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SELECTED ISSUES OF MUNICIPAL WASTE MANAGEMENT IN THE CONTEXT OF IMPLEMENTING THE CONCEPT OF SUSTAINABLE DEVELOPMENT

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Abstract: Ever since the concept of sustainable development first emerged, it has been assumed that this is the most important aspect of development policy at various levels of territorial organization, including at city level. Municipal waste management is one of the elements that has a significant impact on the broadly defined quality of life. The purpose of the article is to identify the barriers to the functioning of the Gdynia system in accordance with the principles of sustainable development. The pilot survey conducted as part of the study was targeted at residents, as they are the ones with the largest decision-making power in terms of how the waste management system will function. They included 18 statements divided into three sections: social, economic, and environmental. Attitude intensity was measured using a five-point Likert scale. The analysis and interpretation of the results helped identify the barriers to be overcome by residents if the city's municipal waste management system is to meet the highest standards regarding sustainable development. In order to generalize and confirm the conclusions, the survey should be conducted on a larger sample.

Keywords: sustainable development, municipal waste management.

1. Introduction

Cities are important because they are the key area of human activity and the pivot of societal development and of economic life, however, because of this, they must also deal with a number of socio-cultural, economic and environmental issues, some of which can lead to worse-quality air, water or soil and therefore to a general

deterioration in the quality of life. In response to these challenges, the principles of sustainable development are being implemented whose primary task is to analyze the causes of excessive exploitation of the natural environment, as well as seek solutions that would curb the impact of these processes.

Measures towards sustainable development are commonly applied in many areas of functioning of Polish cities. An example of this is municipal waste management, whose organization and method have changed significantly over the last few years. One of the strategic goals for cities in pursuing a sustainable policy for waste is to reduce the amount of generated garbage and the share of mixed waste in total waste. However, despite a number of measures which have already been taken by state and local authorities, the expected results are still not quite there.

It therefore seems justified to try and identify the barriers that hinder the proper functioning of a waste management system, especially since its efficiency depends largely on the residents themselves, as they are the ones responsible for the amount of waste generated and the way it is collected.

In the article an attempt was made to determine those barriers which, from the perspective of the residents, appear to prevent Gdynia's waste management system from incorporating the most desirable principles of sustainable development, including that of a circular economy.

In the first part of the study, selected factors are discussed which have historically made it more difficult for cities to manage waste. The second part outlines the most important assumptions of a municipal waste management system compatible with the principles of sustainable development. Subsequently, the findings from the survey involving Gdynia residents are shared, whose goal was to identify the barriers preventing Gdynia's municipal waste management system from applying the principles of sustainable development. The study ends with a discussion of the results and drawing conclusions.

2. Selected factors affecting municipal waste management in urban areas

Urbanization is one of this century's most stark characteristics, particularly visible in countries with developing economies and active migrations patterns between urban areas [He, Lu, Mol 2016]. All economic and demographic forecasts indicate that urbanization will continue to stay highly dynamic. In 2018, more than half of the global population lived in urban areas (55%), and this percentage is expected to rise to 68% in the next three decades [UN 2019]. Poland is at the opposite end of this global trend, having seen a consistent decline in the number of city dwellers since 2000, however the percentage share of urban population in Poland in 2018 remained relatively high at 60.05% [GUS 2019].

High population density and the dynamic advancement of modern civilization both entail a huge amount of municipal waste, posing a deadly threat to the

environment and human health. Although municipal waste represents a relatively small percentage of total waste mass, its concentration within urban areas is certainly more than palpable, with poorly organized management prompting a number of social, environmental and economic challenges.

According to the World Bank, city dwellers around the world have generated in recent years about twice as much solid municipal waste as those living in rural areas [World Bank 2018]. It is estimated that if this trend is not checked, as much as 1.42 kg of municipal waste per capita will be generated each day in 2025, when the population crosses the 1.4 billion threshold [World Bank 2012].

City dwellers tend to have a higher level of income and greater purchasing power, which translates into a higher level of consumption and an excessive waste of goods. By 2025 the number of urban dwellers with incomes high enough to become significant consumers of goods and services is projected to increase [McKinsey Global Institute 2012]. According to Eurostat data, the Actual Individual Consumption rate in Poland stood at 76% in 2018. Based on household material wealth, Poland ranked 21st in the EU, but let us note that Poland's 2008 level of wealth was only 61%. This means that in the last ten years, the consumption rate of Poles rose by 15 percentage points in relation to the EU average [Eurostat 2019], with the increase in societal affluence propelling excessive municipal waste.

Another issue to be addressed is the EU limits which, according to Art. 11 of the Waste Framework Directive, impose an obligation on Member States to achieve a 50% recycling rate for municipal waste by 2020 [2008/98/EC]. However, starting this year, local governments in Poland will calculate the level of recycling against a new EU formula. On its basis, 19.69% of raw waste compared to all municipal waste will have to be recycled. In rural communes this share will be 15.85%, in towns up to 50,000 inhabitants – 18.2%, and in larger cities – 24.65% [Głuszyński 2019]. Many waste management experts nevertheless warn that, given the current level and poor quality of selective waste collection, reaching the proposed objectives is simply unrealistic in most Polish *gminas* (communes). This is particularly problematic in large cities, which may face fines up to tens of millions of Polish zlotys as a result [Toborek 2019]. Given this legal conundrum and the *gminas'* obvious reluctance to pay fines, we should soon see a radical improvement in selective waste collection. This is indeed confirmed by the 2019 report from the research into Poles' awareness and ecological behaviour towards waste management. In that report, only 44.5% of respondents thought that household waste was segregated properly by residents. Negative voices were most often expressed by residents of agglomerations and multi-family housing units (blocks) [Polish Environment Ministry 2019].

To prevent any further economic, environmental and social toll in modern cities, the concept of sustainable development should be applied through the implementation of waste management systems that will lead to waste avoidance, correct segregation, reduced consumption and increased material efficiency, and finally, better resource recovery [Lehmann 2010].

3. A municipal waste management system compliant with the principles of sustainable development

Sustainable development is one of the leading slogans that for over thirty years has been embraced at different levels of territorial organization, including at city level. Looking at urban areas' growing demographic, economic and environmental problems, it is safe to say the assumptions of sustainable development remain as valid today and have not lost their relevance over time.

Let us recall that the concept of sustainable development is about balancing out the social, economic and environmental factors. This means a sustainable policy must envisage the thoughtful and conscious shaping of the relationship between economic growth, care for the environment (mainly the natural environment) and satisfying various types of human needs that largely determine the quality of life [Petrișor, Petrișor 2013]. At the same time, however, none of the areas of human activity should develop at the expense of the remaining ones, so that the principles of intra-generational and inter-generational justice remain intact [Borys 1999].

Yet this approach shows that sustainable development will not arise spontaneously, but rather requires proper planning and effort from each of the city entities (local authorities, residents, businesses, non-governmental organizations, foundations, associations, etc.). The municipal economy has a great impact on the successful pursuit of sustainable development, as it markedly affects the quality of life in urban areas. It should therefore be founded on some basic assumptions such as: 1) waste prevention, where waste is not perceived as an unidentified mass; 2) reuse of waste [Biegańska, Ciula 2011]; 3) waste recycling with the residue neutralized, e.g. through combustion with energy recovery. The process of municipal waste disposal (without earlier stages) by depositing it in landfills should be absolutely prohibited because it occupies a lot of space, greatly pollutes the environment, and leads to the substantial waste of goods.

Ciechelska distinguishes five stages of development of municipal waste management systems, and thus their sustainability [Ciechelska 2014]. The last of these is the most desirable and final stage of development of any municipal waste management system. Its functioning should be based on the concept of a circular economy, which assumes that all stages of the product life cycle are subordinated to reincorporating waste in production circles. In addition, there is a notable change in consumption patterns and increased responsibility among manufacturers. It can be assumed that waste in this system becomes almost entirely a resource or is safely deposited in the environment. Equally important at this stage is also the disappearance of a correlation between income growth and amount of generated waste [Ciechelska 2016]. Polish *gminas* have already been through the earlier stages and should now strive towards this last phase.

Municipal waste management in terms of implementing the principles of sustainable development can be considered in three ways [Maśloch 2014]:

- socially – by fulfilling international obligations, burdening household budgets (waste management fees), environmental awareness, shopping behaviour, comfort of life;
- economically – through municipal-waste investment, economic efficiency of waste management, organization of waste management companies, municipal waste market, waste management system maintenance costs,
- environmentally – through the impact on environmental protection through environment-friendly municipal waste management, production of “green energy”.

Let us then note that the prerequisite for the implementation of any concept of sustainable development with reference to waste management is the appropriate level of awareness among local population, who, as consumers, have a direct impact on the system’s efficiency: on one hand, through their purchasing decisions and subsequent choices regarding the handling of post-consumer residues, both equally important for the quantity and quality of generated waste, and on the other hand, as recipients of services whose satisfaction and the amount of paid waste-management fees must not be overlooked. It is therefore largely up to the residents how a waste management system actually works, with city dwellers acting as the point of entry and the first stage of verification of the system’s efficiency. As such, the local population is an excellent source of information about the pros and cons of waste management in a local area.

4. Surveying Gdynia residents’ responses to identify barriers preventing the city’s municipal waste management system from adopting sustainable principles – a pilot survey

The commune of the City of Gdynia has a population of 246,348. In 2018, 94% of households (multi-family and single-family housing) declared conducting selective waste collection [UM Gdynia 2018]. In addition, selective waste collection by

Table 1. Amount of municipal waste collected from the area of the Gdynia City Commune from residential housing in 2014-2018

Specification	2014	2015	2016	2017	2018
Average amount of unsorted municipal waste per capita (kg/person/year)	232.22	238.86	219.23	221.23	229.49
Average amount of waste from selective collection per capita (kg/person/year)	39.01	38.99	46.25	50.20	53.78
Average amount of municipal waste per capita + green, oversized, ash waste (kg/person/year)	274*	282*	292	301	317
Percentage share of unsorted waste in the total amount of municipal waste (%)	85	85	75	73	72

* excluding green waste and ashes

Source: own elaboration based on [UM Gdynia 2014-2018].

Gdynia residents has been on the rise, while the amount of generated mixed waste has stayed at a similar level in recent years (Table 1). However, the percentage share of unsorted waste in the total amount of municipal waste generated (%) may still be worrying. This poses a significant challenge to the local government and waste treatment plants alike, and is also a financial burden on the budget allocated for this purpose. At the same time, a noticeable increase is observed in the number of municipal waste per capita, which in 2018 stood at 317 kg.

4.1. Method

In order to achieve the purpose of the article, the decision was made to conduct a pilot survey at source, i.e. among the local population. The study aimed to identify the current barriers preventing Gdynia's municipal waste management system from adopting the principles of sustainable development, as perceived by the residents themselves. It was also supposed to answer the question of the measures which should be taken to prepare both residents and the system for a shift towards full sustainability (i.e. reaching the fifth stage).

The results of the study are part of a larger project whose goal is to develop the scope of measures necessary for ensuring the integrated management of municipal waste in Gdynia in a manner consistent with the concept of a zero-waste city.

4.2. Participants

The pilot survey was carried out in a period from March to May 2020, in which participated 363 adult residents of Gdynia, namely 196 women (54%) and 167 men (46%). The majority of respondents were aged 45-65 (40.2%) and 26-44 (31.8%). People over 65 years of age accounted for 19% of respondents, while those under 25 years of age represented 9% of the study sample.

4.3. Instrument

In connection with the epidemiological situation in Poland, the survey was conducted on the basis of an online questionnaire which contained 18 statements divided into three sections: social, economic and environmental, plus four demographic questions. The content was prepared based on literature analysis, previous experience in other cities, and conversations with residents and local-government employees as well as with companies responsible for waste management.

The respondents were asked to respond to each of the statements by determining the extent to which they agree with (accept, adhere to) its content. As in many other studies by other researchers [Milfont, Duckitt 2010; Hassan, Noordin, Sulaimana 2010, pp. 1276-1280], the Likert scale was used to test the degree of agreement. Attitude intensity was measured using a five-degree, bipolar ordinal scale described verbally.

4.4. Results

Table 2 shows the means, standard deviations (sd) and total percentages (VA+A) of Gdynia inhabitants' responses for each statement. It was assumed that the degree of agreement with each statement depends on the mean score (1-2.33 – low level, 2.34-3.66 – medium level, 3.67-5.00 – high level).

Table 2. Mean score, standard deviation and total percentage “very much agree (va)” and “agree (a)”

Item	Statement	Mean	sd	Total % (va+a)
Social section				
1	I know the EU hierarchy of waste management, i.e. prevention, reuse, recycling, other recovery, e.g. incineration, disposal.	3.92	1.29	76
2	I always know the container in which I should deposit municipal waste.	3.56	1.02	76
3	I have easy access to bin shelters in which there are segregation containers.	4.24	1.21	80
4	The municipal waste management fee is too large a burden on my household budget.	3.6	1.2	60
5	The system of calculating fees for municipal waste management in Gdynia based on property area is fair.	2.48	1.3	20
6	My household has sufficient conditions for sorting waste into five fractions.	3.08	1.67	52
Economic section				
7	I have noticed in the past the containers in bin shelters being overfilled.	3.04	1.48	52
8	I believe the frequency of municipal waste disposal is adequate to the amount of waste generated.	3.44	0.94	52
9	Residual waste (waste resulting from recovery, including recycling, that prevents further recovery and therefore must be disposed of) arising in the commune of Gdynia should end up in the incineration plant.	3.2	1.13	40
10	I am willing to pay a higher fee for waste management if the surcharge is to be used towards innovative and pro-environmental technological solutions.	3.48	1.47	60
11	To prevent the disposal of good and working items, an additional fee should be introduced for the collection of electronic equipment and bulky waste.	2.84	1.49	32
12	An additional fee for the collection of faulty electronic equipment would encourage residents to repair it more often rather than replace it with a new one.	2.76	1.42	32
Environmental section				
13	The current municipal waste management system helps reduce the amount of waste generated.	3.24	1.14	48
14	The current municipal waste management system encourages waste segregation.	3.48	1.24	64
15	I believe that segregating waste is good for the environment.	3.8	1.44	72
16	Free paper bags for biowaste could improve the quality of this fraction.	3.76	1.48	64
17	If I were paid PLN 0.10 for every plastic bottle deposited in a local store, I would not throw them away.	4.44	1.13	88
18	If I were given several reusable bags for vegetables and fruit, I would give up using plastic bags.	4.32	1.32	84

Source: own elaboration.

Table 3. Share of “very much agree” and “agree” responses including the tested elements of ecological awareness

Social		
0.0-39.9%*	40.0-69.9%**	70.0-100%***
5	4, 6	1, 2, 3
Economic		
0.0-39.9%*	40.0-69.9%**	70.0-100%***
11, 12	7, 8, 9, 10	
Environmental		
0.0-39.9%*	40.0-69.9%**	70.0-100%***
	13, 14, 16	15, 17, 18

* performed reluctantly/occurred rarely

** performed/occurred in a moderate, medium degree

*** performed/occurred frequently

Source: own elaboration.

In addition, Table 3 shows the percentage of the “va” and “a” responses for each of the statements divided into three areas of sustainable development: social, economic and environmental.

5. Discussion

When considering the collected results, it can be said that local governments, residents and other entities involved in municipal waste management in Gdynia face certain barriers. This is especially noticeable when the economic aspect is considered, 60% of respondents believe the current fee is too large a burden on their household budget, with only 20% thinking that the current system of billing (by property area) is fair. In addition, almost all statements hinting at the introduction of an additional fee met with negative feedback from respondents:

- 32% believe that the introduction of an additional fee for the collection of used electronic equipment and bulky waste (to reduce the disposal of functional appliances by residents) is a good solution,
- 32% agree that the additional fee for having faulty electronic equipment picked up would encourage residents to repair it more often rather than replace it with a new one.

The pilot study carried out shows that further research should be conducted to determine the reasons for this. The respondents may think that:

- the financial stimulus will not change the behaviour of a more affluent society, which is seen as prone to replacing home appliances,
- there are not enough service points where faulty items can be repaired, and if there are, the cost of repair often exceeds the item’s value,
- manufacturers should cover the cost of recycling for their products.

The reported readiness of 60% of the respondents to pay a higher fee provided that the surcharge is used towards innovative and pro-environmental technological solutions is certainly good news. Respondents are nevertheless reluctant to transfer residual waste to incineration plants (40%).

The study also shows that respondents would change their behaviour if they had access to certain tools and appropriate technological solutions; 88% of respondents are ready to deposit plastic containers in reverse vending machines in exchange for a small financial reward (PLN 0.10), while 84% of respondents would also give up plastic bags for fruit and vegetables if they were given several reusable bags. Regarding free paper bags for bio-waste, the respondents are not so optimistic as 64% of them believe this could improve the quality of this fraction. This may be due to the fact that this is a relatively new type of waste that has been collected selectively in Gdynia only since January 2020. Personal observations and conversations with employees responsible for waste management in the city show that it is heavily burdened with plastic bags. The residents do not quite know that only biodegradable and paper bags are suitable for this type of waste.

It is also promising that 76% of respondents believe to know the EU hierarchy of waste management and are able to sort collectable waste into fractions. In addition, the accessibility of bin shelters deserves praise, with as many as 80% of respondents believing that they have good access to those. However, 52% have noticed overfilled containers in the past, yet believe the frequency of waste pick-up is adequate to the amount of waste generated.

An improvement was observed in the approach to sorted collection and 72% of respondents now claim that waste segregation is good for the environment. In addition, 64% believe that the current municipal waste management system encourages waste segregation, but only 52% of respondents admitted that their conditions at home allow for five-fraction waste sorting.

Last but not least, it is worrying that only 48% of respondents think that the current waste management system encourages people to reduce the amount of waste that they generate.

6. Conclusion

The growing population and urbanization, combined with excessive consumerism, lead to an increase in the mass of generated municipal waste, which affects the quality of life in cities. One way to improve this is by introducing a fully sustainable waste management system whose efficiency depends largely on the residents themselves, as it is their actions that ultimately decide how much waste is generated, what happens to it after it is disposed of and how it is sorted. The purpose of this pilot study, conducted among the residents of the city of Gdynia, was to identify the barriers preventing Gdynia's municipal waste management system from adopting the latest principles of sustainable development. Based on the analysis of the results, it was found that the main barriers include:

- the lack of social acceptance (sense of unfairness) as to the current method of calculating the waste management fee,
- the reluctance of residents to incur any additional fees for the disposal of used household appliances or furniture,
- seeing the current municipal waste management system as one that does not encourage less waste generation,
- the unfavourable attitude of residents towards the possibility of burning residual waste,
- the noticeable overfilling of containers in bin shelters and the insufficient frequency of municipal waste collection.

The results and analysis of the conclusions from the pilot study show that it is reasonable to conduct the actual study (with random sample selection). These can provide a guideline for local authorities in terms of the path that Gdynia's waste management system should follow and the areas of cooperation with residents that could make this system more sustainable.

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WYBRANE PROBLEMY GOSPODARKI ODPADAMI KOMUNALNYMI W KONTEKŚCIE REALIZACJI KONCEPCJI ZRÓWNOWAŻONEGO ROZWOJU

Streszczenie: Od momentu pojawienia się koncepcji zrównoważonego rozwoju przyjmuje się, że stanowi ona najważniejszy aspekt polityki rozwoju na różnych szczeblach organizacji terytorialnej, w tym także na poziomie miasta. Jednym z elementów mających istotny wpływ na szeroko definiowaną jakość życia stała się gospodarka odpadami komunalnymi. Celem artykułu jest identyfikacja barier utrudniających funkcjonowanie gdyńskiego systemu gospodarki odpadami komunalnymi zgodnie z zaawansowanymi zasadami zrównoważonego rozwoju. Badanie sondażowe przeprowadzone zostało na mieszkańcach, ponieważ to od nich w głównej mierze zależy, jak będzie działał ten system. Kwestionariusz ankietowy zawierał 18 twierdzeń podzielonych na trzy obszary: społeczny, ekonomiczny i ekologiczny. Intensywność nastawienia mierzono za pomocą pięciostopniowej skali Likerta. Analiza i interpretacja wyników pozwoliła na określenie barier, które ze strony mieszkańców powinny zostać wyeliminowane, jeżeli gdyński system gospodarki odpadami komunalnymi ma działać zgodnie z zasadami zrównoważonego rozwoju. W celu uogólnienia i potwierdzenia wniosków badanie należy przeprowadzić na większej próbie.

Słowa kluczowe: zrównoważony rozwój, gospodarka odpadami komunalnymi.