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THE ASSESSMENT OF THE PUBLIC ACCEPTANCE OF THE IMPLEMENTATION OF INDIVIDUAL SEWAGE TREATMENT PLANTS IN ŚNIADOWO MUNICIPALITY

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ABSTRACT: The aim of the article is to present the public perception of the implementation of an individual wastewater management system, i. e. the so-called household sewage treatment plants in Śniadowo municipality. The contingent valuation method (CVM), part of which is a willingness to pay survey (WTP), was used to get to know the opinions of the inhabitants on the implementation of individual wastewater treatment systems. The contingent valuation method was implemented based on surveys conducted in the selected municipality.

KEY WORDS: contingent valuation method, the social acceptability of the investment, WTP questions, household sewage treatment plants.

Introduction

Wastewater management is one of significant elements of the state's environmental protection activities. Wastewater management addresses three important aspects: social, economic and environmental. It is a major area of interest for many specialists. There are many solutions and methods that can be used to carry out an efficient wastewater treatment process. In urbanized areas, collective sewage systems are used. On the other hand, in rural areas, where the investment costs of such a system are much higher, household sewage treatment plants or drainage-free systems are the most frequently used. Each of these methods has its advantages and disadvantages, but all of them allow the protection of water resources against excessive pollution.

The aim of the article is to present the public reception of the implementation of individual sewage treatment plants in **Śniadowo** municipality, the contingent valuation method (CVM), part of which is a willingness to pay survey (WTP), was used to get to know the opinions of the inhabitants on the implementation of individual wastewater treatment systems. Public opinion polling of the local community was carried out based on surveys.

Wastewater management solutions in rural areas

Wastewater management is currently one of the most important aspects concerning living standards in one's own home or one-family house. Recent years have seen an increase in the volume of wastewater discharged. To a considerable extent, it is true of cities, but it is even more visible in rural areas. This is a result of the intensive development of these areas, and the constant increase in living standards and thus the provision of sanitary facilities.

Wastewater treatment is one of the basic activities related to improving water quality and environmental protection. This is not an easy task, because of the different nature of pollution and therefore the need to apply technical solutions with different degrees of complexity (Kaczor, Bugajski, 2006). However, the main task of wastewater treatment systems is to improve sanitary and hygienic conditions in the countryside and to increase the standard of living of the inhabitants. Nowadays, it has become a standard to equip every newly constructed building, both domestic and household, with sanitary installations (Hartmann, 1996).

The solutions that are used in waste water collection and treatment depend mainly on the type of buildings that are in the area. In the case of compact buildings, it seems more economical to use a communal sewer with a sewage treatment plant. On the other hand, if there are dispersed constructions, where the distance between buildings is greater than 120 meters, then it seems justified to use individual systems that would remove and clean up pollution. An example of such systems is outflow tanks (septic tanks) and household treatment plants (Błażejewski, 2003).

The sewage holding tanks system consists in collecting generated wastewater in leak free tanks and then removing it with the use of gully emptier to a sink station located in the closest wastewater treatment plant, which is prepared to receive and effectively treat this wastewater. Holding tanks are used in the absence of a sewage network on plots smaller than 800 – 1000m^2 and when high ground water level does not allow for the use of sewage treatment plants (Nowak, 2005).

According to the Regulation of the Minister of Infrastructure on the conditions to be met by buildings and their location, holding tanks should be placed not less than 5 meters away from windows and doors of a residential building, 2 meters away from an adjacent plot, and 15 meters away from water intake. Good access is also required to enable the tanks to be emptied. In addition, these tanks should have impermeable bottom and walls, tightly covered with a closed opening for the removal of collected sewage and sediments, as well as venting, at least 0.5 m above the surface of the terrain (the Regulation of the Minister of Infrastructure of 12 April 2002).

The sewage holding tanks system should be used in unimproved land as a target or transitional solution until the households are connected to collective sewage systems or household sewage treatment plants.

Sewage from the kitchen, bathroom, toilet and other living quarters should be fed into the household sewage treatment plant. It should not be filled with rainwater, surface water (from roofs, yards, etc.), water from swimming pools and other tanks of more than 1m^{3,} as well as chemical substances. The plot should comply with regulatory requirements. In the first case, it is important where the primary settling tank will be located. It shall not be closer than 2 meters from the boundary or road. The minimum distance from gas and water pipes is 1.5 meters (the Regulation of the Minister of Infrastructure of 12 April 2002).

The facilities of individual wastewater treatment plants are miniatures of those used for the wastewater disposal in large, collective wastewater treatment plants. Although the amount of wastewater produced by a single house is smaller than that of large settlement units, so that it does not pose a threat to the environment.

Household sewage treatment plants in their operation are based on mechanical and biological treatment processes. However, the choice of the method of disposal of pollutants depends on many aspects, such as the amount of sewage, the surface of the terrain, ground and water conditions or economic conditions (Heidrich, et al., 2008).

The most popular household sewage treatment plants include: ATLANTIS 2000, BIOCLERE, PROX AT 6 and soil-water treatment plant IBMER.

When analyzing the sewer system in economic terms, it turns out that household sewage treatment plants are profitable when the average length of a sewage collector exceeds 20 meters in relation to one household. However, using pressure sewage system, this distance may be several times longer (Błażejewski, 2003). Notwithstanding, the use of septic tanks is more cost-effective when they are used for a brief period (up to 3 years) [Household water treatment plants – a guidebook for villagers].

Depending on the selected type of a household sewage treatment plant, significant differences in investment outlays, annual operating and expected costs may occur (Kundziewicz, Miłaszewski, 2011). An overview of investment outlays, annual operating costs and expected household sewage treatment plant costs is given in table 1.

Table 1. An overview of investment outlays, annual operating costs and expected household sewage treatment plant costs

Type of cleaning equipment	Investment outlays [PLN]	Annual operating costs [PLN]	Expected total cost		
			Annual y [PLN/a year]	Monthly [PLN/a month]	Per unit [PLN/m^3/a year]
Wastewater plant ALTANTIS 2000	3000	150	345	28,8	1,3
Wastewater plant BIOCLERE	8000	170	690	57,5	2,5
Wastewater plant PROX AT 6	7500	334	821	68,5	3
Wastewater plant IBMER	5000	100	425	35,4	1,5

Source: (Kundziewicz, Miłaszewski, 2011).

Considering the above listed costs, they can be compared with the costs of septic tanks, which range from 3 000 to 6 000 PLN. On the other hand, only wastewater disposal costs 15-20 PLN per m^3. In statistical terms, 10m^3 tank is filled by a family of 4 people within about 14-18 days. This means that it must be emptied twice a month for 300 PLN on average. Therefore, it is understandable that the installation of a household sewage treatment plant, despite the costs of its installation, is very quickly profitable and more efficient, and its construction can also be financed with EU funds. On the other

hand, the cost of connection to the communal sewage system varies greatly and depending on a city or municipality, it ranges from 800 PLN (Wodzisław Śląski) to 5000 PLN (Katowice), (KZGW internet site).

Therefore, when choosing an appropriate solution for wastewater treatment, the opinion of the local community, economic conditions, technical solutions considering the specific characteristics of a given municipality as well as the ecological aspect should be considered.

Environmental valuation using the CVM contingent valuation method

The contingent valuation method is used to determine preferences of a given person or group of people, and public or private-public goods. This is done by expressing the opinion of the respondents and then translating the survey results into monetary values. This method has several important advantages. First of all, the method of contingent valuation is the only method by which the valuation of "non-usable" goods, i. e. the natural environment, so-called "wild nature" – is carried out. It should then be stressed that the results obtained using the above method (provided that the tests have been carried out properly) are of high objectivity. This method has been constantly improved, and particularly intensive development of its use has been visible since the 1990s (Wróblewska, 2014). The contingent valuation method (CVM) is a survey method conducted on a group of respondents who have a good or service or are interested in possessing it. The method distinguishes two categories of questions: WTP – Willingness to Pay, and WTA – Willingness to Accept. In the first category of questions, there are indications concerning the willingness to pay for a specific item, activity or service. The second category of questions refers to the issue of tolerance of adverse changes and conditions related to the examined good or service (Graczyk, 2005). The contingent valuation method was first used in the 1960s and has undergone many modifications over the last 50 years. For the first time, it was used on a larger scale in the 1980s. During this period, the method of contingent valuation was a research method, the results of which may be described in scientific publications. The pioneer of the presented method, in relation to environmental goods, was an American researcher R. Davis (Graczyk, 2005). It is worth noting that the contingent valuation method is widely used in economic valuation, especially in respect to parameters and non-useable features, which are difficult to measure in the case of the natural environment (Śleszyński, 2000).

Polish sociologist J. Sztumski, said that anything that is part of any reality can be subjected to social research. Depending on the subject matter of research, reality may include social, financial, economic, political, pedagogical, religious and many other issues (Sztumski, 2005).

The research method chosen for conducting studies is very important. Not every research analysis can be carried out using any technique. The choice of a method relates not only to the issue of preparing and conducting studies, but also to describing and analyzing results and drawing conclusions 9Nowak, 2007). The method of contingent valuation allows to determine the economic value and not only the value in use of a given good. It is based on the opinion of respondents making a choice between hypothetical situations. This allows considerable flexibility in the selection of goods that do not have separate markets and it is difficult to value them. It is extremely useful and more and more commonly used (Marks-Bielska, Zielińska, 2014). The contingent valuation method based on a WTP question, is carried out based on a questionnaire of surveys, which contains questions referring to price preferences for specific services and goods. This method is largely concerned with environmental issues, water resources, waste management or wastewater management. The questions are focused on financial and economic issues, namely the losses resulting from human impact on the environment and the price amounts that the inhabitants of a given area would be willing to pay for the protection of the environment and natural values. This method is used in ecology and spatial management, but it can also be used in medicine, pharmacy, power engineering, industry, fishery and agriculture. People who use this method emphasize its clear and uncomplicated way of preparation and implementation. This is mainly due to the fact that, in addition to questions, specific price amounts or percentages are usually attributed to questions that can be addressed by respondents. In this method, questions are usually closed or closed-ended. The second type of questions is more difficult and requires more experience on the part of a researcher in their preparation (Żylicz, 2004). This method is commonly used, especially for elements related to flora and fauna or environmental protection. An example of this method is the valuation of endangered animal or plant species. In France, it is widely used to test the readiness to increase water usage fees, in return for improving its quality. These studies have shown that a large part of the population demands an increase in charges, but by those subjects which pollute water most, that is agriculture and industry. The contingent valuation method was also used in Greek coastal regions. During the survey residents' opinions were analyzed on increasing payments made by tourists for the use of some marine facilities, in exchange for transferring income obtained for the protection of saltwater and marine fish. This method was also used by Bangkok

park management to determine the possibility of raising the price of using its facilities in exchange for a more favorable environmental impact. In turn, in Colombia and Mexico inhabitants were asked about increasing charges for potable water and wastewater, to raise drinking water standards and to build wastewater treatment plants. The contingent valuation method has also been widely used in Poland. The most famous studies were on the aquatic environment and referred to the willingness of the population to pay payments for the protection of the Baltic Sea against its progressive eutrophication. In another case, the inhabitants of Ełk were asked about the possibility of increasing the protection and reclamation of Ełk lake. In many Polish municipalities and cities research is carried out using the contingent valuation method concerning environmental values and the protection of the environment (Rauba, 2016).

Literature studies carried out on the contingent valuation method show that a few studies related to water resources have been carried out based on this method both in Poland and worldwide. However, there are few studies concerning the social reception of individual wastewater management systems implementation, determined by the readiness to pay for their implementation.

Wastewater management in Śniadowo municipality

Śniadowo municipality is located in north-eastern Poland, in the western part of Podlaskie voivodeship, in Łomża county and covers an area of 162.59 km^2. The population of Śniadowo municipality is 5450 people. There are 43 villages in the municipality (www.sniadowo.pl).

Śniadowo municipality with a high degree of water supply (98%) still faces the problem of unresolved wastewater management in rural areas. The part of the municipality that covers the locality of Śniadowo together with the neighboring village of Ratoon Stare is equipped with a system of communal sanitary sewage system, discharging sewage to the wastewater treatment plant located on the outskirts of Śniadowo. The residents of other localities have no possibility to connect their buildings to the sewer network and discharge wastewater into empty tanks (septic tanks) with a capacity of up to $10m^{3,}$ which after many years of use do not guarantee full tightness. It is in turn leads to soil and groundwater contamination. The location of tanks on plots is in accordance with legal regulations governing these matters, i. e. the distance from the windows and doors of external buildings is at least 5 meters, and the distance from the border of a neighboring plot, street or pavement is at least 2 meters. The maintenance and operation of such a res-

ervoir is to a substantial extent a burden on the inhabitants' budget, as the cost of extraction and removal of sewage from the reservoir to the nearest wastewater treatment plant in Śniadowo amounts to several hundred PLN per month. It should be also mentioned here that legal provisions clearly indicate that this is a transitional solution. The best solution to this problem would be to install a sewer system in the entire area of the municipality, however, due to dispersed development, the construction of sewage connections seems unreasonable, as it would entail huge costs. It is therefore necessary to find a unique way of collecting and treating waste water. Such a solution, which is a supplement to the communal sewage system, is the use of individual sewage system, i. e. the so-called household sewage treatment plants. In Śniadowo municipality it is only allowed to build mechanical and biological household sewage treatment plants whose capacity cannot exceed 5 m^3 per day. It is mainly conditioned by the municipality's land conditions and the lack of space, as well as the presence of permeable and poorly permeable land. In accordance with the regulation on technical conditions to be met by buildings and their location, the underground bottom settling tanks of household sewage treatment tanks are located at least 2 meters from the border of a neighboring plot, road or pavement and at least 15 meters from water reservoirs (Wastewater management program for Śniadowo municipality for the years 2012-2020).

The assessment of public acceptance of the implementation of individual sewage treatment plants in Śniadowo municipality

In the evaluation of social acceptance of individual sewage treatment plants in Śniadowo municipality the contingent valuation method based on WTP question was used. The research tool was a questionnaire survey consisting of three parts. The first part of it contains questions concerning sewage management in Śniadowo municipality, especially relating to the removal of sewage. It also contains questions on the development of wastewater management. The second part of the survey comprised questions about the preferred amounts for using an individual wastewater management system. The third part of the questionnaire concerned personal data and the general socio-economic characteristics of the respondents, which included questions concerning age, gender, education, income and the place of residence of the respondents.

The survey was conducted on a group of 70 respondents, including 49 women and 21 men. Most of the respondents (55%) were aged 18-30 years

and lived in single-family houses. They had in their majority secondary (36%) or higher education (41%) and their monthly remuneration amounted to about 2000 PLN. The analysis of the obtained information indicates that people aged 24-25 years (about 64%), who most often have secondary or tertiary education, show a greater interest in wastewater management and the implementation of individual wastewater treatment plants.

Referring to the question of sewage management system satisfaction in §niadowo municipality, more than half of the respondents (61%) answered that they were quite satisfied. 20% found that their level of satisfaction was high. 11% stated that the sewage management system in Śniadowo municipality was rather not satisfactory for them. In turn, 3% of respondents believed this system was unsatisfactory for them. The remaining 55 of respondents did not have an opinion on this issue.

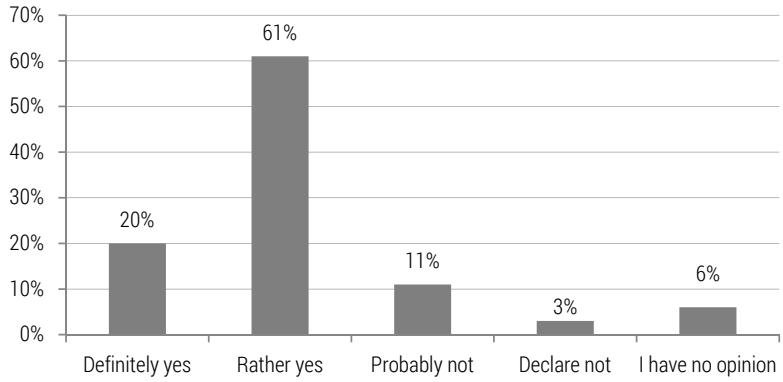

Figure 1. The answer to the question: "Are you satisfied with the sewage management system in the municipality of Śniadowo?"

Source: author's own study.

In response to the question of meeting the expectations of the sewage management system in Śniadowo municipality, the most respondents (56%) responded rather positively. 24% indicated that this system did not meet the expectations of the inhabitants. 8% of the respondents stated that the system meets their expectations at a very high level. The remaining 10% of respondents did not have an opinion on this issue.

69% of the respondents stated that they were not preoccupied with sewage management in Śniadowo municipality. 20% of respondents were definitely affected by any problems. 5% of the respondents that it happened sporadically that some problematic issues occur, while 2% of the respondents stated that they had serious problems with sewage in Śniadowo municipality. 4% said that these problems were related to unpleasant smell.

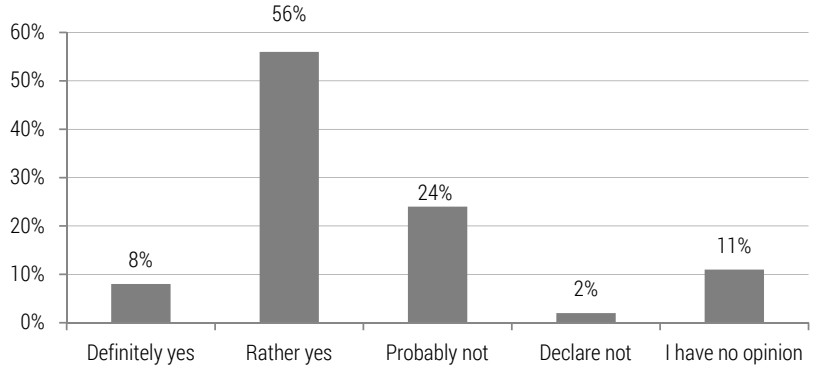

Figure 2. The answer to the question: "Do you think that the sewage management system in the municipality of Śniadowo meets the expectations of all inhabitants of the municipality?"

Source: author's own study.

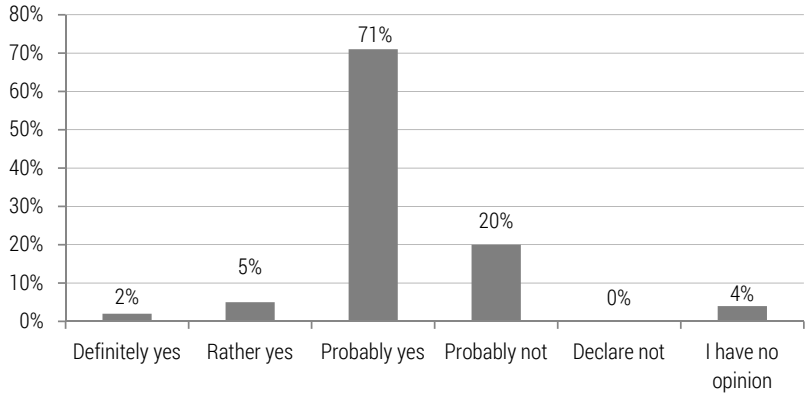

Figure 3. The answer to the question: "Have you ever experienced wastewater problems in the municipality of Śniadowo?"

Source: author's own study.

The largest part of respondents (43%) used a drainage system. 30% of the respondents indicated that they had a household sewage treatment plant. The remaining 27% of the surveyed inhabitants of Śniadowo municipality are connected to a common sewage system.

Referring to the most favorable sewage management system for their own households, most of the respondents (45%) indicated a household sewage treatment plant. The remaining respondents (45%) pointed to the collective sewage system.

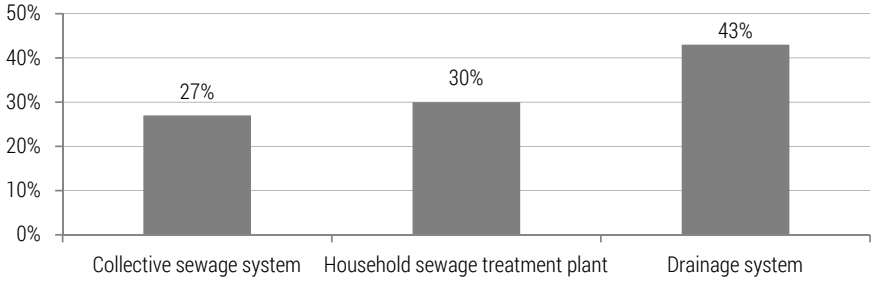

Figure 4. The answer to the question: "Which wastewater management system do you use?"

Source: author's own study.

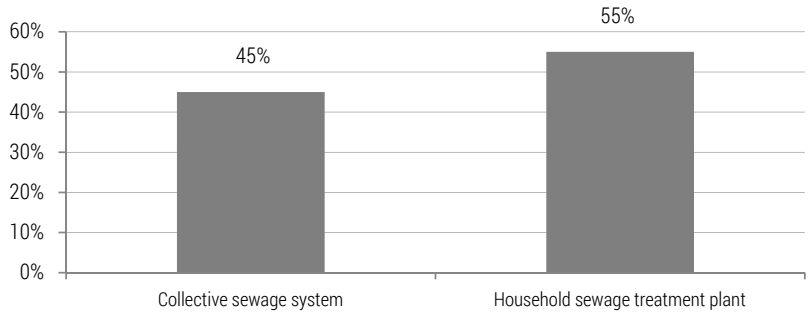

Figure 5. The answer to the question: "Which of the wastewater management systems do you consider to be a better solution for your own household?"

Source: author's own study.

In response to a question concerning the costs that residents would be willing to incur for installing a household sewage treatment plant, the largest number of respondents (32%) indicated 200-500 PLN. 21% marked the price range of 500-1000 PLN. 11% of the respondents considered that they would be willing to bear the cost of 100-200 PLN. 8% of the respondents indicated an amount below 100 PLN, while 6% of respondents chose an amount of above 1000 PLN. The remaining 22% of the respondents replied that they already had a household sewage treatment plant.

When asked about the level of satisfaction of municipality residents with co-financing of the installation of a household sewage treatment plant, 35% of the respondents said they were quite satisfied, while 23% of the surveyed people stated that they were satisfied with this funding. 12% of the respondents were not satisfied and were unsatisfied with the level of the subsidy. The remaining 24% had no opinion on this issue.

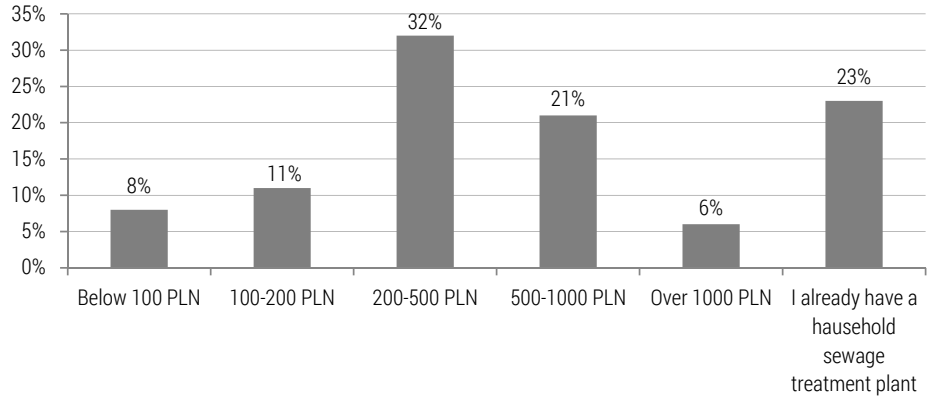

Figure 6. The answer to the question: "What cost would you be willing to bear to install a household sewage treatment plant?"

Source: author's own study.

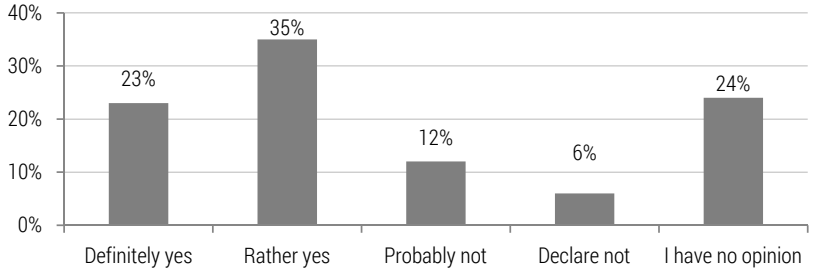

Figure 7. The answer to the question: "Will you be satisfied with the percentage of co-financing to install a household sewage treatment plant?"

Source: author's own study.

Indicating the price that the residents of Śniadowo municipality would be willing to pay for 1m^3 of wastewater treated in a household sewage treatment plant, 35% marked the amount of 1-2 PLN. Slightly fewer respondents (32%) indicated 3-5 PLN. 26% stated that they would be willing to pay less than 1 PLN, and in the case of 5% of people, this amount could amount to 6-8 PLN. 2% of the respondents indicated a price range of 9-10 PLN.

Regarding the annual costs that the inhabitants of the municipality would be willing to bear for the operation of a household sewage treatment plant, almost 30% of the respondents replied that they could amount to 50-100 PLN. The same number of respondents indicated the range of 100-200 PLN, and 20% marked the amount of 200-400 PLN. Slightly fewer residents (17%) showed the costs of 400-600 PLN. 6% of respondents indicated the amount

of 600-800 PLN, while 3% of the respondents stated that they could pay 800-1000 PLN annually.

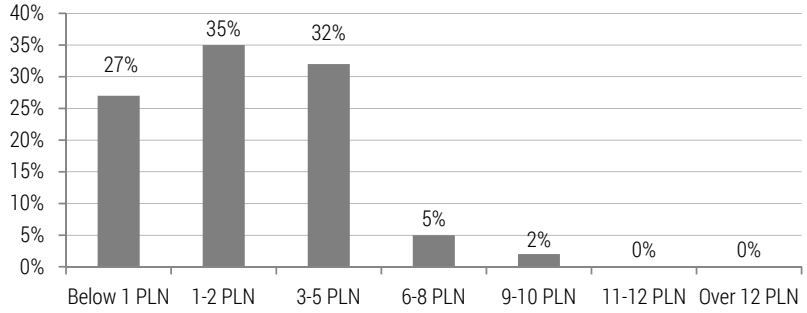

Figure 8. The answer to the question; "What amount would you be willing to pay for 1 m^3 of wastewater treated in a household sewage treatment plant?"

Source: author's own study.

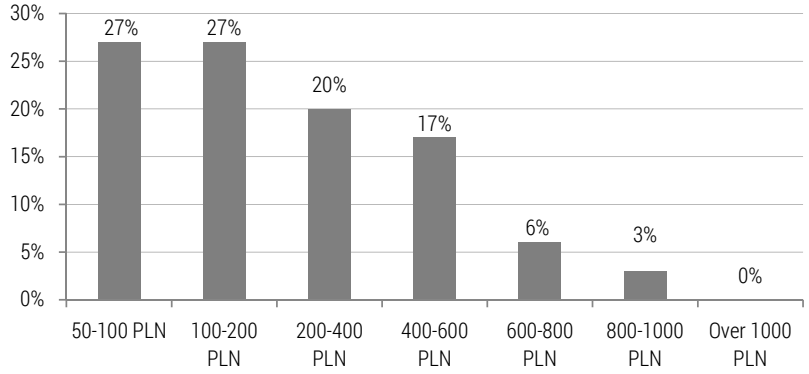

Figure 9. The answer to the question: "What annual costs would you be willing to pay for the operation of household sewage treatment plant (e. g. repair and maintenance)?"

Source: author's own study.

The carried-out research showed that the social reception of the implementation of the individual wastewater management system in Śniadowo municipality is very high.

Most of the residents of Śniadowo municipality show great interest in environmental protection issues, including sewage management. Therefore, it can be concluded that they are aware of their responsibility for the state of the natural environment and the risks associated with the lack of adequate waste water treatment. And in the case of the price that residents of Śniadowo

municipality would be willing to pay for 1m^3 of wastewater treated in a household sewage treatment plant, respondents indicated that the increase in charges could be up to 10-20%. In addition, most respondents (55%) indicated a household sewage treatment plant as the most beneficial wastewater management system for their own households and would be willing to incur higher costs to install an individual wastewater treatment system to reduce the negative impact of wastewater on their lives and the condition of the natural environment.

Conclusion

Environmental protection measures in water and wastewater management include the treatment of wastewater to such an extent that it can be discharged into soil or water. This is done in many ways, making it possible to distinguish many methods. In the municipality of Śniadowo the most common activities wastewater collection and treatment are household sewage treatment plants and connection to the collective sewage system, which includes only the inhabitants of two localities. Financial considerations are a significant problem in meeting the needs of the inhabitants of Śniadowo municipality in sewage management. The local government does not have sufficient funds to ensure the connection of each household to the collective sewage system or to finance a sewage treatment plant at every household property.

The conducted research has shown that residents of Śniadowo municipality are interested in the problem of wastewater management and are willing to pay additional fees for improving the quality of treated wastewater. The respondents indicated that fee increases in this area could be up to 10-20%. At the same time, they could spend up to 1,000 PLN for the establishment of a household sewage treatment plant or pay a fixed fee of about 200 PLN per year for the operation of a household sewage treatment plant. The results of the research also indicate that the inhabitants of Śniadowo municipality are aware of the necessity of taking care of the natural environment and that they are aware that they should bear certain costs to live in areas that will be free from pollution as much as it is possible.

The local authorities encourage the owners of households to invest in household sewage treatment plants with co-financing from public funds, because the cost of constructing a collective sewer system in the whole municipality would be very high. In addition, it should be noted that Śniadowo municipality, as part of "Wastewater Management Program 2012-2020", prepared a simulation of the expenses to be incurred relating to the expansion

of the sewer system. The first variant assumes the construction a household sewage treatment plant in each household, which is not connected to the communal sewage system. It is envisaging that the cost of a one-time investment, together with the preparation of documentation, will amount to 13,150 PLN. For the whole municipality, these costs will amount to 16,187,650 PLN. In turn, the construction of a collective sewer system, which would cover all households in the municipality would cost 26,425,000 PLN. Both amounts are very high and exceed the financial capacity of the municipality. Therefore, it was decided to encourage household owners to invest in household sewage treatment plants with co-financing on the part of the local government. Every year several dozen households use this type of solution (Wastewater management program for Śniadowo municipality for the years 2012-2020).

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The contribution of the authors

Krystyna Rauba, literature review: 60%, acquisition of data:20%, analysis and interpretation of data: 60%

Aneta Brulińska: literature review: 40%, acquisition of data: 80%, analysis and interpretation of data: 40%

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