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Application of the Contingent Valuation Method in Water Resources Protection

Abstract
The option of using the contingent valuation method (CVM) to assess residents' willingness to pay (WTP) for upgrading the quality of water resources in their communes is discussed in the article. Surveys were conducted using the direct interview method. The analysis included the application of CVM to examine the potential for financing projects that are focused on reducing the eutrophication process of the Baltic Sea, financing the construction of municipal sewage treatment plants in selected communes in Greece and Poland and financing the upgrade of sewage disposal and treatment standards in Śniadowo in north-eastern Poland. For authorities of a given area, the CVM is an instrument supporting the decision-making process regarding investments in water resources' protection.

Keywords
contingent valuation method | water resources protection

JEL Codes
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1. Introduction

The objective of the article is to analyse and assess the possibility of using the contingent valuation method (CVM) as an instrument supporting the decision-making process in implementing the surface water pollution control policy. The method may be used to evaluate the public perception of solutions applied. It allows the definition of activities that need to be undertaken, and estimation of their costs. For local administration, such information is of significant assistance in formulating objectives regarding the upgrade of surface water quality.

In Poland, the CVM was used for the first time by Prof. Tomasz Żylicz of the Faculty of Economic Sciences of the University of Warsaw to examine the possibility of financing water resources protection in the so-called 'Baltic Research'.

Three examples of the use of the CVM are discussed in this article, namely:

- the option of financing activities limiting the Baltic Sea eutrophication process (1994);
- the construction of municipal sewage treatment plants located in three communes on the island of Crete in Greece and in three communes in north-eastern Poland (2005–2009); and
- the upgrading of sewage disposal standards and treatment in Śniadowo, a commune located in north-eastern Poland (2017–2019).

The research was conducted in two countries over a period of 25 years. The 'Baltic Research' project included countries of the Baltic Sea catchment area. The study in the Polish–Greek project comprised two regions, each including three communes. The third study focused uniquely on the commune of Śniadowo, located in the Podlaskie Voivodeship in Poland.

2. The Contingent Valuation Method

The CVM is an economic technique that is used to estimate the value of upgrading the state of the environment or preserving its environmental values. It is a direct environment valuation method and requires conducting direct interviews among respondents

interested in given goods or services. Each researcher has a detailed questionnaire and asks questions regarding the respondents':

- Willingness To Pay (WTP) , which is the maximum charge that a consumer is willing to incur for a given good or service; and
- Willingness To Accept (WTA), which is the minimum price that a producer or merchant is willing to accept for selling a given good or service or for assenting to negative changes in an examined element, such as pollution.

Most commonly, surveys are conducted by the direct interview method. The advantage of this approach is that it allows respondents to give direct estimates. Nevertheless, direct interviews have certain limitations, including the fact that the wording of the question may influence the answer. Also, WTP and the ability to pay are two different things. Therefore, each survey must concern a hypothetical situation that will compel respondents to carry out a mental exercise. However, it is never certain that the respondents' decision would be the same, if, in a real-life situation, they faced the necessity to incur the charge indicated earlier.

3. Financing Reduction of the Baltic Sea Eutrophication Process

In 1994, a pilot project called the 'Baltic Research Programme', conducted under the academic supervision of Prof. Tomasz Żylicz was initiated at the Warsaw Ecological Economics Centre, a research hub hosted by the Faculty of Economic Sciences of the University of Warsaw. The objective of the project was to find a response to the question of how much the residents of Poland would be willing to pay to stop eutrophication of the Baltic Sea, which in practice would mean limiting the number of available Baltic Sea beaches, most of which are already closed. Diminishing the overall eutrophication would also upgrade the water quality of the Baltic Sea (Żylicz et al., 1995).

Using an open-ended WTP questionnaire, 1,165 respondents were surveyed and in consequence, an estimate of 18.43 USD per resident was obtained. Based on the analysis of the pilot study, a questionnaire was designed for the main study, which identified seven bid levels. They were used with WTP split questions. In the main study, 1,162 respondents participated. It was estimated that the average per capita level of the WTP for an upgrade of the quality of the Baltic Sea waters was 73 USD (Śleszyński, 2000). Similar studies were conducted in Sweden and Lithuania. For the remaining Baltic Sea countries, estimates were made using the benefits transfer method. This method relies on the adaptation of the previously obtained estimates to the economic conditions of neighbouring countries (Söderqvist & Markowska, 1997). The results of assessment of the WTP for the upgrade of the Baltic Sea water quality are presented in Table 1.

Research results presented in Table 1 showed that residents of all the countries would be willing to pay annually approximately 7 billion USD for upgrading the water quality of the Baltic Sea. This is greater than the overall cost of projects limiting the load of nitrogen compounds discharged into the Baltic Sea and thereby restricting its eutrophication, which was estimated at 5 billion USD (Green & Żylicz, 1993). Such comparison clearly shows the preference of residents of the Baltic Sea countries concerning upgradation of the Baltic Sea water quality. However, it should also be noted that declared WTP is not the same as a special purpose fund, which may be the source for financing specific projects focused on limiting eutrophication in the Baltic Sea.

4. Comparison of the Possibilities of Financing Construction of Municipal Sewage Treatment Plants in Greece and Poland

In the years 2006–2009, a Polish–Greek research project on 'Assessment of the WTP for wastewater treatment and closing of water circuits' was carried out at Białystok University of Technology. The survey was carried out on the island of Crete in Greece and in the Podlaskie Voivodeship in Poland. The study questionnaire was specifically developed to determine the residents' WTP for the construction of communal sewage treatment plants and their discharge systems. Consequently, such water-quality upgradation would improve the quality of local surface and

Table 1. Estimation of the WTP for the upgrade of the Baltic Sea water quality expressed in USD/resident

Country	Lithuania	Poland			Sweden
CVM survey	**Pilot survey (OE)**	**Pilot survey (OE)**	**Main survey (DC)**	**Correspondence survey (DC)**	**Correspondence survey (DC)**
Average WTP value for those willing to pay	9	17	73	207	773
Average WTP value for funding supporters declaring zero willingness to pay	7	14	56	102	610
Mean WTP value of the total sample	5	10	45	80	480

Source: (Markowska & Żylicz, 1996), (Śleszyński, 2000).

ground waters and eliminate the use of septic tanks and environmentally burdensome modes of sewage transport.

Research conducted in Greece focused on three communes located in Crete. It was conducted in 2005 by a scientific team headed by Dr. Konstantinos Tsagarakis from the Economic Department of the University of Crete in Rethymno. The WTP was formulated as a questionnaire and encompassed three different amounts, i.e., 80%, 100% and 150% of the current sewage service charges. As part of the survey, 326 interviews were conducted. Overall results showed that 97.5% of the respondents expressed WTP for the construction of communal sewage treatment plants. The average additional charge to the current bill for sewage services amounted to 44 EUR, which exceeded the amount required to construct sewage treatment plants in the examined communes (Genius et al., 2005).

Research conducted in Poland, in three Podlaskie Voivodeship communes, was carried out by members of the Economics of Water Supply and Water Protection Research Team of Białystok University of Technology, led by Prof. Rafał Miłaszewski (Report, 2008). Before posing the WTP question, respondents were required to indicate whether they would consent to the construction of a municipal sewage treatment plant that could significantly reduce pollution of sewage discharged from their commune. The WTP questions regarded three levels of charges to be paid locally for sewage services. The first regarded the average cost of local wastewater disposal. The second took into account the operating costs, depreciation and profits of the water and sewage utility company. If the respondents did not choose any of the proposed price levels, they could themselves propose the maximum amount they would be willing to pay for sewage disposal and explain why they did not choose any of the options proposed.

Analysis of 250 questionnaires showed that the majority of respondents, i.e., 88.4%, were in agreement with the option of constructing a local sewage treatment plant. Only 11.6% of respondents had opposed the idea. Furthermore, 118 respondents, i.e., 47%, were willing to pay for it. Residents who led an active lifestyle and wanted to avoid environmental degradation caused by the discharge of untreated sewage into surface waters or into the ground expressed WTP for the construction of a sewage treatment plant. On the other hand, among the 132 respondents who did not want to pay, 66 respondents (50%) claimed that wastewater treatment should be free of charge. In turn, 34 respondents (26%) admitted that they could not afford to pay for the construction of a sewage treatment plant and 10 respondents (8%) stated that the construction of such a plant would not improve the situation of sewage treatment in the commune. The remaining 21 respondents (16%) gave other reasons. An important variable in the analysis was the age of the respondents. Older respondents were willing to pay, whereas the younger were not. This may be due to the growing migration of the younger population from smaller centres of the population. Among the latter, there is a visible, steady trend to relocate to larger areas or even abroad to find better paying jobs and more attractive living opportunities. On the other hand, older residents are less mobile and would like to have the problem of local wastewater treatment solved (Miłaszewski & Rauba, 2015).

A comparison of the results of surveys conducted in Greece and Poland showed that in the Cretan communes, almost all the respondents (97.5%) expressed WTP for the construction of local sewage treatment plants. In comparison, only 47% of the respondents expressed such readiness in the communes of Podlaskie Voivodeship. This difference may be explained by the fact that tourism is the main source of income for the majority of the residents of Crete. Thus, proper administration of sewage management, which would upgrade the overall local sanitary conditions, has a decisive impact on the level of income generated by tourism.

5. Financing of Sewage Treatment and Discharge in Śniadowo

Śniadowo, a commune with 162.59 km^2 and a population of about 5,400 residents, is located in north-eastern Poland, in the western part of Podlaskie Province. The local sewerage network is 6 km long and sewage connections extend for 3.96 km. These connections service only the area of Śniadowo (town centre, industrial areas and some single-family houses) and the neighbouring village of Ratowo Stare. A total of 211 households and institutions are connected. Households in other towns and villages discharge their wastewater mainly into septic tanks, from which pollutants are most often transported to local fields or to the mechanical and biological treatment plant in Śniadowo, which has a capacity of 200 m^3/day. After treatment, the sewage is discharged into a drainage ditch using a 200 mm diameter sewer.

To assess the public perception of sewage management solutions implemented in the Śniadowo commune, a CVM survey was conducted as a research tool using a three-part questionnaire to determine the residents' WTP for specific services. The first part contained questions related to the overall issue of sewage management and development in the commune. In the second part, questions were posed regarding the specific level of charges for the use of the sewage management system. The third part of the questionnaire concerned the residents' personal data and their socioeconomic status, including their age, gender, education, income and place of residence.

The survey included a group of 70 respondents. The largest segment of the respondents (43%) had access to a drainless sewage system. Next, 30% of the respondents had an individual wastewater treatment plant. The remaining 27% of the respondents had dwellings connected to a collective sewage system (Rauba, Brulińska & Miłaszewski, 2018).

When asked about the most favourable sewage management system for their households, the majority of the respondents (55%) selected an individual sewage treatment plant. The remaining respondents (45%) indicated their preference for a collective sewage system.

The residents' response to the question concerning the level of charges they would be willing to incur for sewage disposal and treatment is shown in Figure 1. Over 60% of the respondents indicated WTP <50 PLN per month. Almost 40% of the respondents accepted an amount of 50–100 PLN. Only 2% of the respondents indicated the range of 100–200 PLN (Rauba, Brulińska & Miłaszewski, 2018).

In response to the direct questions survey, all the participating residents of Śniadowo declared that they would be willing to pay for 1 m^3 of sewage discharged by a collective sewage system. First, 44% of the respondents indicated the amount of 3–5 PLN. In comparison, a slightly lesser percentage, namely 41%, chose the range of 1–2 PLN. Next, 9% of the respondents specified that it should be <1 PLN and 5% of the respondents indicated the amount of 6–8 PLN. Only 2% of the respondents declared that they would be willing to pay 9–10 PLN (Rauba, Brulińska & Miłaszewski, 2018).

Responding to the question regarding the percentage increase in charges that the residents would be willing to accept for sewage discharge into a collective sewage system, almost 40% indicated the range of 1–10%, slightly fewer (32%) indicated 11–20%, 14% accepted the range of 21–40%, 11% accepted an increase of 41–60%, 3% accepted an increase of 81–100% and finally 2% of the residents were willing to accept an increase of 61–80% (Rauba, Brulińska & Miłaszewski, 2018).

In response to the question concerning the increase in charges that the residents of Śniadowo would be willing to incur for discharging sewage into a home sewage treatment plant, the largest number of respondents (39%) indicated 1–5 PLN, 27% indicated 6–10 PLN, 14% accepted 16–20 PLN, 12% accepted 11–15 PLN, 3% indicated 21–30 PLN, 3% accepted

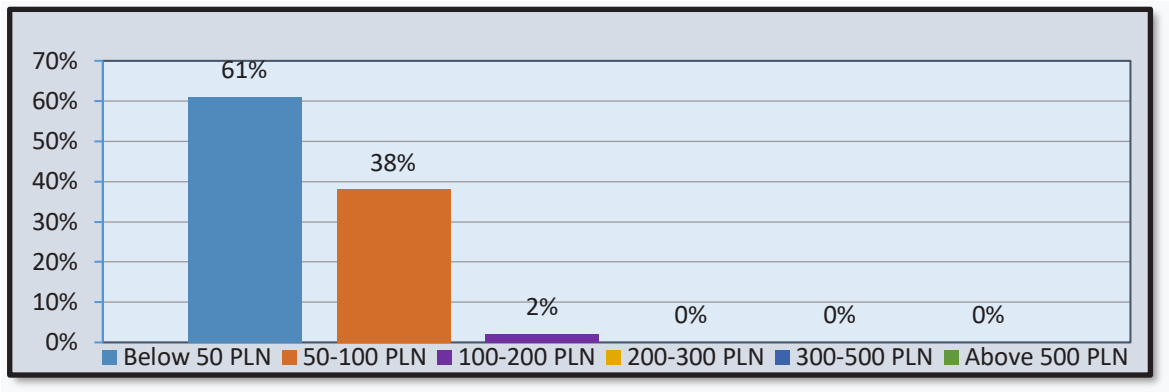

Figure 1. The level of increased charges respondents would be willing to pay for sewage disposal and treatment. Source: (Rauba, Brulińska & Miłaszewski, 2018)

31–40 PLN and 2% accepted 41–50 PLN (Rauba, Brulińska & Miłaszewski, 2018).

Surveys carried out in Śniadowo showed that residents who participated in the project consented to the construction of a communal or home sewage treatment plant. Consequently, they agreed to finance the plant construction and operations, believing that it would upgrade the quality of surface and groundwater in the commune and would allow avoidance of usage of septic tanks and the environmentally burdensome transport of sewage using sanitary disposal vehicles.

6. Conclusions

On the basis of the analysis conducted in the article, it is possible to formulate the following conclusions:

1. The CVM may be used to examine residents' WTP to upgrade the quality of water resources.
2. WTP to limit eutrophication of the Baltic Sea on the part of residents of the Baltic Sea countries indicates that there is a potential for establishing a fund to finance this initiative.
3. Surveys conducted in relation to WTP for construction of sewage treatment plants in chosen communes indicate that the degree of willingness depends on the economic status of the residents. Those who make a living from tourism indicate a higher degree of WTP. Upgradation of the quality of water resources in their area has a significant impact on their level of income.
4. In areas of dispersed settlement, most residents were willing to pay for the construction of household sewage treatment plants because they are more cost effective.
5. For local authorities, the survey results regarding the residents' WTP for the construction of a municipal sewage treatment plant are a significant instrument in the decision-making process regarding the implementation of such a project.

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