

## **Rivers as social assets in urbanised areas: A cost-benefit analysis for bathing in the river Ruhr using contingent valuation method**

Les rivières vues comme des biens sociaux dans les zones urbanisées : une analyse coûts-avantages pour la baignade dans la rivière Ruhr en utilisant la méthode de l'évaluation contingente

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### **RÉSUMÉ**

Cet article présente l'application de la méthodologie de l'évaluation contingente et du classement contingent du bien non commercialisable qu'est la « Baignade dans la rivière Ruhr ». Etant donné qu'il n'y a pas de marché observable pour un bien tel que la « Baignade dans la Ruhr », les résultats et les quantités ne peuvent être utilisés pour vérifier la validité. Dans le cas de l'évaluation contingente, on utilise des constructions pour évaluer leur validité, ainsi que leur convergence. La validité de ces constructions se réfère à la façon dont les résultats peuvent être expliqués par des facteurs prédéterminés. La convergence indique si résultats convergent ou non avec les résultats d'une autre méthode de mesure. A cet effet, la méthode du coût du trajet a été appliquée. Le classement contingent est utilisé pour révéler les préférences des répondants à l'égard de trois scénarios possibles de baignade : les possibilités de baignade dans la nature, les zones dévolues à la baignade et les piscines naturelles de rivière. Une analyse des coûts et des bénéfices a été réalisée en englobant à la fois les résultats de l'évaluation contingente indirecte et l'évaluation directe de l'analyse des coûts concernant la baignade dans la Ruhr. Pour l'évaluation économique directe, quatre études de cas ont été analysées. Les résultats de ces études de cas ont été extrapolés à la région de la Ruhr pour chaque scénario de baignade, individuellement.

### **ABSTRACT**

This paper presents the application of the methodology of contingent valuation and contingent ranking on the non-marketable good "Bathing in the river Ruhr". Since there is no observable market for such a good as "Bathing in the Ruhr", the results and the amounts cannot be checked for validity. In the case of the contingent valuation, constructs to assess the validity and their convergence are used. The validity of these constructs refers to how the results can be explained by predetermined factors. The convergence refers to whether the results converge with the results of another method of measurement. For these purposes, the travel cost method has been applied. The contingent ranking is used to reveal the respondents' preferences with regard to three possible bathing scenarios: nature bathing opportunities, designated swimming areas and river pools. A cost-benefit analysis was carried out comprising both, the results of the indirect contingent valuation and the direct evaluation of the cost analysis for bathing in the Ruhr. For the direct economic evaluation four case studies have been analyzed. Results from the case studies were extrapolated to the Ruhr area for each bathing scenario individually.

### **KEYWORDS**

Contingent valuation, Cost-benefit analysis, Contingent Ranking, Non-market goods; Willingness to pay

## INTRODUCTION

Rivers are experiencing their revival as valuable assets in urbanised areas. They are no longer regarded as receiving body for waste and storm waters, but esteemed for their ecological and recreational value. In various places such as Copenhagen, Munich, Berlin, the Ruhr area and other European metropolitan areas, rivers have been investigated for their bathing water potential. There is currently a ban on swimming for the Ruhr and its lakes. The 3-years-project "Safe Ruhr" that was funded by the German BMBF (Ministry of Education and Research) RiSKWa research program (Risk management of new pollutants and pathogens in the water cycle) explored conditions for the safe future use of the river Ruhr as recreational water and as an improved drinking water source. Optimizations of the waste water and stormwater treatment, the reduction of the microbial burden caused by combined sewer overflows and bathing water safety are part of the research plan. The long-term objective of the project is a comprehensive concept and recommendation guideline for the possible use of the river Ruhr, and in particular the lake Baldeneysee, as recreational bathing water. Working in close cooperation with the authorities of the city of Essen the aim is to implement bathing locally and to transfer the results of the project to other rivers in Europe.

## THE INDIRECT ASSESSMENT VIA CONTINGENT VALUATION: THE BENEFITS OF BATHING

To evaluate the cost-benefit ratios three possible bathing scenarios were analysed. In order to determine the benefit of bathing in the Ruhr, a representative population survey using contingent valuation and contingent ranking was conducted with over 1,000 households. Within this survey, preferences among different bathing scenarios and also the appreciation for bathing in the river Ruhr were asked for. Choosing between three suggested bathing scenarios, the respondents preferred designated swimming areas (42%) over river pools (31%) and nature bathing opportunities (22%). Only 3% of the respondents manifested an interest in leaving everything as it is (bathing prohibited). As around 55% of respondents expressed their willingness to provide an additional financial contribution for enabling bathing, a maximum annual total value for these payment amounts was estimated for the preferred scenario in the studied area river Ruhr and Lake Baldeneysee. Subsequently, the respondents were asked about their general attitudes towards environmental goods (assessment of water quality, environmental awareness, environmental commitment, risk perception, participation perception). These attitudes were used to filter protest responses, warm glow effect, embedding effect and the free rider behaviour from replies of the willingness to pay. The answers to these questions should help to separate the amount of the payment amount for measures at the Ruhr from general measures in environmental protection.

Several parameters for the accuracy of the estimate of the mean willingness to pay for the study region around the Baldeneysee (population) played a role: First, the probabilistic approach set certain requirements for way of interpretation, case number and scattering. Thus, a point estimate could not be made reliably. Instead, confidence intervals were calculated, which may have different bandwidths depending on the number of cases and scattering. Thus, there was always a 'worst case' to look at (the lower limit of the confidence interval) and a 'best case' (the upper limit of the confidence interval). Taking into account this assumption, the true value of the average maximum willingness to pay per year and person for the entire sample and for all respondents (N = 823) was calculated. To actually achieve absolute Euro amounts, calculated confidence intervals were converted to absolute populations. The share values 'px' defined by the confidence intervals as well as the worst and best case scenarios were multiplied by the general population 'n' of the study area (1,256,468 inhabitants). Accordingly, a total estimated maximum annual willingness to pay (= benefit) between € 24,048,798 and € 32,354,051 was calculated for the preferred bathing scenario "designated swimming areas" for the study region around the Baldeneysee.

## THE DIRECT ASSESSMENT OF THE CONTINGENT VALUATION: THE COSTS OF BATHING

Cost estimates exemplarily performed on four bathing areas at the Ruhr were based on the assumption that the total costs would consist of two parts: costs that are independent of the bathing scenario (increase water quality, upgrading of sewage treatment plants, combined sewer overflows

and so on) and those depending on the bathing scenarios (bathing infrastructure, waste management, transport infrastructure, sanitation, safety and communication and so on). These results were extrapolated for the project region afterwards for all three bathing scenarios. Therefore the base cost, investment measures and operations costs for a period of 30 years were considered.

## **THE COST-BENEFIT ANALYSIS FOR BATHING IN THE RIVER RUHR**

The net present value, the benefit-cost ratio and the internal rate were calculated as indicators for the efficiency of measures. The net present value was calculated as the difference between the present value of the benefits and the present value of the costs. A positive net present value is a necessary prerequisite for the implementation of a bath project. An equivalent to the present method evaluation criterion is the benefit-cost ratio. The resulting benefit- cost ratios and the sum of annual costs of (re-) investment and operating costs were illustrated. For all possible bathing scenarios regarding the Ruhr and its lakes these cost-benefit ratios and net present values were positive.

In addition, sensitivity analyses have been carried out. For this purpose, the interest rate, the period under review and the willingness to pay were modified. The results indicate that changes in the willingness to pay have the biggest impact on the benefit-cost ratio. However, even halving the most conservative estimate of the willingness to pay would not result in a benefit-cost ratio below the value of 1.

The research will be compiled into a guideline for bathing in natural waters; this is currently being developed. Furthermore, an interest group "bathing in the Ruhr" was founded, which will pursue the topic of bathing in the Ruhr beyond the end of the project and will implement the research results.

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