Krystyna RAUBA

# RESEARCH METHOD FOR THE SOCIAL ACCEPTABILITY OF IMPLEMENTING A COLLECTIVE SYSTEM OF SEWAGE DISPOSAL AND TREATMENT

**Krystyna Rauba**, PhD – Bialystok University of Technology

correspondence address:
Department of Building Structures
Wiejska 45A, 15–351 Białystok
e-mail: k.rauba@pb.edu.pl

## METODA BADANIA SPOŁECZNEJ AKCEPTOWALNOŚCI REALIZACJI ZBIOROWEGO SYSTEMU ODPROWADZANIA I OCZYSZCZANIA ŚCIEKÓW

STRESZCZENIE: W artykule przedstawiono procedurę oceny społecznej akceptowalności realizacji zbiorowego systemu odprowadzania i oczyszczania ścieków opierającą się na metodzie wyceny warunkowej, wykorzystującej badanie gotowości do zapłaty (WTP). Uzyskane tą metodą informacje pozwolą na określenie, ile lokalna społeczność jest w stanie zapłacić za korzystanie z usługi zbiorowego odprowadzania i oczyszczania ścieków. Opracowana metoda oceny społecznej akceptowalności realizacji zbiorowego systemu odprowadzania i oczyszczania ścieków może stanowić instrument wspomagający proces decyzyjny w zakresie kształtowania polityki opłat za usługi wodne w gminie.

SŁOWA KLUCZOWE: kryterium techniczne, kryterium ekonomiczne, zrównoważony rozwój, społeczna akceptowalność inwestycji, pytania WTP

## Introduction

In deciding on the implementation of the collective system of sewage disposal and treatment, a commune relies on two criteria: technical and economic. The technical criterion defines the conditions that must be fulfilled for a particular type of wastewater treatment plant and sewerage. However, some solutions, despite ensuring that the environmental requirements are satisfied, cannot be fulfilled due to the second criterion, namely the economic one. This situation occurs primarily in the conditions of scattered housing.

However, public opinion is of great importance when implementing public investments. So far, communal authorities have not had a tool that would enable them to become familiar with residents' opinions. Assessment of the social acceptability of implemented projects is important especially with regard to the construction of collective systems of sewage disposal and treatment, since these are long-term investments and their operating period lasts several dozen years.

The article presents a method of assessing the social acceptability of implementation of the collective system of sewage disposal and treatment based on the contingent valuation method (CVM) using a study of willingness to pay (WTP). Information obtained by this method will make it possible to determine how much the local community is willing to pay for the use of the service of collective sewage disposal and treatment.

The method of assessing the social acceptability of implementing the collective system of sewage disposal and treatment can be a tool supporting the decision-making process in terms of developing a policy on fees for water services in the commune.

## Criteria for the selection of sewage disposal and treatment systems

Choosing the appropriate sewage system entails finding the length and configuration of sewage networks discharging wastewater to treatment plants for which one can incur the minimum capital expenditures and operating costs. Sewage systems require large capital expenditures, and therefore selecting the sewage arrangement and system is of fundamental importance for the villagers and for the national economy. Gravitational sewer systems dominate in rural areas, although they are becoming more and more expensive. Collective sewage treatment plants, on the other hand, are characterized by higher efficiency in removing impurities and low individual costs of wastewater treatment.

Choosing the right system of sewage disposal and treatment should be based on four criteria:

1. The technical criterion, which takes into account downslopes, the location of the wastewater receiver, the level of ground water, the character of housing, the existing underground infrastructure, and roads.
2. The economic criterion, which represents the possibility of financing the investments involving building collective systems of sewage disposal and treatment by the commune as well as the operating costs of these devices.
3. The environmental criterion, which includes information on protected areas in the commune and groundwater pollution.
4. The social criterion, which provides all agreements between the authorities and residents of the community as to the implementation and operation of collective systems of sewage disposal and treatment.

In the implementation of public investments, public opinion is of great importance. Society should be aware of the importance of measures taken by local authorities to improve the quality of local water resources.

Until now, communal authorities have not had a tool that would make it possible to become acquainted with residents' opinions. Assessing the social acceptability of implemented projects is important especially with regard to the construction of collective systems of sewage disposal and treatment, since these are long-term investments and their operating period lasts several dozen years.

## Application of a contingent valuation method in the valuation of water resources

A CVM appeared in the early 1960s, and after many modifications and experiments it found practical application in the 1980s. The first surveys regarding consumer preferences were conducted in the 1940s. They concerned consumer purchases in research conducted by the US Federal Reserve[1]. Bowen[2] and Ciriacy-Wantrup[3] conducted the first research surveys revealing consumer preferences regarding environmental goods. In the 1960s, Davis[4] presented the first application of this method to the valuation

[1] F.T. Juster, *Consumer buying intentions and purchase probability: an experiment in survey design*, „Journal of the American Statistical Association" 1966 No. 61, pp. 658–696.

[2] H.R. Bowen, *The interpretation of voting in the allocation of economic resources*, „Quarterly Journal of Economics" 1943 No. 58, pp. 27–48.

[3] S.V. Ciriacy-Wantrup, *Capital returns from soil-conservation practices*, „Journal of Farm Economics" 1947 No. 29, pp. 1181–1196.

[4] R.K. Davis, *The value of outdoor recreation: an economic study of the Maine woods,* Harvard 1963.

of environmental goods, calling it the CVM at the same time. In 1980, the United States accepted the CVM together with other research methods concerning the state of the environment, namely the travel cost method, hedonic pricing method, and research methods of reaction effects on the interaction dose. A current overview of research concerning valuation conducted in many developing countries can be found in Biller et al.[5]

The contingent valuation method has also been used, for example, for the valuation of rare and endangered species of plants and animals[6] or for the valuation of activities aimed at reducing flood risk.[7]

In France, surveys based on WTP questions have been conducted. They concerned WTP for improving the water quality in rivers. The studies showed that industry and agriculture do not bear the costs resulting from the pollution of water resources.

The Greek communes of Lappaion, Georgioupolis, and Krionerida used the C to find out how much residents are willing to pay to keep the sea water clean. Information obtained from the survey conducted was to be used by communes while planning the policy of tariffs for wastewater[8].

Research based on the CVM regarding the aquatic environment was also conducted in Poland. Exemplary studies were carried out at Instytut Nauk Rolniczych in Zamość, where a preliminary study concerning the value of the natural environment was undertaken. Questions regarding different issues were included in the surveys, such as environmental pollution by solid and liquid waste, costs of disposing of pollutants, and willingness to pay a certain sum for the possibility of joining the household to the sewage network and maintaining the cleanliness of the surrounding environment[9].

The best known is the „Baltic" study. This study examined the readiness of Polish citizens to pay for stopping the eutrophication of the Baltic Sea.

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5 D. Biller, K. Rogge, G. Ruta, *The use of contingent valuation in developing countries. A quantitative analysis*, in: A. Albertini, J.R. Kahn (eds), *Handbook on Contingent Valuation*, Cheltenham 2006.

6 J. Loomis, D. White, *Economic benefis of rare and endangered species: summary and meta-analisis*, "Ecological Economics" 1996 No. 18, pp. 197–206.

7 L. Shabman, K. Stephenson, *Searching for the correct benefis estimate: empirical evidence for alternative perspective*, „Land Economics" 1996 No. 72(4); T. Liziński, *Problemy zarządzania ryzykiem w kształtowaniu przestrzeni polderowej na przykładzie delty Wisły*, Falenty 2007, p. 139.

8 M. Geniusz et al., *Estimation of willingness to pay for wastewater treatment,* Crete 2005.

9 I. DeJesus, A. Baryła, *Wycena środowiska przyrodniczego i ocena cenności ekologicznej*, in: T.M. Łaguna, M. Witkowska-Dąbrowska (eds), *Ekonomiczne podstawy zarządzania środowiskiem i zasobami naturalnymi*, Białystok 2005, pp. 120–129.

A reduction in the number of closed bathing areas and the renewal of sea life were presented to the respondents as a result of measures undertaken[10].

The social value of the effect of remediation of Ełckie Lake[11] was also identified using the CVM.

The CVM was also used in Lubelskie voivodeship in the commune of Łukowa. The aim of the study was to determine how much the inhabitants of the examined commune appreciate the advantages of the natural environment. In addition, we were acquainted with people's opinions and wishes regarding the sustainable development, their attitudes towards environmental issues, the perception of environmental threats and countermeasures, and responsibility for the environment[12].

The use of the CVM has also been undertaken in the cost-benefit analysis for the implementation of EU Directive 91/271/EEC concerning urban wastewater treatment. The survey was conducted in cooperation with the Public Opinion Research Centre (CBOS).The willingness to pay for improving the quality of surface waters in Poland to the level that would correspond to the condition after the implementation of the Directive on urban wastewater treatment, or to such a condition where one would be able to bathe and fish in most waters that are currently highly polluted was shown in the context of cost-benefit analysis. Apart from that, willingness to pay for ensuring the high quality of tap water in Poland was also examined[13].

In 2007, a study concerning valuation of the quality of surface and tap water was conducted in the form of individual interviews by a professional public opinion research centre on a representative group of adult urban residents in Poland[14].

In 2008–2010, assessment of the social acceptability of the project was carried out. The project concerned the implementation and operation of the collective sewage disposal and treatment systems in three selected communes

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10 T. Żylicz et al., *Contingent Valuation of Eutrophication damage in the Baltic Sea Region*, CSERGE, Working Paper, GEC 95-03, 1995; R.K. Turner et al., *Managing Nutrient Fluxes an Pollution in the Baltic*: *An Interdisciplinary Simulation Study*. CSERGE, Working Paper, GEC 97–17, Norwich 1997; A. Markowska, T. Żylicz, *Costing an International Public Good: The Case of the Baltic Sea*, Warsaw 1996.

11 H. Manteuffel-Szoege, E. Kubicka, *Makroekonomiczna efektywność rekultywacji jeziora*, in: *Uwarunkowania i mechanizmy zrównoważonego rozwoju*, Białystok 2007, pp. 265–274.

12 B. Kościk, A. Kowalczyk-Juśko, K. Kościk, *Taksacja skutków zmian w środowisku przyrodniczym w gminie Łukowa*, in: M. Kistowski (ed.), *Studia ekologiczno krajobrazowe w programowaniu rozwoju zrównoważonego*. *Przegląd polskich doświadczeń u progu integracji z Unią Europejską*, Gdańsk 2004, pp. 99–105.

13 A. Markowska, *Zastosowanie metody wyceny warunkowej w analizie kosztów i korzyści*, "Ekonomia i Środowisko" 2006 No. 2(30), pp. 57–67.

14 A. Bartczak, *Wycena korzyści z poprawy jakości wody kranowej i powierzchniowej w Polsce*, „Ekonomia i Środowisko" 2010 No. 2(38), pp. 124–141.

in Podlaskie voivodeship, namely Zbójna, Miastkowo, and Dubicze Cerkiewne. The lack of collective sewage disposal and treatment systems in these communes decided their choice as objects of research[15].

The CVM is based on surveys conducted among respondents interested in a particular good or service. The researcher can ask the respondents a question in the form of:

- WTP (Willingness To Pay), which concerns how much the respondents are willing to pay for access to given goods or services,
  or
- WTA (Willingness to Accept), which concerns the minimum amount of money that the respondents are willing to accept for tolerating adverse changes in the tested element or restricting access to it.

It is generally assumed that WTP is used to estimate the value of environmental projects and profits and WTA is used to determine the ecological losses resulting from the emission of pollutants into the environment[16].

In order to achieve credibility of the information obtained in the questionnaire survey, it is important to select the right kinds of questions.

There are many ways to ask survey questions. The simplest are open questions that generate data in a continuous form and if the answer of the respondent is sincere, the amount of money stated may be treated as WTP[17].

The most commonly used group of questions is closed questions, in which one indirectly obtains information on whether the respondent's WTP lies above or below the amount specified in the question. Usually, surveys are carried out in several variants, differing in the amount, which allows for a more accurate estimation of the distribution of WTP. A variation on closed questions is questions that are doubly closed, where depending on the answer to the first question, another is asked and the amount is reduced in the event of a negative response or increased in the case of a positive response[18].

Knowledge of how to ask survey questions allows one to choose the best method of preparation of a questionnaire survey.

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15 K. Rauba, Społeczna akceptowalność spełnienia zasady zwrotu kosztów usługi zbiorowego oczyszczania ścieków na obszarach wiejskich, „Handel Wewnętrzny" 2012 No. July–August, 2, pp. 258–266.

16 A. Graczyk, *Ekologiczne koszty zewnętrzne. Identyfikacja, szacowanie, internalizacja*, Białystok 2005, pp. 42–49.

17 J. Szyszko, J. Rylke, P. Jeżowski (eds), *Ocena i wycena zasobów przyrodniczych,* Warszawa 2002, pp. 245.

18 M. Czajkowski, *Metody wyboru warunkowego i wyceny warunkowej. Teoria, praktyka i zastosowania w kontekście zarządzania lasami w Polsce*, in: *Wartości nierynkowych korzyści z lasów. Metody wyceny oraz zastosowanie wyników w analizach ekonomicznych*, Warszawa 2011, pp. 29–30.

Method for assessment of social acceptability of implementing the collective system of sewage disposal and treatment

The unit responsible for ensuring collective sewage disposal and treatment for local communities is the commune. It is important that the commune, while realizing its policy in this regard, should take into account the opinion of the residents. In this situation, communal authorities can use a tool based on the CVM.

The developed research procedure to find the social acceptability of implementing collective sewage disposal and treatment is based on questions in the form of WTP.

The proposed method comprises the following steps:

1. Development of the concept of building a sewage treatment plant and the concept of implementing the sewage system
2. Cost analysis of proposed solutions
3. Determination of individual capital expenditures and individual exploitation costs
4. Determination of price levels
5. Development of a questionnaire survey
6. Conducting surveys
7. Statistical analysis of the obtained results.

The first phase of the study does not differ from the standard approach to implementation of investments from a particular range. It is therefore necessary to develop the concept of the technical–technological sewerage system and to conduct a financial analysis of the proposed solutions.

Then, one needs to determine the price for 1 $m^3$ of wastewater. To avoid cross-subsidization, one should divide the recipients of the service of collective sewage disposal and treatment into groups according to the generated costs. At this stage one may, however, set the same price for all customers especially in the areas where the recipients of the service of wastewater treatment are mainly households.

Prices for wastewater should be designed in variants. By setting particular price levels, one should take into account:

- operating costs,
- depreciation, which constitutes the recovery of capital expenditures,
- profit.

Based on the identified costs, one can determine five possible horizontal prices for wastewater. They result from different policies of communes in relation to implementation of the cost recovery principle of water services associated with the possibility of charging households for the costs of wastewater collection and treatment. The cost recovery principle of water

services was introduced by the Water Framework Directive.[19] The collective sewage disposal and treatment are included in the water services.

Often, in the case of poorer communes, achieving full cost recovery for water services takes time. One should then approach this in stages, going through the subsequent levels of prices.

At level I, the fees will provide only an incomplete recovery of the basic operational costs of the company, namely exploitation costs. This situation should be temporary in the case of aiming to satisfy the cost recovery principle of water services.

In the case of level II, the fees will fully cover the maintenance costs, but the generated revenue will not provide the possibility for new investments.

At level III, apart from operating costs, the price will partially include the capital expenditures in the form of depreciation.

The price for sewage from level IV will provide full coverage of operating costs and depreciation and will thus provide the opportunity to implement replacement and development investments.

Profitability of the project will be achievable only at level V, where the profit will be included in the price in addition to the operating costs and depreciation costs.

Four basic prices corresponding to the levels shown above were adopted in the proposed method of studying social acceptability regarding the collective system of sewage disposal and treatment:

1. Price I, corresponding to the current average cost of sewage disposal in the commune.
2. Price II, corresponding to level II.
3. Price III, corresponding to level IV.
4. Price IV, corresponding to level V.

The values of individual prices can be determined as follows:

1. Price II – full operating costs:

$$C_2 = K/Q \qquad [1]$$

$$K = Ko + Kk$$

where:
K – operating costs of a sewage disposal and treatment system, zl/year;
$K_o$ – operating costs of a sewage treatment plant, zl/year;
$K_k$ – operating costs of a sewage system, zl/year;
Q – amount of wastewater, $m^3$/year.

[19] Dyrektywa 2000/60/EC Parlamentu Europejskiego i Rady z dnia 23.10.2000 roku w sprawie ustanowienia ram działalności Wspólnoty w dziedzinie polityki wodnej.

2. Price III – full operating costs and depreciation:

$$C_2 = (K+A)/Q \quad [2]$$

where:
K – operating costs of a sewage disposal and treatment system, zl/year;
A – depreciation, set as 2.5% of capital expenditures, zl;

3. Price IV – full operating costs, depreciation, and profit:

$$C_2 = (K+A+Z)/Q \quad [3]$$

where:
K – operating costs of a sewage disposal and treatment system, zl/year;
A – depreciation, set as 2.5% of capital expenditures, zl;
Z – annual profit (set as 20% in the method), zl/year;
Q – amount of wastewater, $m^3$/year.

The next step in the proposed method is to prepare a questionnaire survey. The questionnaire should be divided into three parts. The first part should contain the initial questions, which will make it possible to assess the level of knowledge of the respondents on the issues of wastewater management in the commune. Information obtained from this part of the study will help to draw conclusions regarding the premises concerning the choice of prices. The second part of the survey should include questions about the preferred amount of money that respondents will be able to pay for using the collective system of sewage disposal and treatment. Therefore, these questions will take the form of WTP questions. Hence, prices I–IV will be used in this part. The initial price will be the money that residents currently pay for wastewater disposal in the commune. Prices I to IV, corresponding to the consecutive levels of reimbursement for providing services of sewage disposal and treatment, will appear in the subsequent questions. In the event that the respondents do not choose any of the proposed prices, they should be given the option to state the price that would be acceptable to them with a justification.

The last part of the questionnaire concerns personal data and the overall socio-economic characteristics of the respondents such as gender, age, income, and education.

The final stage of the procedure is to compile the statistical results obtained from the surveys conducted among the local community.

In the case of using the proposed method as a tool for implementing the wastewater management policy in the commune, a representative sample of residents will be surveyed in the research. The implementation of the project will concern the residents.

An important aspect of methods based on surveys is also the method of interviewing. Surveys are exposed to systematic errors that may contribute to distortion of the results. In order to avoid the occurrence of systematic errors one should adjust the survey according to the principles developed in 1993 by a committee of the American Commission for National Oceanic and Atmospheric Administration (NOAA).[20]

In the case of the proposed research method regarding social acceptability of implementing the collective system of sewage disposal and treatment, conducting research in the form of a direct interview is proposed. The fact that the results obtained in this way have systematic errors is known, but an experienced interviewer can conduct the interview in a right way. With regard to the problem that the method concerns, the ability to explain the aim of the survey is important, namely to what the investment relates and from what the various price levels result.

## Summary

When designing investments contributing to environmental protection in rural areas, one must take into account the wastewater treatment plant and the sewer system of a given region with regard to local conditions. Constructing the sewage treatment plant and extending the sewerage system should be related to the financial possibilities of the commune. The cost of building the sewage system bringing wastewater to the sewage treatment plant is often several times higher than the cost of building the plant itself.

It is important for communal authorities to get to know the degree of social acceptability of projects in the field of wastewater management in the commune. In order to become familiar with the views of citizens on the implementation and operation of collective systems of sewage disposal and treatment, one can use the contingent valuation method, using a study of willingness to pay (WTP). The results of the conducted survey based on the WTP question can be used as an instrument for supporting the decision-making process by the communal authorities in determining fiscal policy in terms of fees for wastewater disposal. Information obtained by this method will allow one to specify how much the local community is willing to pay for the use of the services of collective sewage disposal and treatment.

The developed method of assessing social acceptability of implementing the collective system of sewage disposal and treatment can be a tool sup-

20 K. Arrow et al., *Report of the noaa panel on contingent valuation*, "Federal Register" 1993 No. 10, pp. 4601–4614.

porting the decision-making process in terms of shaping the policy of fees for water services in the commune.

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