Economic valuation of the non-market benefits of the European Water Framework Directive: An international river basin application of the contingent valuation method

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Abstract

This paper is the first of its kind to investigate the economic value attached to the non-market benefits associated with reaching the European Water Framework Directive (WFD) objective of good ecological status in an international river basin context. Applying a common dichotomous choice contingent valuation survey design we assess and quantify public willingness to pay (WTP) in four sub-basins in three different countries, which together form the international Scheldt river basin district. We find significant differences in public perception and valuation of water quality across sub-basins in the three countries. Although the value of the non-market benefits of WFD implementation is more or less in the same range, between 15 and 25 euros per household per year, they are nevertheless non-transferable, also not when using a more sophisticated WTP value function approach, accounting for differences in demographic, socio-economic and socio-cultural characteristics. This study shows that in any future assessment of the cost-efficiency of proposed WFD measures and/or their disproportionality in an international river basin context, policy makers have to take into account that the perceived benefits differ between regional sub-basins. We find that the economic value of the non-market benefits of WFD implementation are significantly lower downstream than upstream if we control for a wide variety of influencing contextual factors.

Key words: Non-market benefits, Water quality, Contingent valuation, Water Framework Directive, Willingness to Pay, Benefits transfer

1. Introduction

Aquatic ecosystems are adaptive, but ecologically sensitive systems, which provide many important services to human society. This explains why in recent years much attention has been directed towards the formulation and operation of sustainable management strategies, the recent adoption of the European Water Framework Directive (2000/60/EC) being a good case in point. Both natural and social sciences can contribute to an increased understanding of relevant processes and problems associated with such strategies. The key to a better understanding of aquatic ecosystem problems and their mitigation through more sustainable management lies in the recognition of the importance of the diversity of functions and values supplied to society at different spatial and time scales. This includes a better scientific understanding of aquatic ecosystem structure and processes and the significance of the associated socio-economic and cultural values.

The Water Framework Directive (WFD) is the first European Directive to explicitly recognize the importance of this interdependency between aquatic ecosystems and their socio-economic values and provides a more integrated catchment approach to water policy. Investments and water resource allocations in river basin management plans are guided by cost recovery, cost-effectiveness criteria and the polluter pays principle. The plan formulation and assessment process must furthermore include a meaningful consultative dialogue with relevant stakeholders. Such a dialogue will inevitably raise socio-political equity issues across the range of interest groups and therefore affect the management strategies.

Much of the work so far across Europe regarding the implementation of the WFD has focused on the identification of management problems and appropriate measures to deal with these problems, using cost-effectiveness as the prime guiding principle. It is claimed that the Directive will also deliver substantial benefits. However, perhaps surprisingly for such a major policy change, there does not appear to have been any formal economic assessment of these benefits. While the policy may generate a number of market benefits, such as reductions in water treatment costs for water companies and manufacturers, less tangible, but potentially major, non-market values generated by the WFD have been underresearched (Bateman et al., 2006). These benefits include use values such as improved opportunities for, and qualities of recreation and non-use benefits, such as the values individuals may hold for improvements in wildlife habitat, which are not incorporated within recreation and amenity values. These benefits form an important part of the assessment of the proportionality of costs, which should inform WFD implementation.

This paper addresses the value of the non-market benefits the public places on the implementation of the WFD in the international Scheldt River Basin District (SRBD), in particular reaching the environmental objective in the WFD of ‘good ecological status’ for all water bodies, even though there does not yet exist a common definition of ‘good ecological status’ and corresponding parameter values. For this purpose we apply a large-scale contingent valuation (CV) survey, assessing public knowledge, understanding and perception of current water quality and preferences for improved water quality as a result of the implementation of the WFD in four administrative sub-basins of the Scheldt in three different countries: Artois-Picardie in France where the Scheldt originates (upstream), the Flemish and Brussels region in Belgium (middle stream), and Zeeland in the Netherlands where the Scheldt flows into the North Sea (downstream).

A previous study in the United Kingdom applying a choice experiment to estimate the economic value of reaching a good ecological status shows that lay public appears to be unable to distinguish between various indicator values used to represent good ecological status and the authors therefore recommend the use of the CV method (Hanley et al., 2005, p.9). In the CV study presented here we use a simple ‘choice experiment’ where people are asked to value good ecological conditions of all water bodies in their part of the basin by taking additional WFD measures, described in general terms compared to the presented baseline scenario of doing nothing extra to protect the water bodies. Current water quality in the international Scheldt basin is ‘moderate’ to ‘bad’ and quality levels are expected to stay the same or deteriorate in the future if no additional measures are taken (Scaldit, 2004).

Based on a common survey design we furthermore test transferability of economic values for reaching good ecological status across these four different sub-basins. Contrary to previous research in this area (Brouwer, 2004), Hanley et al. (2005) find that economic values are not transferable between two different river systems in one and the same country. Very little evidence exists about the transferability of economic values for the same or similar environmental goods and services across countries, especially in the field of water quality (e.g. Ready et al., 2004; Brouwer and Bateman, 2005; Scasny et al., 2006). International transfer errors are considerable in the studies listed above, and value adjustments based on value transfer do not necessarily improve transfer performance. To our knowledge, no empirical evidence exists so far about the transferability of economic values and value functions across countries sharing the same river basin, and the study presented here is in that sense unique.

The remainder of this paper is organized as follows. First, we briefly describe the international Scheldt river basin in the next section, followed by a discussion of the general methodological approach in section 3 and the common survey design in section 4. Section 5 presents the results, focusing specifically on differences and commonalities found between the four sub-basins, including the transferability of the estimated economic values and value functions. Finally, section 6 discusses the key findings and concludes.

2. The international Scheldt basin

The Scheldt is a 350 km long river that originates in France, flows through Flandres and Walloon in Belgium and discharges into the North Sea in the Netherlands (Figure 1). The international basin covers an area of 36,416 km², where 12.8 million people live and work. This corresponds with an average population density of 350 inhabitants/km^2, which is almost three times the European average (Scaldit, 2004). Major cities in the basin along the main river Scheldt include from south to north Valenciennes (400 thousand inhabitants), Lille (1.1 million inhabitants), Brussels (960 thousand inhabitants), Ghent (225 thousand inhabitants), Antwerp (445 thousand inhabitants) and Middelburg (460 thousand inhabitants). The international SRBD also includes a number of smaller river basins like the Somme in France, the IJzer in Belgium and the Oosterschelde in the Netherlands.

The Scheldt and its tributaries are lowland watercourses with slow currents and drainage. It contributed to the formation of fertile soils, which were the basis of important and intense farming in the rural areas like Zeeland. Nowadays, 60 percent of the entire basin is used for agricultural purposes. It also allowed the region to become a pillar for transport, industrial activities and urban development and the basin has important urban-industrial areas like Antwerp, Brussels and Lille. In addition, the entire coastal strip is popular with tourists. The basin has an extremely dense network of waterways and roads and has contributed to a large-scale industrial and urban infrastructure. Both maritime and inland shipping are important driving forces behind the economic activities in the region. This required a deep channel in the Westerschelde to ensure access for sea-going vessels to the port of Antwerp as well as dredging and canalization of the river.

Figure 1: The international Scheldt river basin district

The Scheldt estuary is also a rich natural area as tides create unique freshwater, brackish and saltwater ecosystems as parts of the riverbanks are daily flooded and the tides allow seawater to enter the river. It includes the only freshwater tidal area in Western Europe and the biggest salt marsh in Western Europe, the flooded land of Saefthinghe. On the other hand, the tide also increases the risk of storm surge and flooding, which required flood protection measures like storm barriers, dikes and floodplains. Ecosystems and water quality have suffered from the successes of transport, flood protection, agriculture, industry and urbanization. Although large investments and efforts have been made to reduce the discharge of polluting substances, the water quality is still a limiting factor for an optimal functioning of the aquatic ecosystems.

The riparian states and regions in the Scheldt basin collaborate to protect the Scheldt through the International Scheldt Commission based on the Scheldt treaty. The objective is to create a single river basin management plan for the entire international SRBD before 2010. The Scheldt is furthermore one of the fourteen Pilot River Basins (PRB) in the European WFD Common Implementation Strategy. In this Network of PRB, European guidance documents developed for the implementation of the WFD are tested for their applicability. In the European Interreg funded project ‘Scaldit’, France, Belgium and the Netherlands work together towards a common inventory of the relevant management issues and a common approach and harmonization of available data and information in the WFD implementation. For this purpose, the Scheldt is split into five different regions, managed by five different water authorities: Artois-Picardie in northern France, the Flemish, Walloon and Brussels region in Belgium and the delta estuary in Zeeland in the Netherlands.

In the context of the WFD, the main challenge is to define the most cost-efficient mix of measures to achieve the Directive's environmental objectives: reduction of pollution discharges to and from the public sewage system, diffuse emissions from agriculture, point source emissions from industry, improvement of the self-cleaning capacity of the river, limiting secondary emissions from contaminated sludge and sediments. This will require the valuation of water quality improvements and ecosystem functions of the river. For example, valuation of the goods and services provided by a healthy functioning aquatic ecosystem under 'good status' conditions for comparison with investments in emission reduction measures. How the non-market benefits of achieving a good ecological status throughout the international Scheldt basin in the different regions are estimated in this study will be discussed in the next section.

3. Methodological approach

Protecting water bodies from excessive use or contamination has benefits in terms of the value of uses that are damaged. Aquatic ecosystems provide a large number of goods and services that are of value to humans. Direct uses of water include extraction for use as drinking water, irrigation, or in industrial production. Water resources are also used indirectly for the disposal of waste chemicals, including excess fertiliser and pesticides from agriculture. Water may also have non-use values associated with it if people that are currently not using the resource place a value on its continued existence or pristine state. In addition people that currently do not use water might place a value on having the option to use it in the future, or for it to be available to future generations.

Evaluation of the trade-offs necessary to allocate resources between competing wants requires that we consider their economic value. In particular, one of the main principles of efficient and sustainable resource allocation requires knowledge of the marginal value or benefits of the resource in its alternative uses. Valuation is used in conventional economic terms to refer to the estimation of individuals' preferences for the conservation or improvement in quality of a resource, as well as individuals' loss of welfare due to resource depletion or quality decline. An individual's preferences are measured in terms of how much they are willing to pay to obtain or preserve a good or service, which is also referred to as the economic value or benefit. Economic value to society of a good or service is determined as the aggregate of all individuals' willingness to pay (WTP). It is important to point out that the price of a good or service and its economic value are distinct concepts and can differ greatly: water can have a very high value, but a very low price or no price at all.

Some values associated with water may be directly observable in well-functioning markets, for example if water users pay a fee for the quantity of water they extract. Often, however, water values are not readily observable and can only be estimated using appropriate non-market valuation methods. In this case study, we apply the CV method (Mitchell and Carson, 1989; Bateman et al., 2002) to assess public perception and valuation of water quality improvements to reach a good ecological status of all water bodies in the Scheldt basin.

In CV research, a survey is conducted where people are asked a range of questions including questions regarding the amount of money they would be willing to pay for an improvement in an environmental good or service, i.c. water quality improvement in the Scheldt basin. This may be conducted through face-to-face interviews, telephone or mail surveys. The design of the questionnaire is very important and typically comprises three components. Firstly, the questionnaire provides an explanation of the environmental issue of interest together with information on the change in quality. Secondly, it includes questions regarding respondent WTP. The third part of the questionnaire consists of questions about the demographic and socio-economic characteristics of the interviewee, which enable analysis and verification of the validity of responses on WTP given by respondents.

A respondent's choice or preference can be elicited in a number of ways. The simplest is to ask the respondent a direct question about how much he would be willing to pay for the good or service (known as open-ended questions). High rates of non-responses can be a problem with this approach if respondents are not very familiar with this question. Alternatively, a respondent can be asked whether or not he would want to purchase the service if it costs a specified amount. This is known as a discrete or dichotomous choice (DC) question, and may be favoured because they do not give the respondent any incentive to answer untruthfully, i.e.

the approach is ‘incentive compatible’. A hybrid approach is the ‘bidding game’, where respondents are asked a series of questions to iterate towards a best estimate of their valuation. Alternatively, respondents may be shown a list of possible answers – a ‘payment card’ – and asked to indicate their choice. This requires a careful determination of the range of possible answers, usually elicited through thorough pre-testing using open-ended WTP questions. Each approach implies particular requirements in terms of statistical methods, and the appropriate choice for a specific problem is often a matter of judgement on the part of the analyst. In this case study, we apply a single bound DC question given this elicitation format’s incentive compatibility properties. The CV study design will be presented in more detail below.

4. Common survey design

4.1. Sampling procedure

The CV survey design is based on previous water quality valuation work discussed in Brouwer (2006). A common questionnaire design was applied to four of the five administrative Scheldt sub-basins, which together comprise 90 percent of the whole basin area and the total basin population: Artois-Picardie (36% of the whole basin population), the Flemish region (44% of the whole basin population), the Brussels region (7% of the whole basin population) and Zeeland (3% of the basin population).

A total of 17,300 questionnaires were sent by mail by the end of October 2005 to a random selection of households in Artois-Picardie (5,000), Flandres (7,000), Brussels (2,000) and Zeeland (3,300). The response rate was 13.0, 14.3, 14.7 and 26.7 respectively. The higher response rate in Zeeland is due to the fact that for this region a financial incentive was used to stimulate respondents to complete and return the questionnaire. The total useable response is slightly lower in all regions because of missing values. The total number of useable observations for the analysis is 646 for Artois-Picardie, 998 for the Flemish region, 286 for the Brussels region and 874 for Zeeland.

4.2. Questionnaire design

The questionnaire was originally developed and thoroughly pre-tested in Dutch and afterwards translated into Flemish (for Flandres) and French (for Artois-Picardie and

Brussels). The questions were exactly the same in the four questionnaires, including the WFD valuation scenarios, except that the description of the current situation in the map was adapted with the help of water experts to fit regional conditions. After translation, the questionnaires were once again pre-tested on a small scale in each region.

The questionnaire consists of five parts. In the first part respondents are asked about their water related activities (type of recreation and frequency), followed in the second part by a series of questions about respondent perception of current water quality, the importance attached to (good) water quality compared to a number of other socio-economic issues, and the importance attached to being informed about water quality. Except in Brussels, a distinction is made between public perception of coastal water quality and fresh inland water quality.

Following these introductory questions, respondents are presented in the third part of the questionnaire with a one-page information statement (see the annex of this paper), where the actual water quality situation is described, the WFD is introduced, including the different water quality classes, and the WFD objectives. After reading through the information statement, respondents are asked to indicate how familiar they are with the information they are presented with and how important it is to them personally that the WFD objective of a 'good ecological status' is reached. This is then followed by a series of DC WTP questions:

- WTP in principle (and if not, why not);
- WTP a specific bid amount (10 bid levels are used, ranging from €5 to €2560) and if so, why;

The fourth part of the questionnaire consists of a series of questions about the respondent's demographic and socio-economic household characteristics, to test the representativeness of the sample and check the internal consistency of the WTP replies. The fifth and final part includes questions about the questionnaire self and in particular the WTP questions to test respondent perception of the validity and reliability of the WTP questions.

4.3. Statistical model

The DC format was originally developed to increase the incentive-compatibility of the valuation question (e.g. Mitchell and Carson, 1989). It matches the way consumers make choices in the market (they either decide to buy or not to buy a product at a given price) or, to a lesser extent, the way voters decide in political referenda. Kriesel and Randall (1986) show that this format gives respondents the most appropriate incentive to reveal their preferences. The DC method does not reveal the maximum WTP amount, only a discrete indicator of maximum WTP. Different mean WTP values can be calculated depending on the statistical specification of the valuation function and the applied truncation strategies. Mean and median WTP are inferred from the underlying statistical distribution of the probability that respondents say 'yes' or 'no' to different bid levels (Hanemann and Kanninen, 1999). This means that relatively large samples are needed to calculate expected average WTP with the same accuracy as methods that ask respondents directly for their maximum WTP amount. The calculation procedures for mean and median values based on binary CV response data were first outlined by Hanemann (1984). Various statistical models exist to estimate these underlying distributions such as logit or probit models. These models usually produce significantly different results and are an important source of statistical model specification bias in the analysis of CV results.

In this paper, we use the logistic probability or logit model for binary outcomes to estimate the probability that individual respondents say 'yes' or 'no' to a pre-specified question as a function of one or more explanatory factors. The reduced form of the logistic probability or logit model is (e.g. Langford and Bateman, 1993):

$$\Pr[\,y_{i=1}\,] = \frac{e^{\beta' x}}{1 + e^{\beta' x}}$$

where $\Pr[y_i=1]$ is the probability that a respondent says 'yes' to a specific bid amount. Beta (β) is a vector of variable parameters to be estimated, while x is the corresponding vector of explanatory variables. The error terms of the logit model are assumed to be normal distributed with zero mean and variance of one.

Two sub-models are usually used, i.e. the linear-logistic and log-logistic model. In the latter case the binary response variable is made a function of the natural logarithm of the original bid levels, a procedure originally proposed by Bishop and Heberlein (1979) to make the data better fit the underlying (inverse) normality assumptions. Another important reason for using the log-logistic model is to avoid the possibility of negative WTP (e.g. Hanemann, 1989;

Johansson et al., 1989). When using a linear-logistic model, the probability distribution function (PDF) also has a negative tail. Although usually not part of the range of bid levels used in DC CV questionnaires, negative bid levels can be assumed present when respondents feel they should be compensated for a specific environmental change. Willingness to accept compensation (WTA) instead of WTP would in that case be a more appropriate question (Hanemann, 1991). In this study, no indication is found that the WTA question would have been more appropriate for those people who refuse to answer the WTP question. Another possible reason to use the log-logistic model is that CV produces censored data. When aiming to compare DC results with open-ended WTP results or open-ended after DC WTP results, as in our case study, one could argue that a similar censored distribution including positive bids only should be used.

5. Results

5.1. General respondent characteristics

The general respondents characteristics are presented in Table 1. Respondents differ significantly across the four sub-basins for most of the demographic and socio-economic characteristics analyzed (indicated in the last column in Table 1 through the outcome of the non-parametric Kruskal-Wallis test statistic). This includes household size, income and education level, employment, place of birth and membership of any environmental protection organization. Only respondent age is statistically not significant at the five percent level. Although respondent age ranges between 18 and 92 years, the average age of the respondents is relatively high around 52 years. Correspondingly, a relatively high share of the sample population is retired (about one third).

Most of the questionnaires were filled in by men. Only in Brussels is the share of women significantly higher than in the other sub-basins, and are the respondents almost equally distributed between both sexes. Brussels also has the highest share of relatively higher educated one-person households, and the lowest share of respondents originally born in the area. On average across the whole international SRBD, three quarters of the sample population was originally born in the sub-basin where they currently live and work. This share is highest in the Flemish region where 95 percent of all respondents who completed and returned the questionnaire is originally born.

Table 1: Summary statistics of respondent demographic and socio-economic characteristics

Respondent characteristic	**International SRBD**	**Artois Picardie**	**Flandres**	**Brussels**	**Zeeland**	**KW Chi-square***
Percentage male respondents	66.3	64.9	70.0	54.5	67.1	25.12 (*p*<0.01)
Average age	52	51	52	50	52	6.41 (*p*<0.10)
Average number of family members	2.7	2.8	2.8	2.3	2.7	47.82 (*p*<0.01)
Percentage one person households	16.1	14.7	12.7	30.7	16.3	54.53 (*p*<0.01)
Percentage households with children	36.8	42.3	37.7	26.5	34.3	24.96 (*p*<0.01)
Average household income (€/month)	2190	2030	2265	2110	2250	28.48 (*p*<0.01)
Percentage higher education	46.4	37.7	49.2	69.1	42.0	93.64 (*p*<0.01)
Percentage employed	51.6	50.3	51.4	46.9	54.3	8.21 (*p*<0.05)
Percentage retired	29.8	35.6	30.0	27.6	26.0	8.21 (*p*<0.05)
Percentage unemployed	3.8	4.4	3.4	9.4	2.0	8.21 (*p*<0.05)
Percentage respondents born in region	76.0	78.0	95.3	47.2	62.1	425.04 (*p*<0.01)
Percentage member environmental protection organization	21.5	3.7	21.4	15.0	36.7	241.23 (*p*<0.01)

* Kruskal-Wallis Chi-square test statistic. Statistical significance level between brackets.

The average household size across the whole international SRBD is 2.7 persons, and is lowest in Brussels (2.3 persons), corresponding with the finding related to the high share of one-person households in this area. About one in every third respondent has children. This percentage is highest in Artois-Picardie where over 40 percent of the respondents have children.

Average household income in the international SRBD is almost 2,200 euros per month. Multiplied by twelve, this is slightly (15%) higher than the European average in 2005 of 22,600 euro per inhabitant (Eurostat, 2006). Income levels are highest in the Flemish region and lowest in Artois-Picardie. The distribution of respondents over the various income levels is relatively equal in all sub-basins (Figure 1). A relatively high share earns between 1,000 and 1,500 euros per month in all sub-basins.

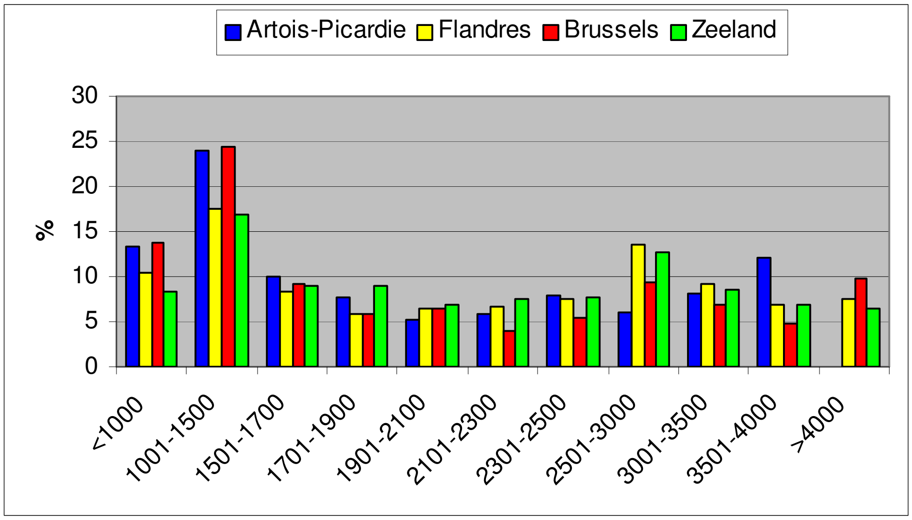

Figure 1: Distribution of the sample population in the four sub-basins across income groups (net disposable household income per month)

The share of higher educated respondents is also relatively high in the whole sample (Figure 2). About 45 percent has completed higher secondary education, a third of which has a university degree (15% of the total sample population). A remarkably high share of almost 40 percent of all respondents in Brussels completed an academic education. The share of respondents with only primary education is highest in Artois-Picardie (16%), followed by Flandres (7%) and Zeeland (6%).

About half of all respondents is employed, full or part-time, in the SRBD. Less than 5 percent is unemployed, which is lower than the European average of 7.9 percent in 2005 (Eurostat, 2006). Less than 10 percent is independent employer or entrepreneur. The share of unemployed respondents is remarkably higher in Brussels than in the other sub-basins. Less than 5 percent is housewife (highest in Flandres with 6 percent and lowest in Brussels with 1 percent), one percent is student (highest in Brussels with 2 percent and lowest in Flandres with 0.3 percent). About one percent is unable to work (invalid) and receives, as a result, social benefits (highest in Zeeland with 2.6% and lowest in Artois-Picardie with 0.5%).

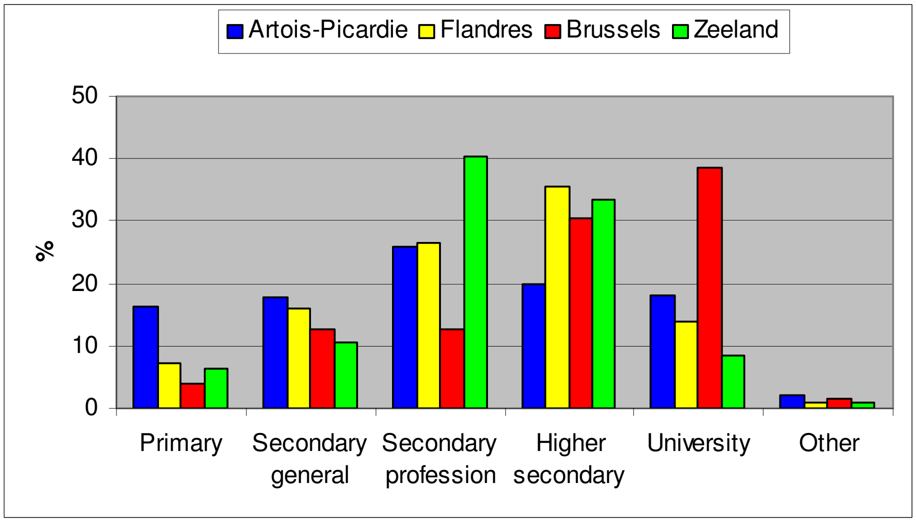

Figure 2: Distribution of the sample population in the four sub-basins across education levels

About thirty percent of the respondents are employed in the industrial sector, including construction, followed by the public (government) sector (16%), health care (16%), education (11%), and the service sector (10%). Less than 4 percent is employed in agriculture and fishery, 2.5 percent in the transport sector (including commercial shipping) and only one percent in tourism and recreation. The share of government employees is particularly high in the Flemish and Brussels region (around 20%), and lowest in Zeeland (7%). A relatively high share of the Zeeland sample is employed in health care (20%), agriculture (7%) and fishery (1%).

Finally, membership of an environmental protection organization like WWF or Greenpeace varies significantly between sub-basins, from less than 4 percent in Artois-Picardie to almost 40 percent in Zeeland.

5.2. Recreational water use and public perception of water quality

Significant differences are also found between sub-basins when looking at the intensity of various water-based recreational activities. Most respondents in the SRBD (62%) undertake some form of water-based recreation and most (54%) live within a radius of 10 kilometers from the nearest water body where they undertake these recreational activities (Figure 3). This share is highest in Zeeland (62%) and lowest in Artois-Picardie (38%). Remarkable is the relative high share of respondents in Artois-Picardie and Brussels (33 and 21 percent respectively) who say that they have to travel more than 75 kilometers to the water body where they recreate. The differences found in Figure 3 are statistically significant[1].

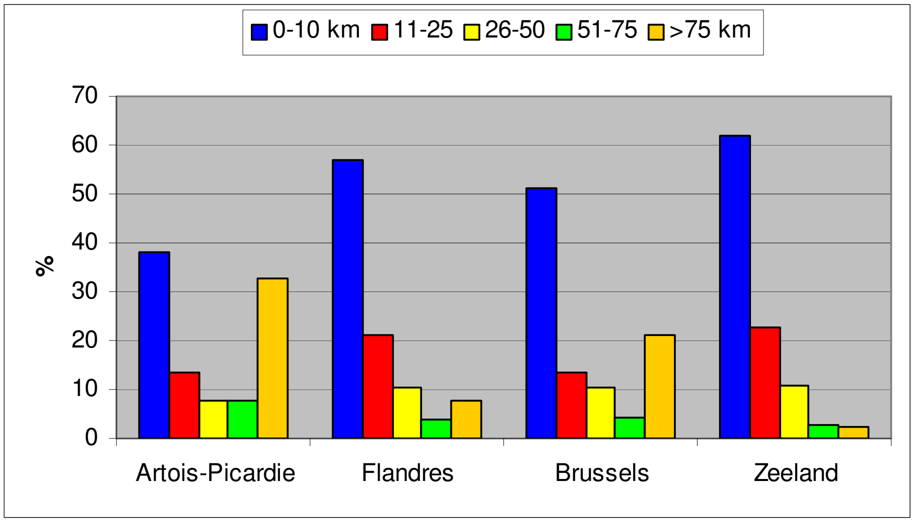

Figure 3: Distance traveled to recreate in and near water in the four sub-basins

Swimming and bathing is the most popular recreational activity, followed by boating and surfing (Figure 4). About half of the respondents swim now and again in open water. Most frequent bathers are found in Zeeland and Artois-Picardie. Almost 70 percent of all respondents in the Flemish and Brussels region indicate never to bathe in open water in their region. On average, one in every fifth respondent fishes now and again. The number of recreational fishermen is highest in Artois-Picardie (30%), followed by Zeeland (21%) and is lowest in Brussels (9%).

As expected, respondents who recreate in, at or near water have a significantly different perception of water quality than respondents who do not. The former perceive water quality of water bodies as being in a slightly, but significantly better state than the latter[2]. On the other hand, no significant difference can be detected between the two groups when examining respondent perception of water quality development over the past decade. Both groups

[1] The Kruskal-Wallis Chi-square is equal to 197.47 (p<0.01).

[2] Water quality is measured on a gliding scale from ‘poor’ to ‘very good’. The Kolmogorov-Smirnov Z value testing the equality of the two distributions (for respondents who recreate now and again and respondents who do not) is 2.457 (p<0.01), while the Mann-Whitney Z value testing equality of the central tendency of the two distributions is –6.259 (p<0.01).

believe that water quality has improved over time. However, substantially more respondents who never recreate in, at or near water (36%) than those who do (27%) have no idea about the evolution of water quality over the past decade. The same applies for current water quality levels, where twice as many respondents who never recreate in, at or near water have no idea about current water quality levels (respectively 16 and 7 percent).

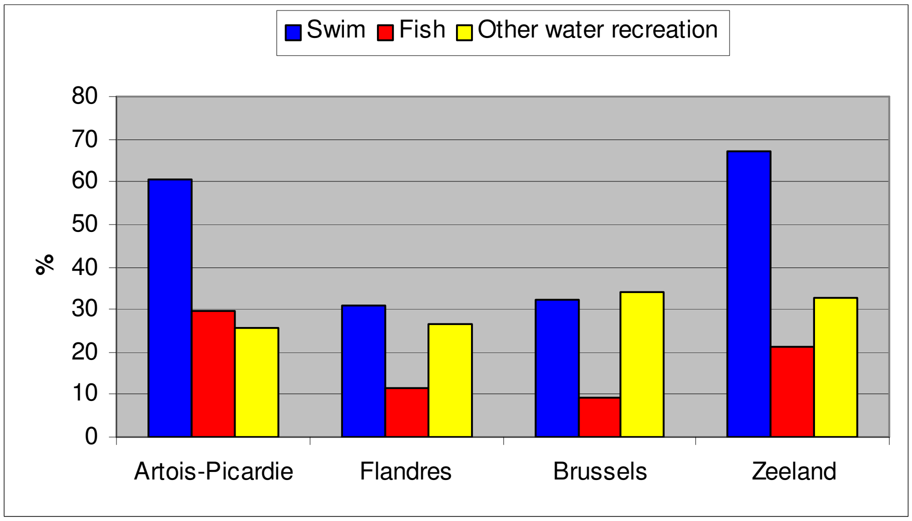

Figure 4: Water based recreational activities undertaken in the four sub-basins

As many as 60 percent of the whole sample population in the international SRBD feel that they are insufficiently informed about water quality levels in their region[3]. This percentage is especially high in the metropolitan region of Brussels where 80 percent of the sample feel that they are insufficiently informed. About one third in the SRBD says that they are sufficiently or more than sufficiently informed. This percentage is highest in Zeeland where over 40 percent of the sample population feel this way. A majority of about 80 percent of the whole sample population wants to be informed, because they believe this is important for them to know.

Public perception of current freshwater quality, using the official WFD classification of water quality is presented in Figure 5. The differences observed in Figure 5 are statistically

[3] This could possibly explain the high share of 'don't know' responses related to water quality perception. However, no significant relationship can be found between respondents who feel they are insufficiently informed and those who claim not to know the current state of water quality.

significant[4]. A majority of 70 percent of all international river basin inhabitants perceive water quality levels as moderate to poor, corresponding with the official classification of most water bodies in the WFD article 5 report (Scaldit, 2004). This share is even higher in France and Belgium (80%), but considerably lower in the downstream basin Zeeland in the Netherlands (50%). About 10 percent of all basin inhabitants have no idea what the current water quality level is. This percentage is highest in Brussels (15%) and lowest in Artois-Picardie (6%). Finally, a minority of 6 to 14 percent perceives current water quality as good or very good. Only in Zeeland as many as almost 40 percent of all respondents perceive current water quality as good.

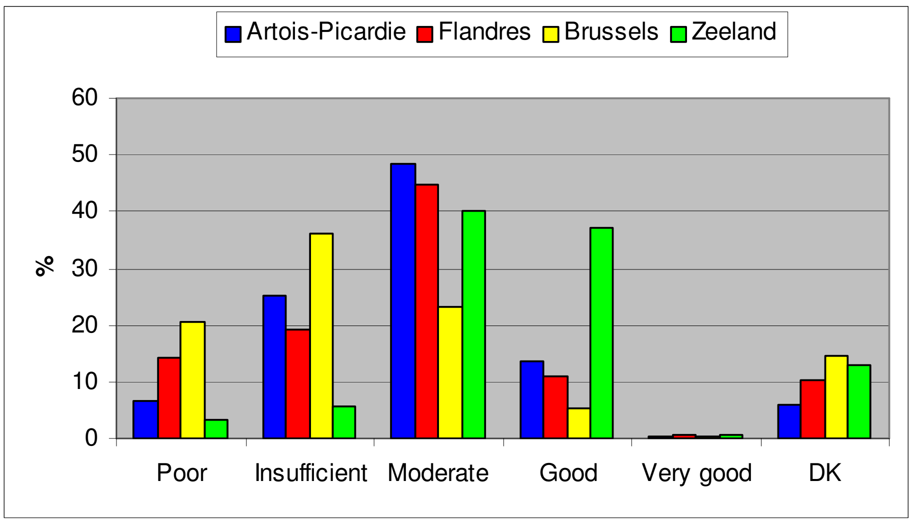

Figure 5: Respondent perception of current water quality based on the official WFD classification in the four sub-basins

For the three next to the North Sea located sub-basins, respondents are also asked for their perception of seawater quality. Again significant differences are found between sub-basins, with Zeeland inhabitants having a significantly more positive perception of seawater quality than those in the further upstream basins in Artois-Picardie and Flandres. Strikingly, more than twice as many respondents in the three sub-basins perceive seawater quality as good or very good compared to fresh inland water quality. Hence, seawater is generally perceived as of better quality throughout the entire river basin than fresh inland water bodies. No big differences are found within sub-basins when looking at respondent perception of freshwater and seawater quality changes over the past 10 years, except in Flandres. Twice as many

[4] The Kruskal-Wallis Chi-square is equal to 417.03 ($p<0.01$).

respondents in the Flemish region believe that freshwater quality has improved compared to seawater quality, while twice as many believe that seawater quality has deteriorated compared to freshwater quality.

5.3. Willingness to pay for the WFD and transferability of WTP values

Significant differences are found between sub-basins when examining the importance respondents attach to water quality improvements compared to other social and economic issues[5]. Almost all SRBD respondents (90%) agree that water quality improvements are important. Similar results are found when asking respondents to indicate how upset they will be if a good status will not be reached in their region in the next 10 years. A large majority says they will be upset or very upset if this is the case. When asked to rank water quality problems compared to other relevant social issues such as employment, health care, safety on the street, noise and other environmental problems like air pollution, a slightly different picture emerges. Most respondents (40%), especially in Brussels and Zeeland, feel that water quality is less important than these other social and environmental issues. About 30 percent ranks them equally high, while another 30 percent believes that water quality is more important.

Following these questions, respondents are also asked whether they are willing to financially commit themselves to improving water quality in their region. For this they are asked to indicate whether they are willing to pay in principle to reach a good ecological status in the year 2015 in their sub-basin. Just over 50 percent (52%) of all SRBD inhabitants are willing to pay in principle. Positive WTP is highest in the Flemish region and Zeeland (both 53%), and lowest in the Brussels region (47%). In Artois-Picardie 49 percent of all respondents are willing to pay in principle.

When asking respondents why they are not willing to pay, the following results are found (Figure 6). Most respondents (30%) indicate that they have insufficient financial resources to pay extra for the proposed water quality improvements, followed by 'the polluter should pay' (16%), and 'I already pay taxes for water quality' or 'I already pay enough for water quality'

[5] The Kruskal-Wallis Chi-square is equal to 27.60 ($p<0.01$).

(15%). Related to this latter reason, 6 percent says that the responsible authorities and Government should reallocate the current amount of money they pay.

About 10 percent of those respondents who are not willing to pay extra say that there are other more important things they could spend their money on, and another 10 percent thinks that the current situation is good enough. Only one percent does not consider water quality improvement important and three percent considers water quality improvement a government task.

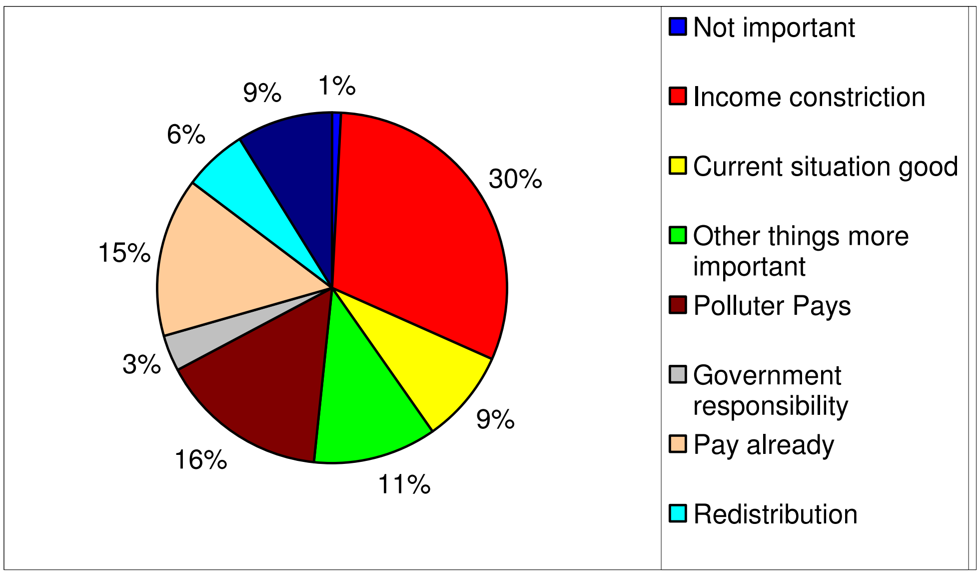

Figure 6: Reasons why respondents are not willing to pay in principle for the implementation of the WFD and reach a good ecological status in the international Scheldt river basin district

The reasons why respondents are not willing to pay extra for reaching a good ecological status are used to separate protest bidders from non-protest bidders (also called 'legitimate zero bidders'). Protest bidders typically object against the imposed market structure in a CV study (Jorgensen et al., 1999; Meyerhoff and Liebe, 2006). However, no consensus exists in the international literature about the exact definition of a protest bidder. There often exists a grey area where there is doubt about the true underlying reasons for WTP refusals. In this study, we define protest bidders as respondents who claim that:

- the polluter should pay (and hence do not see themself as a polluter) (n=203);
- this is a government responsibility (n=43);
- reaching a good ecological status is not feasible (n=4);

- they do not trust the responsible authorities and expect that their money will be wasted through inefficient management (n=16).

The total number of respondents protesting against the WTP question based on these considerations is 266. This is equal to 9.5 percent of the total sample. Although there also do not exist clear guidelines regarding acceptable protest rates, this overall rate is below the rates found in similar previous studies (Brouwer, 2006) and hence not considered alarming or as invalidating the survey results. The protest rates across the four sub-basins range from only 4.6 percent in the Brussels region to 12.8 percent in Artois-Picardie. Protest in the Flemish region is 7.9 percent and in Zeeland just over 10 percent (10.7%). A separate analysis was carried out to test differences between protest and non-protest bidders. Compared to non-protest bidders, protest bidders appear to be significantly higher educated and wealthier men from slightly bigger households, with less trust and confidence in the baseline scenario and WFD objective of reaching a good ecological status for all water bodies in their region.

Following the WTP in principle question, respondents who are willing to pay in principle are subsequently asked the DC WTP question where an increase in general taxation is used as the payment vehicle. The WTP cumulative probability distribution function (CPDF) for each sub-basin is presented in Figure 7. The horizontal axis shows the ten bid amounts presented to respondents, the vertical axis the cumulative probability of accepting the bid amount. The higher the bid amount, the lower the probability that the respondent is willing to pay. On average and for all sub-basins together, less than 20 percent of the respondents say ‘yes’ to the highest bid amount. Hence there does not seem to be any ‘fat tail’ problem (e.g. Cooper, 1993; Alberini, 1995), i.e. relatively high acceptability rates at higher bid levels. The absence of a fat tail is largely due to thorough pre-testing of the bid design. The bid functions are very similar and largely coincide in the four sub-basins. Only in Zeeland we find a relatively higher share of positive WTP responses at the highest bid level (30%).

Mean and median WTP values are derived from these bid functions in Figure 7 and presented in Table 2. Mean and median WTP are the same in the case of the linear-logistic model (Hanemann, 1984). For the log-logistic model, the median WTP values and their standard errors have been calculated. These median WTP values will be used here for comparison and tests of transferability.

Median WTP values range between 12 and 43 euro per household per year based on the linear-logistic models and between 14 and 24 euro per household per year based on the log-logistic model. Median WTP values derived from the linear-logistic model are less accurate than the median values derived from the log-logistic model. The variation coefficient for the entire SRBD is 27 percent in the case of the linear-logistic model and less than 10 percent in the case of the log-logistic model. The average variation coefficient based on the estimated individual sub-basin WTP values is as high as 64 percent based on the linear-logistic model and 20 percent for the log-logistic model. Especially the standard error of the estimated linear-logistic model in the French sub-basin Artois-Picardie is very high, both in absolute and relative terms. Hence, the log-logistic median WTP values are more precise and hence more reliable than the linear-logistic WTP values.

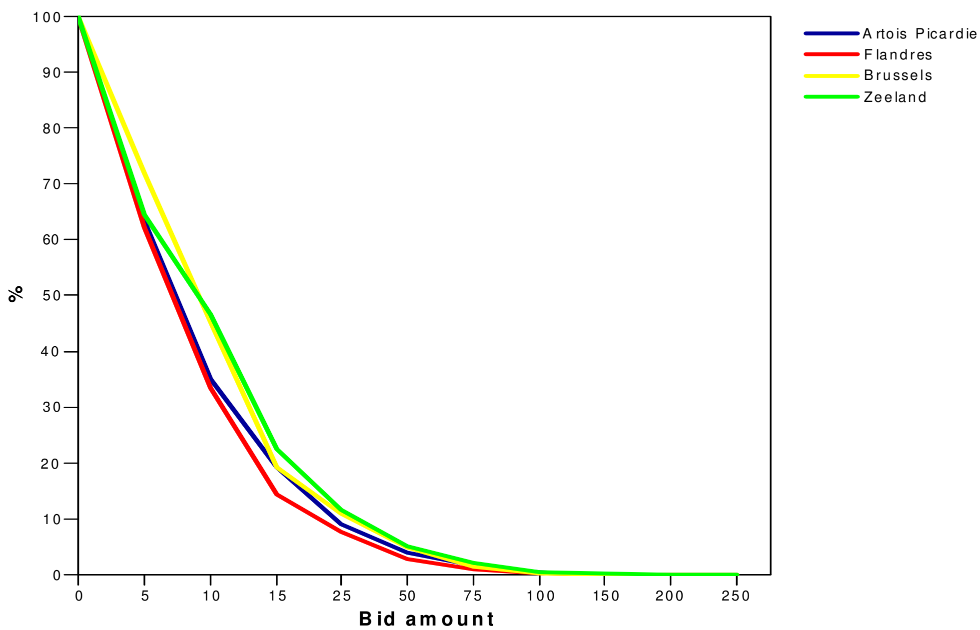

Figure 7: WTP cumulative probability distribution function for the four sub-basins

The estimated WTP values are significantly different at the one percent level and hence the estimated benefits are not transferable across sub-basins, except for the two sub-basins in Belgium, i.e. the Brussels and Flemish region (based on the Normal test). No significant difference can be detected between these WTP values, either based on the linear-logistic model or the log-logistic model[6].

[6] The Z test value for the difference between the Brussels and Flemish region equals –2.53 in the case of the linear-logistic model and –1.97 for the log-logistic model. These values are less than the critical value at the one

Table 2: WTP summary statistics for the four sub-basins

	International SRBD	**Artois-Picardie**	**Flandres**	**Brussels**	**Zeeland**
WTP in principle (%)	51.6	49.4	53.2	47.2	52.8
Protest rate (%)	9.5	12.8	7.9	4.6	10.7
DC WTP Linear-logistic					
Median WTP (€/year)	29.4	12.1	30.1	33.1	43.2
Standard error	8.0	13.8	13.7	18.2	18.2
95% Confidence interval	13.7 – 45.1	-14.8 – 39.1	3.2 – 57.0	-2.5 – 68.8	7.5 – 79.0
Number of observations	2510	907	558	271	774
DC WTP Log-logistic					
Median WTP (€/year)	18.9	14.1	18.7	19.2	23.9
Standard error	1.7	2.7	2.9	4.0	3.8
95% Confidence interval	15.6 – 22.1	8.7 – 19.4	13.0 – 24.5	11.5 – 27.0	16.4 – 31.4
Number of observations	2510	907	558	271	774

The main reasons why inhabitants in the four different sub-basins are willing to pay for reaching a good ecological status in the international Scheldt river basin are listed in Figure 8. The most important perceived benefits are the effect of good ecological status on human health and quality of life, related to respondents self and future generations. Almost half of all respondents (45%) state reasons, which are directly related to the WFD objectives of good ecological status and the importance they attach to meeting this objective, their own health and well-being and that of their children and grandchildren. This suggests that both use and bequest (non-use) values dominate the estimated WTP compensating surplus welfare measures, justifying the use of a stated preference method like the CV method applied here for the assessment of the total economic benefits of the implementation of the WFD (besides the use of other valuation methods to estimate other (in)direct benefits such as avoided treatment costs).

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percent level, resulting in a rejection of the null hypothesis of equality. The full test results are available on request from the corresponding author.

Just over 10 percent of the positive WTP replies relate to reasons, which have been labeled 'warm glow' and the 'purchase of moral satisfaction' in the CV literature (e.g. Kahneman and Knetsch, 1992; Nunes and Schokkaert, 2003), such as importance attached to the environment in general, wanting to contribute to a good public cause or feeling a moral obligation or responsibility to pay.

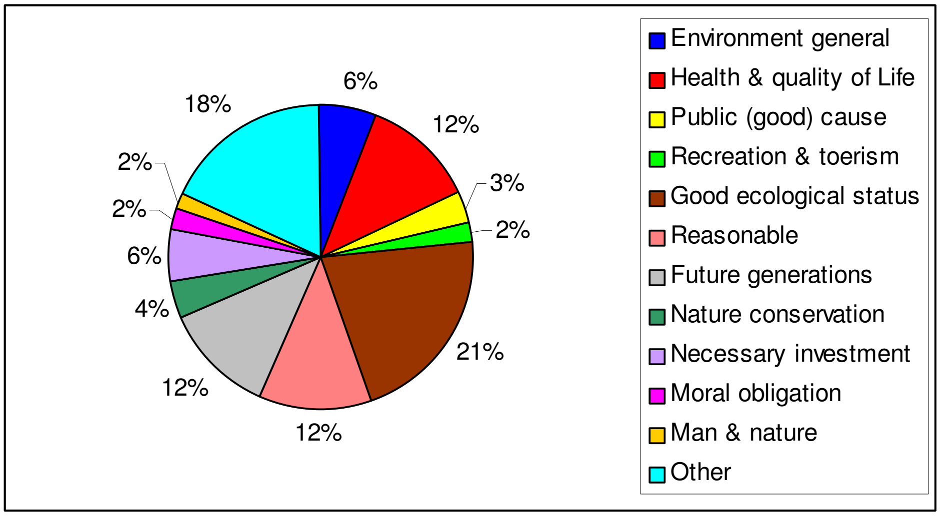

Figure 8: Reasons why respondents are willing to pay (expected benefits) for the implementation of the WFD and reach a good ecological status in the international Scheldt river basin district

Almost 5 percent has a pure nonuse interest in nature conservation, while 2 percent is willing to pay only for use value motivations such as improved water quality for recreational swimming and fishing. Just over 5 percent believe that the necessary measures to reach the WFD objectives will cost money and are happy to pay the proposed bid amount in view of its purpose.

5.4. Factors influencing Willingness to Pay and transferability of WTP functions

In this section we present the estimated full multivariate (statistically best fit) logistic model for the DC WTP replies. Besides household income, a number of other variables have a significant impact on stated WTP. Some of these are expected from a theoretical point of view, others reflect more ad hoc conditions of this specific study. Transferability of the estimated WTP functions is tested by the inclusion of dummy variables for the sub-basins in which the survey is carried out. If these dummy variables are significant, this implies that the estimated functions are not transferable (see, for example, Downing and Ozuna, 1996).

The outcome of the multivariate regression model is presented in Table 3. The model is estimated using maximum likelihood (ML) techniques (Maddala, 1983). In order to avoid any multi-colinearity the variables are tested, as usual, for possible correlation. Correlation coefficients between explanatory factors do not exceed 33 percent.

Table 3: Multivariate logistic regression results

		DC WTP model
Explanatory variable	**Value range**	
Constant	-	-8.089*** (1.417)
Bid level	5-250 (natural log)	-0.974*** (0.069)
Household net monthly income	750-4500 (natural log)	1.048*** (0.165)
Age	18-92	0.018*** (0.005)
Born in sub-basin	Dummy (1=born in sub-basin)	-0.363* (0.190)
Place of residence = Flandres	Dummy (1=Flandres)	-0.533** (0.250)
Place of residence = Brussels	Dummy (1=Brussels)	-0.506* (0.309)
Place of residence = Zeeland	Dummy (1=Zeeland)	-0.698*** (0.257)
Membership of EPO [§]	Dummy (1=member)	0.584*** (0.182)
Credibility reaching good ecological status	0=not credible at all – 4=very credible	0.443*** (0.074)
Familiarity with information in questionnaire	Dummy (1=never heard of before)	-0.669*** (0.183)
Importance attached to water quality improvement	0=not important at all – 4=very important	0.367*** (0.131)
Knowledge about current water bill	Dummy (1=respondent knows his current water bill and is able to state money amount; 0=has no idea or only guesses)	-0.532*** (0.184)
Certainty of WTP specific bid amount [§§]	0-100%	0.027*** (0.003)
Likelihood Ratio chi-square		600.59 (*p*<0.01)
-2 Log likelihood		1148.819
R^2		50.2
Number of observations		1287

Explanatory notes: Standard errors of the parameter estimates between brackets.

***: *p*<0.01; **: *p*.05; *: *p*<0.10

[§] EPO: environmental protection organization

The model is statistically significant at the one percent level (measured through the Likelihood Ratio test statistic). The logit model is able to explain about half of the variation in stated WTP (as measured through Nagelkerke's R-square).

Three groups of explanatory factors are distinguished. The theoretically expected variables are highly significant and have the expected sign. In the logit model, bid level is negative, meaning that the higher the bid level, the lower the probability that a respondent says 'yes' to the presented bid amount. Household income is positive: the higher household income, the higher stated maximum WTP or the higher the probability that a respondent says 'yes' to the presented bid amount.

The most remarkable finding is the fact that the parameter estimates for the sub-basins (Artois-Picardie being the baseline basin) are negative in the multivariate Logit model, suggesting that whilst accounting for other significant explanatory factors, the logit model shows that, on average, WTP is significantly lower in the further downstream sub-basins compared to the upstream basin Artois Picardie. The further downstream, the lower, on average and all other things being equal WTP for reaching a good ecological status for all water bodies in these downstream sub-basins. Given the significance of the dummy variables, the estimated WTP function is not transferable between sub-basins.

Significant positive relationships are found between stated WTP and respondent membership of an environmental protection organization (members are WTP more on average and all other things being equal), respondent belief in the presented policy scenario, i.e. the feasibility of reaching a good ecological status in the next 10 years (the more the respondent beliefs this is possible, the higher stated WTP or the higher the probability of willing to pay a specific bid amount), the importance attached to reaching the WFD objective of good ecological status (the more important the higher stated WTP or the probability of paying), and the experienced certainty or uncertainty in stated WTP (the higher the experienced uncertainty, the lower the probability of paying or the lower the stated maximum WTP). Better informed respondents are WTP more or are more likely to pay a specific bid amount if it concerns their knowledge about the current status of water bodies. However, respondent knowledge about his own current water bill has a significant negative impact on his stated WTP.

6. Discussion and conclusions

This paper is the first of its kind to investigate the economic value attached to the non-market benefits associated with reaching the WFD objective of good ecological status in an international river basin context. Applying a common CV survey design we assess and quantify public WTP as a compensating surplus welfare measure in four different sub-basins of the international Scheldt river basin district. We find significant differences in public perception and valuation of water quality across sub-basins located in three different countries. Although the value of the non-market benefits of WFD implementation is more or less in the same range (between 15 and 25 euros per household per year in the case of the DC WTP model), they are nevertheless non-transferable, also not when using a more sophisticated WTP value function approach, accounting for differences in demographic, socio-economic and socio-cultural characteristics.

Inhabitants in the SRBD are not willing to give up more than 0.2 percent of their annual household income to achieve the WFD objectives. This share is lowest in the upstream basin Artois-Picardie and highest in the downstream basin Zeeland. Half of the inhabitants of the international SRBD who know their current water bill are willing to pay maximum 40 percent over and above this bill. However, this latter estimate is very unreliable and cannot be used in any policy evaluation given the fact that it is based on a very limited number of observations. Almost 80 percent of all SRB inhabitants have no idea what they currently pay for their water bill.

This study shows that there are substantial additional non-market benefits to be expected besides for example market based benefits such as avoided treatment costs as a proxy of the economic welfare implications of WFD implementation. Maximum WTP values can be as high as 40 euros per household per year. Roughly aggregated across the relevant market of beneficiaries of WFD implementation (4.5 million households of which half are willing to pay), this amounts to a total economic value of the non-market benefits of about 90 million euro annually for the whole SRBD, or a net present value of 760 million euro at for example a discount rate of 4 percent for this European public investment project.

This study furthermore demonstrates that in any future assessment of the cost-efficiency of proposed WFD measures and/or their disproportionality in an international river basin context, policy makers have to take into account that the perceived benefits differ between regional sub-basins. We find that the economic value of the non-market benefits of WFD implementation are significantly lower upstream than downstream if we do not control for any other influencing factors. This result is reversed when we do control for contextual factors. We also find that a substantial proportion of around 35 percent of the total benefits consist of nonuse values, justifying and stressing the importance of applying non-market valuation methods in the future economic assessment of the implementation of the WFD. Concern for future generations appears to be an important nonuse motivation, while public health and quality of life are important use oriented motivations underlying stated WTP.

About half of the international river basin inhabitants are willing to pay extra for the implementation of the WFD. Half of those respondents who are not willing to pay state reasons, which can be explained theoretically on economic grounds, like income constraints, lack of preferences and substitution effects. About 15 percent of the respondents who are unwilling to contribute financially refuse to pay because they believe the polluter should pay and hence implicitly believe they are not a polluter. This is often heard as a strong protest vote in CV research looking at water quality problems. However, comparing total protest numbers with the total number of useable response, the overall protest rate is less than 10 percent in this study, supporting the validity and reliability of the CV survey. Other important indicators of the validity and reliability of the CV study are derived from respondent own perception of the quality of the survey. A majority of 80 percent of all respondents in the international basin find the information provided in the questionnaire sufficient or more than sufficient to answer the WTP questions. Although about a third of all respondents find answering the WTP question difficult, it is clear or very clear to more than three quarters (77%) what they are being asked to pay for exactly. Hence, overall we believe that these indicators show that the survey performed well, increasing our confidence in the CV survey results, and attribute this to a large extent to the thorough pre-testing that preceded the final survey implementation.

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References

Alberini, A. (1995). Efficiency vs bias of willingness-to-pay estimates: bivariate and interval-data models. Journal of Environmental Economics and Management, 29: 169-180.

Bateman, I.J., R.T. Carson, B. Day, M. Hanemann, N. Hanley, T. Hett, M. Jones-Lee, G. Loomes, S. Mourato, E. Ozdemiroglu, D.W. Pearce, R. Sugden and J. Swanson (2002), Economic Valuation with Stated Preference Techniques: A Manual, Edward Elgar, Cheltenham, UK.

Bateman, I.J., Brouwer, R., Hanley, N., Georgiou, S., Machado, M., Mourato, S. and Saunders, C. (2005). A 'Natural Experiment' Approach to Contingent Valuation of Private and Public UV health risk Reduction Strategies in Low and High Risk Countries. Environmental and Resource Economics 31: 47-72.

Bateman, I.J., Brouwer, R. Davies, H., Day, B.H., Deflandre, A. Di Falco, S., Georgiou, S., Hadley, D., Hutchins, M., Jones, A.P., Kay, D., Leeks, G., Lewis, M., Lovett, A.A., Neal, C., Posen, P., Rigby, D. and Turner, R.K. (2006). Analysing the agricultural costs and non-market benefits of implementing the Water Framework Directive. Journal of Agricultural Economics 57(2): 221-237.

Bishop, R. and Heberlein, T. (1979) Measuring values of extra-market goods: are indirect measures biased? American Journal of Agricultural Economics, 61: 926-930.

Brouwer, R. (2000). Environmental value transfer: State of the art and future prospects. Ecological Economics, 32: 137-152.

Brouwer, R. (2004). Public willingness to pay for the implementation of the Water Framework Directive in the Netherlands [in Dutch]. H_2O, 12: 4-5.

Brouwer, R. and Bateman, I.J. (2005). Benefits Transfer of Willingness to Pay Estimates and Functions for Health-Risk Reductions: A Cross-Country Study. Journal of Health Economics 24: 591-611.

Brouwer, R. (2006). Valuing water quality changes in the Netherlands using stated preference methods. In: Pearce, D.W. (ed.). Valuing the environment in Developed Countries. Edward Elgar, Cheltenham, UK.

Cooper, J.C. (1993). Optimal bid selection for dichotomous choice contingent valuation surveys. Journal of Environmental Economics and Management 24: 25-40.

Downing, M. and Ozuna, T. (1996). Testing the reliability of the benefit function transfer approach. Journal of Environmental Economics and Management 30: 316-322.

Eurostat (2006). http://epp.eurostat.ec.europa.eu.

Hanemann, W.M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics, 66: 332-341.

Hanemann, W.M. (1991) Willingness to pay and willingness to accept: how much can they differ? The American Economic Review, 81: 635-647.

Hanemann, W.M. and Kanninen, B. (1999) The statistical analysis of discrete-response CV data, in Bateman, I.J. and Willis, K.G. (eds.) Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries, Oxford University Press, pp. 302-441.

Hanley, N., Wright, R.E. and Alvarez-Farizo, B. (2005). Estimating the economic value of improvements in river ecology using choice experiments: an application to the water framework directive. Journal of Environmental Management, 1-11.

Johansson, P-O., Kriström, B. and Mäler, K-G. (1989) A note on welfare evaluations with discrete response data. American Journal of Agricultural Economics, 71(4): 1054-1056.

Kahneman, D. and Knetsch, J.L. (1992). Valuing public goods: The purchase of moral satisfaction. Journal of Environmental Economics and Management, 22(1): 57-70.

Kriesel, W. and Randall, A. (1986). Evaluating national policy by contingent valuation. Paper presented at the annual meeting of the American Agricultural Economics Association, Reno, Nevada.

Langford, I.H. and Bateman, I.J. (1993). Welfare measures for contingent valuation studies: estimation and reliability. Global Environmental Change Working Paper 93-04, Centre for Social and Economic Research on the Global Environment, University of East Anglia and University College London.

Mitchell, R.C. and R.T. Carson (1989). Using surveys to value public goods: The contingent valuation method. Resources for the future. Washington D.C.

Nunes, P.A.L.D. and Schokkaert, E. (2003). Identifying the warm glow effect in contingent valuation. Journal of Environmental Economics and Management, 45: 231-245.

Ready, R., Navrud, S., Day, B., Dubourg, R., Machado, F., Mourato, S., Spaninks, F., Vázquez Rodriquez, M.X. (2004). Benefit transfer in Europe: How reliable are transfers between countries? Environmental & Resource Economics, 29:67-82.

Scaldit (2006). Scaldit report. Transnational analysis of the state of the aquatic environment of the international Scheldt river basin district: pilot project for testing the European guidance documents. Vlaamse Milieumaatschappij, Erembodegmem, Belgium. http://www.scaldit.org.

Scasny, M., Melichar, J., Skopkova, H., Czajkowski, M., Markowska, A., Markiewicz, O. and Bartczak, A. (2006). Water quality valuation: empirical evidence from CV surveys in the Czech Republic and Poland. Paper presented at the Third World Congress of Environmental and Resource Economists, Kyoto, Japan, July 3-7 2006.