of Janów, Koniecpol, Konopiska, Olsztyn, Przyrów (62.5%) did not indicate a threat in the form of a change in the national and European Union legislation. The remaining units consider this type of risk to be present (37.5%). In the case of municipalities that do not reach the required levels (Kamienica Polska, Kruszyna, Mstów, Mykanów, Przyrów, Kłomnice), all of them confirmed that the changes to the regulations pose a threat to the city/municipality. The result of Fisher's exact test, $p = 0.031$, shows a significant relationship between the achievement of the required levels of recycling and preparation for the reuse of waste and the threat of changes in the national and European Union legislation. The strength of the observed effect appeared to be high (V-Cramer = 0.65). The above relationship presented in Table 14 assumes that all municipalities that have not reached the target level of recycling and preparation for reuse of waste indicate changes in the national and European Union legislations as a threat. This means that these municipalities are concerned about changes to the regulations and a possible increase in the required standards they will have to meet. This is the same as bearing the consequences of not respecting these rules.

The next stage of the research was conducted to demonstrate the relationship between the degree of waste segregation (strengths/weaknesses of the city/municipality) and the level of recycling and preparation for the reuse of the following municipal waste fractions: paper, metals and plastic (strengths/weaknesses of the city/municipality). This relationship is presented in Table 15.

Table 15. Achieving the required levels of recycling and preparation for the reuse of waste vs. changes in the national and EU legislations (municipal threats)

Achievement of the required levels of recycling and preparation for the reuse of waste	Changes in the national and EU legislations (threat)		
	No	Yes	TOTAL
No	0	6	6
Yes	5	3	8
Fisher's exact test result		***p***	V-Cramer
Achieving the required levels of recycling and preparation for the reuse of waste/Changes in the national and EU legislations (threat)		0.031	0.65



The municipalities of Blachownia, Dąbrowa Zielona, Konopiska, Mykanów, Olsztyn, Starcza and Kłomnice, which estimated that the degree of waste segregation is their strength, also indicated the advantage of the level of recycling and preparation for the reuse of municipal waste fractions. Of the remaining municipalities under analysis that indicated that the degree of waste segregation was a weakness, the units of Koniecpol and Częstochowa (25.0%) expressed that the level of recycling and preparation for the reuse of waste was their strength. The municipalities of Kamienica Polska, Janów, Kruszyna, Lelów, Mstów, and Przyrów (75.0%) indicated that this is a weakness of these units. The result of Fisher's exact test accounts for the significant relationship between the degree of waste segregation and the level of recycling and preparation for the reuse of municipal waste fractions, $p = 0.007$. The strength of the observed effect appeared to be high (V-Cramer = 0.76). The relationship is shown in Table 16.

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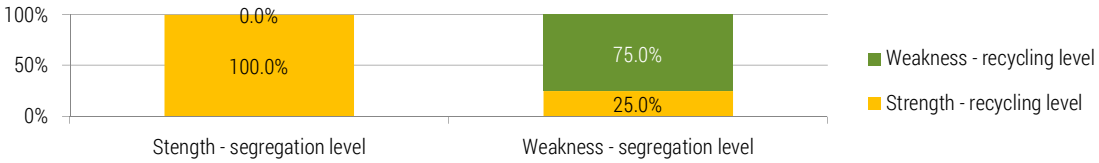
Table 16. Degree of waste separation/level of recycling and preparation for the reuse of the following municipal waste fractions: paper, metals, plastic

	Level of recycling and preparation for the reuse of the following municipal waste fractions: paper, metals, plastic		
Degree of waste separation	**Strength**	**Weakness**	**TOTAL**
Strength	7	0	7
Weakness	2	6	8
Fisher's exact test result		***p***	V-Cramer
Degree of waste separation vs. recycling and preparation for the reuse of municipal waste fractions		0.007	0.76



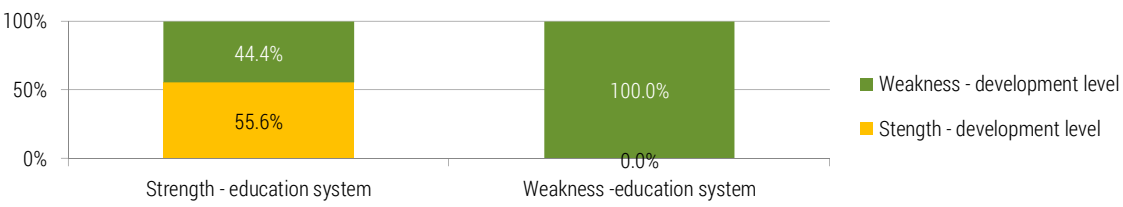
Based on the results of the study, it can be concluded that municipalities should direct their activities towards increasing the level of waste segregation, as this is one of the factors impacting the level of recycling and preparation for the reuse of municipal waste. According to legal regulations, these units are obliged to achieve the required levels of recycling and preparation for the reuse of waste, while proper segregation of waste and increasing the share of selective collection in the total mass of collected waste determines the realisation of the established plans in this respect.

The research also contains an analysis of the relationship between the system, which contributes to the environmental education of the society and positive pressure among residents (strengths/weaknesses of the municipality), and the level of technical and technological development of the municipality (strengths/weaknesses). The results are shown in Table 17.

The municipalities of Kamienica Polska, Janów, Konopiska, Lelów, Mstów, Mykanów, Przyrów, Kłomnice, Częstochowa indicated that a system that contributes to the environmental education of the society and positive pressure among residents is a strength. The municipalities of Janów, Mstów, Przyrów, Kłomnice and Częstochowa estimated the level of technical and technological development of the municipality as their asset (55.6%). The municipalities of Kamienica Polska, Konopiska, Lelów and Mykanów considered this aspect to be their weakness (44.4%).

Table 17. A system that contributes to environmental education of the society and positive pressure among residents vs. the level of technical and technological development of the municipality

A system contributing to environmental education of the society and positive pressure among residents	**Level of technical and technological development in the municipality**		
	Strength	**Weakness**	**TOTAL**
Strength	5	4	9
Weakness	0	6	6
Fisher's exact test result		***p***	V-Cramer
A system that contributes to environmental education of the society and positive pressure among residents vs. the level of technical and technological development of the municipality		0.044	0.58



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All of the municipalities that identified a system that contributes to the environmental education of the society and positive pressure among residents as a weakness also indicated the level of technical and technological development of their unit as a disadvantage. The result of Fisher's exact test shows a significant relationship between the system, favourable to the environmental education of the society and positive pressure among residents, and the level of technical and technological development of the municipality, $p = 0.044$. The strength of the observed effect appeared to be high (Cramer's V = 0.58). The relationship is shown in Table 8.

Based on the above results, it can be concluded that municipalities that are technically and technologically underdeveloped are not implementing measures to improve the system, which contributes to the environmental education of the society, which may indicate a lack of involvement of adequate resources in local development.

The next stage of the empirical research was to analyse the relationship between the level of waste management fees (strengths/weaknesses) and the low environmental awareness of the society (threats). The results are presented in Table 18. The municipalities of Dąbrowa Zielona, Koniecpol, Konopiska, Lelów, Mykanów, Olsztyn, Przyrów, Starcza, Częstochowa indicated that the amount of waste management fees is a strength of the municipality. The units of Dąbrowa Zielona, Lelów, Olsztyn, and Przyrów (44.4%) confirmed the threat of low environmental awareness, while other units denied it (55.6%).

The other surveyed units, which considered the amount of waste management fees as a weakness, also indicated the threat of low environmental awareness in society. The result of Fisher's exact test shows a significant relationship between the amount of waste management fees (strengths/weaknesses) and the low environmental awareness of the society (threats), $p = 0.044$. The strength of the observed effect appeared to be high (Cramer's V = 0.58). The relationship is presented in Table 18.

Table 18. Waste management fees (strengths/weaknesses) vs. low environmental awareness of the society (threats)

Waste management fees	Low environmental awareness of the population (threats)		
	Yes	No	TOTAL
Strength	4	5	9
Weakness	6	0	6
Fisher's exact test result		***p***	V-Cramer
waste management fees and low environmental awareness of the society		0.044	0.58

Based on the relationship shown, the authors emphasise that raising the environmental awareness of the local community should be one of the factors taken into account in the municipal management process. There is a variety of tools available to municipal authorities to increase the level of separate collection; however, raising fees for waste collection, in the absence of environmental awareness among residents, is not very effective, which does not determine the effectiveness of the waste management system.

The relationship between the level of reduction in the mass of biodegradable municipal waste sent to landfills (strengths/weaknesses) and the level of municipal waste generated in the municipality (strengths/weaknesses) was also examined. The results of the analysis are presented in Table 19.

Among the municipalities of Kamienica Polska, Janów, Blachownia, Koniecpol, Konopiska, Kruszyna, Lelów, Mstów, Mykanów, Olsztyn, Starcza, Kłomnice, which indicated that the level of limitation of the mass of biodegradable municipal waste sent to landfills is a strength of the municipality, the units of Kamienica Polska, Janów, Konopiska, Kruszyna, Lelów, Mykanów, Olsztyn, Starcza, Kłom-

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nice (75.0%) also considered the level of municipal waste generated as a strength. The municipalities of Blachownia, Koniecpol, and Mstów indicated this aspect as a weakness of their unit (25.0%).

Table 19. Level of reduction in the weight of biodegradable municipal waste sent to landfill vs. level of municipal waste generated

Level of reduction of biodegradable municipal waste transferred to landfills	Level of municipal waste generation in the municipality		
	Strength	Weakness	TOTAL
Strength	9	3	12
Weakness	0	3	3
Fisher's exact test result		***p***	V-Cramer
level of reduction in the weight of biodegradable municipal waste sent to landfills vs. the level of municipal waste generated		0.044	0.61

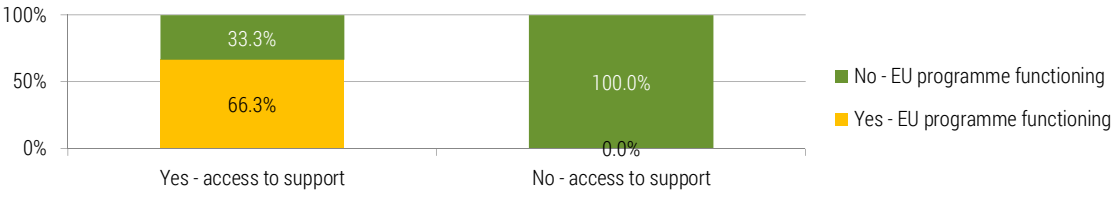
All municipalities that considered the level of reduction of the mass of biodegradable municipal waste sent to landfills as a weakness also negatively assessed the level of municipal waste generated in their area. The result of Fisher's exact test indicates a significant relationship between the level of reduction in the mass of municipal, biodegradable waste sent to landfills and the level of municipal waste generated, $p = 0.044$. The strength of the observed effect appeared to be high (V-Cramer = 0.61). The relationship is presented in Table 19.

The demonstrated relationship allows for the conclusion that in municipalities where the total mass of municipal waste is at an unsatisfactory level, the amount of biodegradable waste transferred to landfills is also not consistent with the assumption. Due to the above, municipalities should strive to increase the share of biodegradable waste in their total [waste] weight, as separating this fraction enables more effective processing.

In the course of the conducted research, the relationship between access to financial support for the development of the waste management system and the functioning of European Union programmes supporting the development of environmental protection infrastructure was analysed. The results are presented in Table 20.

Table 20. Available financial support for the development of the waste management system and the functioning of EU programmes supporting the development of environmental protection infrastructure

Available financial support for developing a waste management system	Functioning of EU programmes supporting the development of environmental infrastructure		
	Yes	No	TOTAL
Yes	6	3	9
No	0	6	6
Fisher's exact test result		***p***	V-Cramer
access to financial support for the development of the waste management system and the functioning of EU programmes supporting the development of environmental protection infrastructure		0.028	0.67



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Among the municipalities of Blachownia, Koniecpol, Kruszyna, Lelów, Mstów, Mykanów, Przyrów, Kłomnice, Częstochowa, which indicated the available financial support for the development of the waste management system as an opportunity, the units of Koniecpol, Lelów, Mykanów, Przyrów, Kłomnice, Częstochowa (66.7%) also considered the functioning of European Union programmes as an opportunity.

The result of Fisher's exact test shows a significant relationship between access to financial support for the development of the waste management system and the functioning of European Union programmes supporting the development of environmental infrastructure, $p = 0.028$. The strength of the observed effect appeared to be high (V-Cramer = 0.67). The relationship is presented in Table 20.

Based on the results of the study it can be concluded that financial support for environmental infrastructure and waste management system development is insufficient to cover the needs of municipalities. Subsidies from the central authorities are a factor determining the development of the waste management and environmental protection system for municipalities. Municipal authorities should make efforts to raise funds from external sources.

Discussion

In the course of the research process, to verify the hypotheses, the authors formulated research questions that were developed based on the collective results of the questionnaire interview.

- Do municipalities carrying out an annual analysis of the state of waste management achieve the officially required levels of recycling and preparation for the reuse of waste in the municipal management process?

In the municipalities of Janów, Blachownia, Koniecpol, Konopiska, Lelów, Olsztyn, Starcza, and Częstochowa they were achieved in the last analysed period. The Municipality of Częstochowa does not carry out an annual analysis of the state of waste management, while other units basis. The authors note that carrying out an annual analysis can be important for achieving the required levels of recycling and preparing for the reuse of waste.

- In rural municipalities, are the measures taken in the waste management process impacted by the needs of the local community?

Of the twelve rural municipalities surveyed, eleven indicated that local community needs impact waste management activities to a great or very great extent. Only the municipality of Kruszyna did not show such a relationship. According to the authors, in rural municipalities, the needs of the local community are particularly important. This is determined by the fact that in units with a small number of inhabitants, a characteristic feature of the management process is focusing on the needs of residents – including activities in the field of municipal waste management.

- In urban or urban-rural municipalities, are the measures taken in the waste management process impacted by consumerism?

Based on the responses received, it was exhibited that in the municipalities of Blachownia, Koniecpol and Częstochowa, being urban or urban-rural units, consumerism strongly impacts the waste management measures taken. According to the authors, this proves that in large units, consumerism is a common phenomenon among communities and it has a real impact on the level of generated waste, which must be properly managed.

- In municipalities where the state of the environment strongly impacts the measures taken in the waste management process, is the level of recycling and preparation for reuse of the municipal waste fractions, i.e. paper, metals, plastics and glass, a strength?

In the analysed municipalities, where the state of the environment largely affects the waste management activities, the level of recycling and preparation for reuse of municipal waste fractions: paper, metals, plastics and glass was indicated as a strength. An essential element of a well-functioning waste management system aimed at recycling and preparing for reuse is to include it in the management process.

- Is the strength of the municipalities supervising municipal waste management the collection system for used electrical and electronic equipment and large-size waste?

The survey showed that all of the analysed municipalities that supervise municipal waste management, including the implementation of tasks entrusted to entities collecting municipal waste from

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property owners, i.e. the municipalities of Częstochowa, Konopiska, Dąbrowa Zielona, Kłomnice, Mstów, Kruszyna, Blachownia, Janów, Lelów, Mykanów, Olsztyn, Kamienica Polska, Koniecpol (*n*=13), identify the system of collecting used electrical and electronic equipment and large-size waste as the strength of the unit. It should be emphasised that the supervision of the municipal waste collection system is an important element of the waste management process and determines the proper functioning of the collection system for used electrical and electronic equipment as well as large-size waste. This has a positive impact on the environment and the level of social satisfaction because the collection of electrical, electronic and large-size waste is organised in a way that enables residents to efficiently transfer waste, which in turn reduces their uncontrolled storage, and thus the negative environmental impact.

- In municipalities where waste prevention measures are taken in the management process, is there no problem with wild dumps?

The survey showed that in the municipalities of Kamienica Polska, Kruszyna, Mstów, Mykanów, and Przyrów, where there is no problem with wild dumps, the extent to which preventive measures are taken is a strength. The municipality of Olsztyn, which is not confronted with the problem of wild dumps, is the only municipality where no such relationship was found. On this basis, the author concludes that in the process of managing the waste management system, municipalities should take measures to prevent waste generation, as this supports the proper operation of the system, one of the main objectives of which is to reduce its [waste] mass. Additionally, this has an impact on reducing the amount of illegally collected waste.

This article presents considerations that prove the verification of 1) the research hypothesis: *The inclusion of waste management activities in the municipal management process, contributes to the improvement of the performance of the waste collection system and the increase of recycling and waste reduction in municipalities.*

The analysis of the results of the conducted research showed that in the municipalities where waste management activities were included in the management process, there was a visible improvement in the quality of its elements, i.e. the level of recycling and preparation for reuse of waste and the collection system for electronic, electrical andlarge-size waste. In addition, it was pointed out that these municipalities are fulfilling the social and environmental needs found in the area. The implementation of waste management tasks is an important part of the municipal management process and affects the state of the environment in the municipality. In addition, and this should be emphasised, municipal management focused on waste management determines the improvement of recycling and waste reduction rates.

Based ona study using T-Fisher, the authors verified and proved 2) the research hypothesis: *Factors affecting the operation of the municipality determine the performance of the municipal waste management system.* The results obtained allow us to conclude that the performance of the waste management system depends on the factors identified in the municipality. Therefore, they should be taken into account by the entity's authorities in the municipal management process. This enables municipal management to be directed towards achieving the objectives of the waste management system. In addition, the demonstrated relationships between the elements of the waste management system and the determinants affecting the management process of the municipality constitute the basis for modifying the existing model of the waste management system by extending it with the indicated factors.

This study has shown that municipal waste management in the surveyed local government units in Poland encounters a range of challenges, including a lack of coherent waste management plans, limited environmental awareness among residents, and insufficient financial and technological support. The results indicate that municipalities with established waste management plans achieve better outcomes in various aspects of waste management, highlighting the importance of planning and organisation of ineffective municipal waste management. It was also noted that despite existing challenges, some local government units undertake effective actions in the field of environmental education and waste segregation, indicating that the situation can be improved by focusing on informational and educational activities and strengthening technical infrastructure. In the context of the European Green Deal and the move towards a circular economy, this study sheds light on the need to integrate these concepts into local waste management strategies. A more integrated approach is required, taking into account both economic and ecological aspects, which can contribute to increas-

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ing the efficiency of waste management systems and achieving long-term sustainable development goals. Furthermore, the study's findings underscore the significant role of inter-municipal and inter-institutional cooperation in improving waste management. Such partnership can enable the exchange of experiences, resources, and best practices, which, in the long-term perspective, can contribute to the development of more efficient and sustainable waste management systems. In light of the SWOT/TOWS analysis conducted, it is recommended that municipalities focus on maximising their strengths and exploiting available opportunities while minimising weaknesses and neutralising threats. Such a strategy should include investments in modern technologies, infrastructure development, and the intensification of educational and social activities aimed at raising residents' environmental awareness.

This study highlights the urgent need for systemic changes and adaptation to new regulatory frameworks and sustainable development principles. Achieving these goals requires the commitment of all stakeholders, including local governments, businesses, local communities, and scientific and research institutions.

Conclusion

In conclusion, the pilot study of selected local government units in Poland reveals significant gaps in municipal waste management, particularly in planning and execution. While municipalities with dedicated waste management plans exhibit improved outcomes, the majority lack structured approaches, undermining the efficiency and effectiveness of their waste management systems. The findings underscore the necessity for all municipalities to adopt comprehensive action plans that integrate budgetary considerations, objectives, and regulatory frameworks. Additionally, the establishment of specialised units for organising and controlling waste management activities is crucial for enhancing recycling rates and overall environmental sustainability. The research highlights the urgent need for systematic changes and provides a foundation for further investigation into municipal waste management practices, simultaneously emphasising the necessity to integrate principles of sustainable development and circular economy. This should be by the objectives of the European Green Deal, aiming for climate neutrality and promoting more sustainable, eco-friendly practices at both local and national levels.

The contribution of the authors

Conceptualization, A.A.B., J.Ł.S., A.B. and S.B.; literature review, A.A.B., J.Ł.S., A.B. and S.B.; methodology, A.A.B., J.Ł.S. and A.B.; formal analysis, A.A.B., J.Ł.S. and A.B.; writing, A.A.B., J.Ł.S., A.B. and S.B.; conclusions and discussion, A.A.B., J.Ł.S., A.B. and S.B.

The authors have read and agreed to the published version of the manuscript.

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ZARZĄDZANIE ODPADAMI KOMUNALNYMI W KONTEKŚCIE UWARUNKOWAŃ GOSPODARCZYCH I ORGANIZACYJNYCH NA POZIOMIE LOKALNYM W POLSCE

STRESZCZENIE: W artykule poruszany jest temat wyzwania gospodarki odpadami komunalnymi w Polsce, które stanowi problem na poziomie lokalnym. Wskazuje się na różnorodne aspekty zarządzania odpadami komunalnymi. Poruszono również kwestię roli polityk krajowych i regionalnych w kontekście gospodarki odpadami komunalnymi oraz znaczenia wdrażania skutecznych strategii i programów, które odzwierciedlają lokalne uwarunkowania. Głównym celem opracowania jest ocena gospodarowania odpadami komunalnymi w procesie zarządzania gminą. Aby go zrealizować przeprowadzono badania ankietowe, analizę SWOT/TOWS, a także ocenę zależności pomiędzy elementami systemu gospodarki odpadami, a czynnikami mającymi wpływ na proces zarządzania gminą. Do badań wybrany został powiat częstochowski ze względu na jego największą powierzchnię oraz gmina Częstochowa, która jest drugim co do liczby ludności miastem na prawach powiatu w województwie śląskim.

SŁOWA KLUCZOWE: zarządzanie, gminy, gospodarka odpadami komunalnymi, SWOT/TOWS

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