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THE ANALYSIS OF TARIFFS FOR COLLECTIVE SEWAGE TREATMENT SERVICES IN THE CITIES OF THE WARMIŃSKO-MAZURSKIE VOIVODESHIP

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ABSTRACT: The aim of the article is to analyze the tariffs for collective sewage disposal in the cities of the Warmińsko-Mazurskie Voivodeship in terms of the type of tariffs and compliance with the principle of elimination of cross-subsidization. On the basis of available statistical data of the Central Statistical Office and information from water supply and sewage companies, the prices of sewage in 49 cities were analyzed. The prices were presented depending on the type of wastewater treatment plant. On the basis of the type of tariffs, the degree of elimination of cross-subsidization was also assessed. The dependence of sewage prices on the amount of treated sewage and the design capacity of the treatment plant expressed in p.e. was also examined.

KEY WORDS: collective wastewater treatment service, tariffs, wastewater prices

Introduction

The development of modern cities is connected with the collection of significant amounts of water and, consequently, with the emission of sewage. In shaping water and sewage management, the aim is to create a sewage system and municipal sewage treatment along with the development of the water supply system. The service of collective water supply and wastewater treatment is then provided. In Poland, municipalities are responsible for providing this service. The operators of the services are water supply and sewage companies. Prices for sewage are specified in the so-called water service tariffs. According to the requirements of the European Union, prices should take into account the principle of cost recovery of water services and ensure the elimination of cross-subsidies. These principles are reflected in most European countries. Prices for wastewater for communes in Poland are at very different levels.

The aim of the article is to analyze tariffs for collective sewage disposal in 49 cities of Warmińsko-Mazurskie Voivodeship in terms of tariff type and compliance with the principle of elimination of cross-subsidization. The analysis also presents the prices for sewage and the degree of their dependence on the volume of services provided, measured by the amount of treated sewage and p.e.

Tariffs for collective wastewater collection and treatment in Polish law

It is the responsibility of the municipality to ensure the collective collection and treatment of wastewater (Act, 2001). The operators of this service are water supply and sewage companies. In order to ensure the financing of this activity, the companies draw up tariffs for the price of sewage. The tariffs are approved by the State Water Management Authority (Państwowe Gospodarstwo Wodne Wody Polskie).

The rules of developing tariffs are included in the Regulation of the Minister of Maritime Economy and Inland Navigation of 27 February 2018 on the determination of tariffs, the template of the application for approval of tariffs and the terms of settlements for collective water supply and collective sewage disposal. The tariff should be constructed in such a way as to ensure that it is in place:

- obtaining the necessary revenues,
- protecting service users from unjustified increases in prices and fee rates,
- the elimination of cross-subsidization,

- motivating service users to use water rationally and reduce wastewater pollution,
- the ease of calculation and verification of prices and fee rates.

Water and sewage companies should take into account the following things when calculating future sewage prices:

- operating and maintenance costs for collective wastewater collection, including depreciation or amortization charges, environmental charges, and water service charges,
- company-independent taxes and charges,
- the cost of discharging wastewater into sewerage facilities not being in their possession,
- the repayment of interest on credits and loans taken out or bonds issued,
- provisions for non-performing receivables,
- the repayment of capital installments in excess of the value of depreciation or amortization,
- margin and profit.

In order to eliminate cross-subsidization, the company should allocate costs to particular groups of recipients of the service. Prices should be proportionate to the volume of service provided. They may take into account the size of the pollutant load in the sewage discharged and the use of the capacity of the sewerage facilities.

The following types of tariffs can be distinguished in terms of consumer groups:

- uniform – containing uniform prices of services and uniform rates of charges for all tariff groups of recipients of the service,
- not-uniform – containing different prices for particular tariff groups of recipients.

On the other hand, it can be distinguished by its structure:

- single-part tariff – including the price related to 1 m^3 of sewage discharged, without the subscription fee rate,
- multi-part tariff – containing prices and fee rates, including the subscription fee rate.

The tariffs may also take into account different prices depending on the range of wastewater discharges. Then it can be distinguished:

- seasonal tariff – higher prices of sewage in the peak season of demand for water supply and sewage services and lower prices in the off-season,
- a progressive tariff, applied with limited wastewater treatment capacity by water supply and sewerage company, in which prices for sewage increase with the increase in the amount of sewage above the range not smaller than the average water consumption standards (Regulation, 2018).

The method of pricing for the service of collective wastewater collection and treatment should ensure compliance with the principle of reimbursement of costs of water services and the elimination of cross-subsidization (Water Law Act, 2017; Directive 2000/60/EC).

Research object

The analysis included tariffs binding in 49 towns and cities of the Warmińsko-Mazurskie Voivodeship, namely: Olsztyn, Elbląg, Ełk, Ostróda, Iława, Giżycko, Kętrzyn, Bartoszyce, Szczytno, Mrągowo, Działdowo, Pisz, Braniewo, Olecko, LidzbarkWarmiński, Nidzica, Morąg, Gołdap, Pasłęk, Węgorzewo, NoweMiastoLubawskie, Biskupiec, DobreMiasto, Lubawa, Orneta, Lidzbark, Olsztynek, Barczewo, Orzysz, Susz, Reszel, Ruciane-Nida, Korsze, Górowo-Iławeckie, BiałaPiska, Mikołajki, Jeziorany, Ryn, Pieniężno, Tolkmicko, Miłakowo, Pasym, Miłomłyn, Bisztynek, Frombork, Zalewo, Kisielice, Sępopol, Młynary.

Taking into account the population of these cities, it is possible to distinguish:

- two cities of over 100 thousand inhabitants,
- one city of 50-100 thousand inhabitants,
- two cities of 30-50 thousand inhabitants,
- six cities of 20-30 thousand inhabitants,
- thirteen towns of 10-20 thousand inhabitants,
- six towns of 5-10 thousand inhabitants,
- nineteen towns of less than 5 thousand inhabitants.

Sewage collection and treatment services are provided by entities whose legal and organizational forms are:

- limited liability company – 45 cities,
- budget plant – 3 cities,
- self-government organizational unit – 1 city.

Towns are served by 18 biological wastewater treatment plants and 31 wastewater treatment plants with increased nutrient removal.

Research methods

The analysis of tariffs and prices for collective wastewater collection and treatment services was carried out on the basis of documents approved by Polish Waters. The structure of the tariff was analyzed, i.e. whether it is a single or dual member tariff. The degree of compliance with the principle of

elimination of cross-subsidization was also determined on the basis of different prices for sewage for different groups of customers. Price levels were analyzed, specifying minimum prices, maximum prices, average values, and standard deviation. The prices were also considered in relation to the volume of the service provided, expressed in terms of the amount of treated wastewater.

Graphically, the relationship between the price of social and living wastewater and the amount of treated wastewater and p.e. is presented. Correlations between these values were also determined.

Results of the research

Polish law provides for two tariff structures: single and multi-member. In thecities of the Warmińsko-Mazurskie Voivodeship, most companies apply a single-member tariff, taking into account the price per m^3 of sewage. These are tariffs set for 34 cities. Thus, only 15 companies have included in the tariffs a fixed fee, the so-called license fee.

For the majority of cities uniform tariffs were in force, i.e. groups of customers were not distinguished and the price was the same for all those discharging wastewaters. Only in 11 cities, a non-uniform tariff was applied and prices for different recipients of sewage treatment services were differentiated (table 1).

Table 2 presents the prices for wastewater in relation to the volume of services provided, expressed in terms of the amount of treated wastewater. For biological wastewater treatment plants, the prices for wastewater ranged from 3.6 to 10.48 PLN/m^3. The lowest price is valid for Korsze and the highest for Kisielice. For WWTPs with increased nutrient removal, the prices ranged from 3.71 PLN/m^3 for Nidzica to 8.22 PLN/m^3 for Barczew. Table 3 presents the minimum, maximum and average prices of wastewater, taking into account the type of treatment plant. Biological wastewater treatment plants were found primarily in smaller towns and therefore, despite the less complex treatment process, the average prices for the treatment service were higher than for plants with increased nutrient removal.

Table 1. Towns and cities with non-uniform sewage tariffs

Town	Tariff groups and sewage price [PLN/m^3]
Giżycko	living 4.20 industrial 5.32
Nidzica	household 3.71 industrial 5.28
Morąg	households 6.89 food industry 11.09 manufacturing industry 8.75 recreation 11.46
DobreMiasto	households 4.82 production 5.09
Lubawa	the method of discharge – household pumping stations 4.72 others 5.46
Orneta	households and other social and living recipients 4,63 industry and services 5.46
Liczbark	households 5.85 industry 5.86 wastewater suppliers to the catchment point 5.90
Olsztynek	social and living recipients 5,07 others 6,03
Ryn	households 6.25 other social and living recipients 6.81 industry and other 6.91
Miłakowo	social and living recipients 6.42 industrial and other customers 10.70
Zalewo	living 5.15 industry and others 6.00
Młynary	living 4.10 industrial 5,32

Source: author's own work based on information from plumbing and sewage companies [25-09-2018].

Table 2. Prices of sewage and the types of treatment plants for particular groups of cities in 2018

The amount of treated wastewater thousand [m³/year]	Prices [PLN/m³]	The number of towns
<100	4,7 – 10,70	8
100-200	3,89 – 6,91	8
200-300	4,10 – 8,22	7
300-500	3,71 – 6,79	8
500-800	4,72 – 6,89	6
800-1000	3,6 – 5,89	3
1000-3000	3,89 – 5,48	7
>3000	4,05 – 5,96	2

Source: author's own work based on www.stat.gov.pl and information from plumbing and sewage companies [20-09-2018].

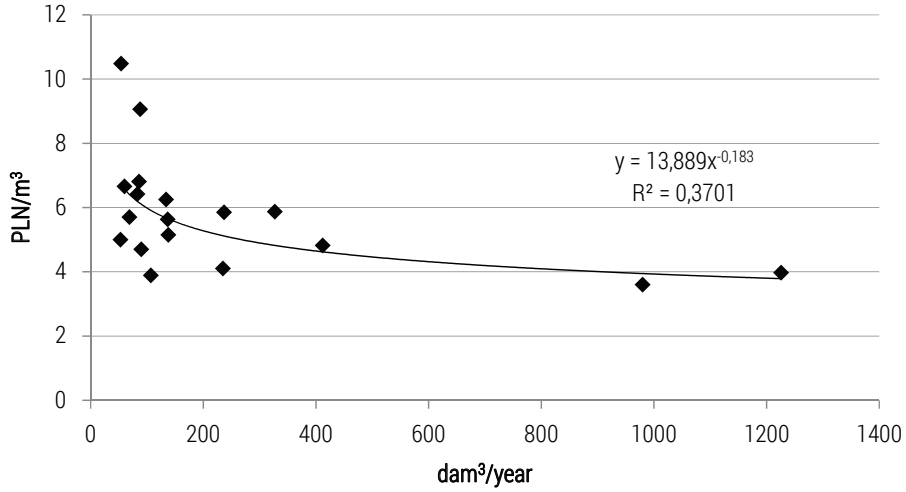
Table 3. Prices of social and living wastewater in the towns of the Warmińsko-Mazurskie Voivodeship in 2018

Specification	Prices for m³ all towns	Prices for m³ increased nutrient removal	Prices for m³ biological treatment plant
Average price	5,56	5,78	5,41
Minimum price	3,6	3,6	3,71
Maximum price	10,48	10,48	8,22
Median	5,27	5,67	5,2
Standard deviation	1,41	1,76	1,15
Variance	1,99	3,11	1,32

Source: author's own work based on www.stat.gov.pl and information from plumbing and sewage companies [20-09-2018].

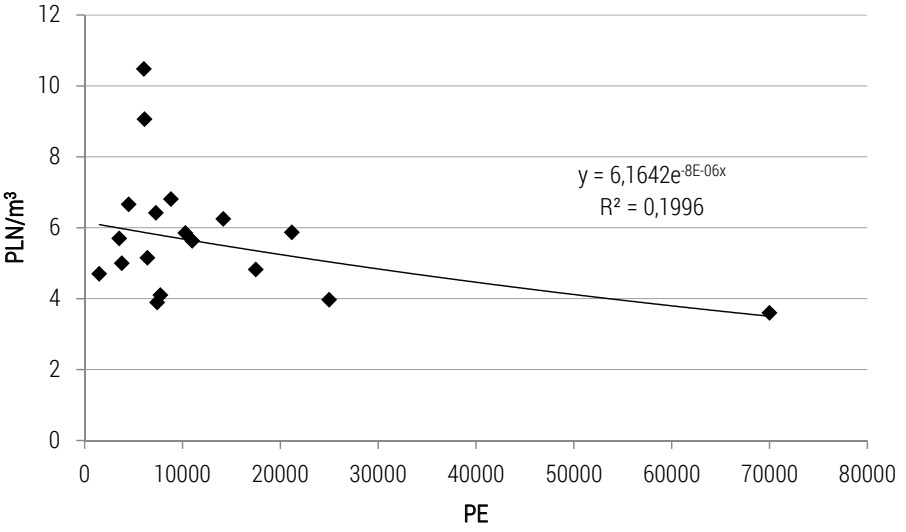
The distribution of prices according to the amount of wastewater is shown in figure 1. It can be stated that there is no clear correlation between the amount of treated wastewater and the price for the wastewater treatment service. It can be said that 37% of the variance of the water price depends on the annual amount of wastewater.

Figure 1. Prices for treatment of domestic sewage in biological treatment plants depending on the amount of treated sewage



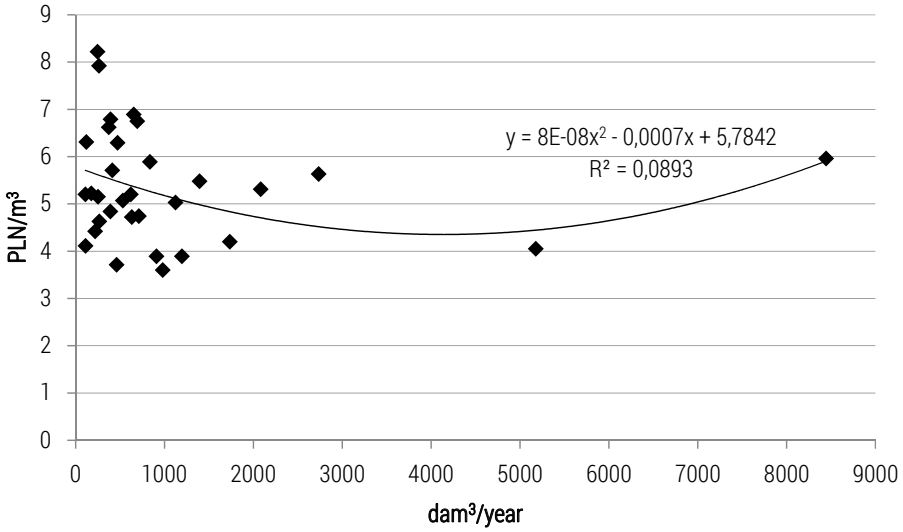
Source: author's own work based on www.stat.gov.pl and information from plumbing and sewage companies [20-09-2018].

Figure 2. Prices for treatment of domestic sewage in biological treatment plants depending on the capacity of the p.e.



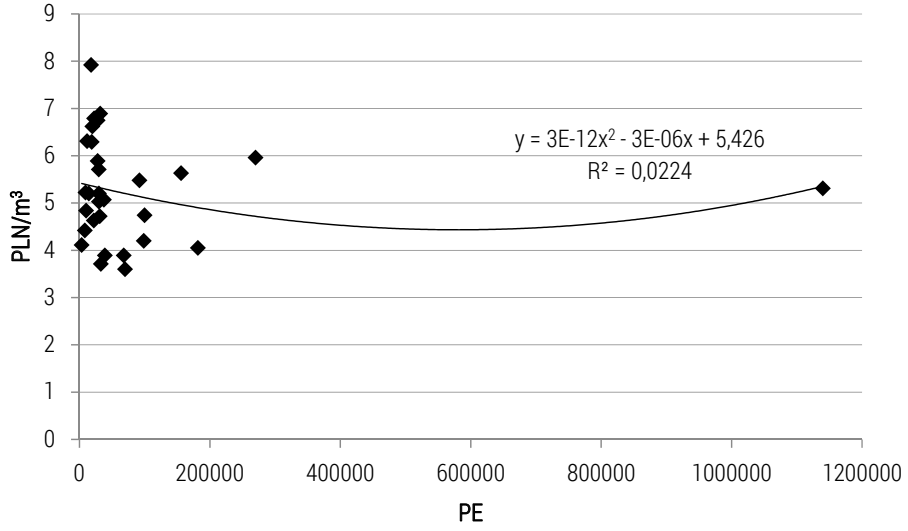
Source: author's own work based on www.stat.gov.pl and information from plumbing and sewage companies [20-09-2018].

Figure 3. Prices for treatment of domestic sewage in treatment plants with increased nutrient removal depending on the amount of treated sewage



Source: author's own work based on www.stat.gov.pl and information from plumbing and sewage companies [20-09-2018].

Figure 4. Prices for treatment of domestic sewage in treatment plants with increased nutrient removal depending on the designed p.e.



Source: author's own work based on www.stat.gov.pl and information from plumbing and sewage companies [20-09-2018].

The prices of sewage also depended to a small extent on the design capacity of the treatment plant expressed in the p.e. (figure 2).

There was also no clear correlation between the amount of treated wastewater and the price of 1m^3 wastewater in the case of treatment plants with increased nutrient removal (figure 3).

The same is true for the impact of the capacity in p.e. on the price of 1 m^3 of treated wastewater in wastewater treatment plants with increased nutrient removal in the towns of the Warmińsko-Mazurskie Voivodeship. The treatment plant capacity has no direct impact on the level of wastewater prices. The distribution of this relationship is shown in figure 4.

Discussion

According to the analyses, most of the sewage tariffs for cities in the Warmińsko-Mazurskie Voivodeship have a one-member structure. Only 30% of companies applied a two-member tariff. The Polish regulation (Regulation, 2018) does not impose a tariff structure on water service operators. Two-member tariffs containing a fixed and variable part occur in many European countries, e.g. Austria, France, Slovenia (http://www.eureau.org).

Another issue related to the establishment of prices for wastewater is the elimination of cross-subsidization, i.e. compliance with the polluter pays principle. This is connected with the establishment of appropriate groups of service recipients and the appropriate allocation of costs related to the collection and treatment of wastewater to these groups. In relation to the cities of the Warmińsko-Mazurskie Voivodeship, only 11 companies differed in prices for particular groups of service recipients. Different mechanisms of cross-subsidization can be found in the world, i.e:

- large cities subsidize small towns and rural areas (e.g. through national and local water tariffs),
- urban areas subsidize poorer suburbs,
- higher-income consumers subsidize poorer consumers,
- consumers connected to the network subsidize the connection of non-connected households (e.g. the $2 fee introduced by "AguasArgentinas" for all current service users in Buenos Aires to finance new network connections for poor residents),
- water charges subsidise sewage services in companies that provide both types of services in urban areas – in these areas the amount of sewage results directly from the amount of water abstracted and the charges are paid together as a single bill; this type of subsidization is more difficult to implement in rural areas, where the degree of sewage disposal is very

often small compared to the degree of water supply (Price of Water, 2008).

Cross-subsidization occurs in many countries of the world. In European countries, cross-subsidization and state funding are not isolated practices. This is the case, for example, in the Czech Republic. In Ireland funding for domestic customers is provided from central taxation. Cross-Subsidy from non-household use to household use is relatively strong in Indonesia and Brazil, while this is relatively weak in Thailand, China, and Vietnam. Different ranks are established on tariffs for households in Indonesia and Brazil and Cross-Subsidy toward the household segment is stipulated under laws and regulations on water services. assumed that the purpose of accepted in these countries as it diffusion rate for water services toward households and, especially, to consider for the poor (Study of the Tariff, 2011).

The prices of wastewater should be at an acceptable level for households. Assuming an average water consumption of 4.2 m^3/person per month (Rozporządzenie, 2002), it is possible to determine the approximate part of the income to be covered by the sewage fee. The calculations are shown in table 3.

Table 3. The share of sewage charges in gross remuneration of residents of Warmińsko-Mazurskie Voivodeship

Gross price (including 8% VAT) [PLN/m^3]	Gross fee [PLN/ month per capita]	% of gross minimum remuneration (2100 PLN)	% of gross average remuneration (3680 PLN in Warmińsko-Mazurskie voivodship)	% of monthly income per person in a household (1586 PLN in Warmińsko-Mazurskie voivodship)
Minimal 3,89	16,34	0,78	0,44	1,03
Mediana 5,69	23,90	1,14	0,65	1,51
Maksymalna 11,32	47,54	2,26	1,29	3

Source: author's own work based Report on the socio-economic situation of Warmińsko-Mazurskie voivodship in 2017, 2018; Sytuacja gospodarstw domowych w 2017 r. w świetle wyników badania budżetów gospodarstw domowych.

The data presented in table 3 show that with the minimum wage (2100 PLN gross) already at the average wastewater price, the fee is more than 1% of the salary. However, it exceeds 2% at the maximum price and monthly income per person in a household. Thus, wastewater alone accounts for more than 2% of income, which is considered acceptable for water service charges.

Conclusion

On the basis of the analyses carried out, it can be concluded that:

1. Polish law takes into account the regulations of the European Union, which obliged to comply with the principle of water service cost recovery and elimination of cross-subsidization.
2. The dominant legal form of the operators of sewage treatment services in the cities of the Warmińsko-Mazurskie Voivodeship is a limited liability company. 92% of the enterprises have accepted this legal form.
3. Over 69% of the analyzed tariffs had a single-member structure.
4. Wastewater treatment plants with increased nutrient removal account for 65% of the wastewater treatment plants serving towns in the Warmińsko-MazurskieVoivodeship. Increased nutrient removal is important due to the fact that Poland has been recognized as an area sensitive to eutrophication, i.e. requiring reduction of discharges of nitrogen and phosphorus compounds and biodegradable pollutants into waters. The introduction of increased nutrient removal also results from the National Program for Municipal Wastewater Treatment, which requires such wastewater treatment for agglomerations > 15 000 p. e. (Guide, 2010).
5. Only 11 cities, i.e. about 24.5% of all towns of the Warmińsko-Mazurskie Voivodeship introduced non-uniform tariffs, setting different prices for particular groups of recipients of sewage treatment services. Usually two groups have been distinguished, namely: suppliers of domestic sewage, as well as industry and others.
6. There were no clear correlations between the price of wastewater and the amount of treated wastewater and the design capacity of the wastewater treatment plant.
7. A significant part of the wastewater tariffs in Poland does not ensure the elimination of cross-subsidization and compliance with the polluter pays principle. This is due to the premises of the social policy related to the issue of the possibility of charging households for water and sewage. It is assumed that these charges should not be higher than 2% of income.
8. The design of wastewater tariffs worldwide is based on similar principles. The structure of tariffs may be single or multi-member. There are also cross-subsidies, especially for households that are subsidized by local governments, from the central budget or from other service sectors.

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