Evidence for demonstrating the benefits of water quality improvements - Guidance to the Water District Authorities

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Swedish Agency for Marine and Water Management

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This report has been produced by the Swedish Agency for Marine and Water Management. The Agency is responsible for the content and conclusions of the report.

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Foreword

Assessing disproportionate costs as a basis for decisions on exemptions in the form of less stringent objectives under Chapter 4, Section 10 of the Water Management Ordinance (2004:660) entails a need for knowledge of the economic benefits of achieving good status or potential and of the economic costs of the environmental measures needed to achieve good status or potential. In this guidance, the focus is on the need for evidence about the economic benefits, and the type of data that is prioritised to produce as a basis for the benefits estimates to be made. The purpose of this guide is to highlight and discuss some important aspects related to the need for knowledge and data. Some aspects addressed are:

- the values that should be included in an assessment of economic benefits;
- how general and specific valuation studies can be used as a basis,
- the importance of supporting data that enables benefits estimates that are adapted to the conditions in the specific location to the extent that is reasonable in terms of resources;
- the need to pay particular attention to the estimation of non-use values given their elusive nature;
- the need to carry out several and different types of studies to cover the value of all ecosystem services affected by environmental measures.

This guidance can be used to support the assessment of what evidence is needed to demonstrate the benefits of achieving good status and good potential under the Water Management Ordinance (2004:660). However, the reasoning in the report is valid for the economic valuation of environmental improvements more generally. The guidance can therefore, for example, also be used to estimate the benefits of reaching specific requirements in protected areas.

The report can be read in conjunction with the Swedish Agency for Marine and Water Management’s report 2022:14 Assessment methods for disproportionate costs according to the Swedish Water Management Ordinance (2004:660).

Gothenburg, 2024-03-11

Johan Kling

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Disposition of the report

The purpose of this guidance is to highlight and discuss aspects relating to the need for evidence that can provide support with regard to the benefit side of assessments of disproportionate costs when deciding on exemptions under Chapter 4, Section 10 of the Water Management Ordinance (2004:660). This is done by first looking back at previous recommendations on how the application of economic valuation should be strengthened in the implementation of the Water Framework Directive. Thereafter, general and specific valuation studies are discussed, where the former, unlike the latter, evaluate water quality improvements without any specific water area being investigated, described or singled out. As an example, the general valuation study that forms the basis for the benefits estimates in the Water District Authorities' programmes of measures for water 2022-2027 is used. Finally, the need for evidence is discussed on the basis of valuation studies that are planned to be carried out in the next few years with funding from the Swedish Agency for Marine and Water Management and the Swedish Environmental Protection Agency, respectively, and the knowledge needs that have prompted these studies.

Content

1 Introduction

Assessing disproportionate costs as a basis for decisions on exemptions in the form of less stringent objectives under Chapter 4, Section 10 of the Water Management Ordinance (2004:660) (VFF) entails a need for knowledge of the economic benefits of achieving good status or potential and of the economic costs of the environmental measures required to achieve good status or potential. In this guide, the focus is on the need for knowledge of the economic benefits; for these, the terms ‘benefit(s)’ and ‘(economic) value’ are also used below. Since these benefits arise to a significant extent from the fact that non-market-priced goods benefit from environmental measures, environmental economics valuation methods need to be used to obtain information on the size of the benefits. Applying such valuation methods requires knowledge and resources in terms of time and money. A key question is therefore what types of evidence on benefits should be produced in the future to support assessments of disproportionate costs of measures when deciding on less stringent objectives. This is a large and complex question that this guide is unable to answer – the purpose of this guide is instead to contribute to the search for answers by highlighting and discussing certain aspects related to this question. The considerations in the guidance are general for the economic valuation of environmental improvements and can therefore also be relevant for, for example, the benefits of achieving specific requirements in protected areas and improved nature protection.

The complexity of the issue is partly due to the fact that water areas provide many different ecosystem services that can give rise to many different types of economic value.[1] The usual classification of these economic values is in use and non-use values, see Table 1.1. The classification reflects the anthropocentric focus on human well-being that is common in economic analyses and thus on nature's instrumental values for humans. This includes the instrumental values of biodiversity for humans, as biodiversity is seen as the basis for nature's provision of ecosystem services (TEEB, 2010). Thus, impacts on biodiversity will have an impact on the provision of various ecosystem services, and such impacts can be economically valued in terms of use and non-use values. To estimate such values empirically, various environmental economics valuation methods are used, see Freeman et al. (2014) for an overview. In order to estimate non-use values, it is generally considered necessary to apply stated preference methods such as contingent valuation (CV) and choice experiments (CE). Any non-instrumental values of nature including biodiversity (often referred to as intrinsic values) are not captured by an economic analysis and must therefore be taken into account separately, see for example Turner et al. (2000), TEEB (2010), Dasgupta (2021).

[1] An example of a ‘water area’ could be a water body. However, the term ‘water area’ is used here as a more general term and may also refer to, for example, parts of a water body or groups of water bodies. Surface water is the focus of this guidance, but the reasoning should also be valid for groundwater, although the range of services provided by groundwater is partly different from that of surface water, cf. Lundin Frisk et al. (2022).

Table1.1. Different types of economic values related to water areas. The sum of use and non-use values is usually referred to as ‘total economic value’. After TEEB (2010, Chapter 5)

Main type	Subtype	Interpretation
Use values	Direct use values	The value the individual places on being able, thanks to the water area, to fish, swim, visit a beautiful lake, get drinking water, etc. (i.e. often provisioning and cultural ecosystem services).
	Indirect use values	The value the individual places on the water area supporting the provision of ecosystem services such as climate regulation, flood control, etc. (i.e. often regulating and supporting ecosystem services).
	Option values	The value the individual places on the possibility of their future use of the water area.
Non-use values	Bequest values	The value the individual places on future generations being able to benefit from the water area.
	Altruistic values	The value the individual places on other living individuals being able to benefit from the water area.
	Existence values	The value the individual places on the very existence of the water area, for example, because of the species that live in it.

The question of what types of data regarding benefits should be produced is not new. For example, the issue was examined by Economics for the environment (Eftec) (2010) in a report to the European Commission. The report deals with the application of environmental economics valuation in the implementation of the Water Framework Directive (WFD) as a whole, including the assessment of disproportionate costs. The report is almost 14 years old and progress has been made since then, but its recommendations and some observations can serve as a starting point for the continuation of this guidance.[2]

The report highlights the ecosystem services approach as a way to systematically demonstrate how improvements in the aquatic environment can have an impact on human well-being and to identify the multidisciplinary work required to gain sufficient knowledge of the links between the aquatic environment and well-being. Furthermore, the report stresses that applying spatial analysis using geographic information systems (GIS) in valuation studies can improve the way to demonstrate spatial variability in specific conditions that may have an impact on economic values. Such conditions may include, for example, the geographical scope of the environmental improvement, the availability of substitutes in the form of other water bodies and the socio-economic characteristics of the population affected by the environmental improvement. Both the ecosystem services approach and the use of GIS are seen as tools to reduce the risk of errors in the valuation of benefits of water environment improvements, i.e. reduce the risk of values being overestimated or underestimated.

[2] One of the report’s lead authors, Allan Provins at Eftec, is not aware of any updates to these recommendations (email 2023-08-21). However, there is ongoing EU-wide work under the Common Implementation Strategy for the WFD on good practice in assessing disproportionate costs under Article 4(5) of the Directive. Results of that work are expected to be available at the earliest in January 2024 (Ilona Kirhensteine, WSP, email 2023-12-21).

The report concludes with six recommendations on how to strengthen the application of economic valuation:

1. *Use spatial analysis tools.* GIS can provide an improved and more pedagogical picture of the effects that environmental measures can achieve, for example by illustrating the spatial variation in where the effects can be expected to occur. Furthermore, GIS can be used to show the spatial variation in aggregated economic values and also how the economic values are geographically distributed (e.g. between rural population and urban population). GIS can therefore contribute to an improved design of valuation studies, lead to more robust estimates of aggregate values and strengthen distributional analyses. Integrating economic valuation and GIS can also improve value transfers (see also recommendation 5).
2. *Make better use of multidisciplinary expertise.* The robustness of economic valuation studies depends in part on a proper assessment of the environmental improvements resulting from environmental measures and their impact on the availability of ecosystem services. In order to investigate these relationships, multidisciplinary cooperation is required.
3. *Provide better and more appropriate scientific information.* Implementing economic valuation requires good data on water quality and a good understanding of the links between quality status, environmental changes and impacts on people, as well as the uncertainties of these links.
4. *Apply economic valuation where it provides the most added value for decision-making.* Here, the report points out that the use of economic valuation should focus on cases where qualitative or quantitative assessments are not sufficient to inform decision-making.
5. *Develop value transfer tools.* The report points out that the implementation of the WFD is on several different geographical scales (from individual water bodies to water districts and whole countries) and that value transfer is therefore an important tool, especially since it is not practical to collect primary data through new valuation studies for all decisions to be taken, for example because of the large amount of water bodies. However, transfer of value must be used in such a way that the necessary consideration is given to context-specific characteristics of economic values and should include tests that make it possible to understand the causes of transfer errors and estimate the magnitude of such errors. Combining GIS and economic valuation can provide more robust value transfer because GIS increases the ability to capture factors that exhibit spatial variation and factor these into the value transfer. Furthermore, meta-analyses should be carried out when the data is large enough for such analyses, especially since meta-analyses can also highlight effects that depend on the valuation method itself.
6. *Improve communication on economic valuation.* There is a need for a broader and better understanding of: (i) the role economic valuation can play in the context of the WFD, (ii) the information required to carry out good quality valuation studies, and (iii) the limitations to economic valuation.

Progress has been made since the publication of the Eftec report. The ecosystem services approach is by now well established in both theory and practice and the framework for this approach has been significantly strengthened with version 5.1 of The Common International Classification of Ecosystem Services (CICES), which in turn was used as a basis for the Swedish Environmental Protection Agency's list of ecosystem services (Swedish Environmental Protection Agency, 2017). CICES version 5.1 is also under revision and a draft version 5.2 is available on the CICES website (www.cices.eu, read 2023-12-27). Furthermore, the approach has been enriched by more precise lists of ecosystem services for specific applications. One example is lists of services provided by surface and groundwater used as a source of drinking water (Gärtner et al., 2022). The concept of geosystem services has also been used, among other things, to highlight what happens below the surface, such as the importance of groundwater for humans (Lundin Frisk et al., 2022). The concept of ecosystem services has been put under critical scrutiny through the work of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), which launched the concept of *nature's contributions to people* (NCP) as a broader concept than ecosystem services in order to cover many different ways in which people relate to nature (IPBES, 2022; Pascual et al., 2023). All this work has stimulated multidisciplinary cooperation that has increased knowledge of how nature supports people's well-being. Such knowledge is a key to understanding also the conditions under which environmental measures can lead to multiple benefits. Such understanding is central in an era of intertwined environmental problems, such as climate impacts and biodiversity loss. One example specifically highlighted by the European Commission (COM, 2021) is nature-based solutions[3] that can help achieve both the WFD and the Floods Directive objectives. See also, for example, COM (2022) and the Swedish Agency for Marine and Water management's mandate to strengthen work on aquatic restoration (The Swedish government, 2023). At the same time, it is important to recognise that such knowledge and understanding should always be considered preliminary and incomplete – nature can support humans in ways that are as yet unknown, compare Carpenter et al. (2006).

Other advances include the ever-increasing volume of valuation studies and increased availability of valuation results through databases such as the Ecosystem Services Valuation Database (www.esvd.net). Furthermore, the amount of geographic data is continuously increasing and thus the ability to use GIS tools. From a valuation perspective, it is particularly interesting that there is increasingly detailed data on people's travel and visit patterns with location data linked to mobile phones – the accessibility of such data is another issue.[4]

Eftec (2010) strongly emphasises that economic values are context-specific and can therefore be expected to vary between different water areas depending on a variety of factors. For the example of water-related recreation, the report mentions three different types of factors:

- factors related to the *water area*, such as the type of water, the water quality at the baseline and following an environmental measure, and the availability of other water areas that can serve as substitutes;
- factors linked to *recreation,* such as the types of recreation that occur in the initial situation and that may occur in the future;
- factors linked to *individual users and non-users,* such as their proximity to the water area and their income;

However, it can be noted that the valuation studies carried out on water environment improvements are not always specific with regard to how factors of the above kind manifest themselves in individual water areas. This gives reason to distinguish between *specific* and *general* valuation studies, where the former value improvements in named water areas (for example individual water bodies, parts of water bodies or groups of water bodies) based on factors that characterise these particular water areas and the improvements in these water areas,

[3] https://www.naturvardsverket.se/amnesomraden/klimatanpassning/naturbaserade-losningar/, read 2023-08-23.

[4] One example is the Archipelago Barometer, which reports visitor statistics for the Stockholm Archipelago, https://skargardsstiftelsen.se/om-skargardsstiftelsen/publikationer-och-dokument/skargardsbarometern/, read 2023-12-27.

and the latter value improvements without any specific water area being investigated, described or identified.[5]

An example of a recent general valuation study of water areas in Sweden is Carlsson et al. (2019), whose results have been used for the impact assessments in the Water District Authorities' programmes of measures. The amount of specific valuation studies of water areas in Sweden is relatively large, see Safsing and Nordzell (2020) for a compilation of such valuation studies regarding recreational fishing. Some examples of specific valuation studies that focus on valuing improved status/quality in water bodies are Soutukorva et al. (2017), Soutukorva Swanberg and Wallström (2018) and Östberg et al. (2012).

To describe and discuss what information specific and general valuation studies provide and do not provide is relevant for the purpose of this guidance. Section 2 therefore describes what information is produced by the general study by Carlsson et al. (2019) as a background for a discussion of general and specific studies. Section 3 describes and discusses planned valuation studies of the aquatic environment in Sweden. The guidance concludes with conclusions in section 4.

[5] The classification is approximate, as there are valuation studies that have a general character but still point out named water areas. One example is the Baltic Sea-wide valuation studies, where the Baltic Sea is singled out, but where the valued water quality improvements are described in an overall and not site-specific way (see, for example, Ahtiainen et al., 2014).

2 General and specific valuation studies

2.1 Information from a general study

The general study by Carlsson et al. (2019) estimates the economic value of an improved water quality in Swedish surface water areas through a stated preference method (CE). The study applied CE by allowing the respondents to choose between three different options: Two options with improvements in water quality and the cost to the respondent associated with the respective improvement and a status quo option with the current water quality situation and at no cost to the respondent (in addition to what they already pay in taxes, water and sewage tariffs, etc.). This choice situation was repeated six times for each respondent.

The main study was conducted in May 2016 as an online survey of people living in six different counties: Skåne, Östergötland, Södermanland, Värmland, Västernorrland and Västmanland. The questionnaire included information on the different levels of water quality. Furthermore, respondents received information on the total water surface area in square kilometres (km^2) nationally and county-by-county, and on how water quality levels ‘low’, ‘medium’ and ‘high’ are distributed as a proportion of total water surface area in km^2 nationally and county-by-county.

After the information, respondents were asked how often they spend time near water, after which they were introduced to the six different choice situations that they were asked to consider. Choice situations varied with respect to three different attributes: (1) water quality in the respondent's own county in 12 years, (2) water quality throughout Sweden in 12 years and (3) an increased annual cost per household for 12 years to finance increases in water quality compared to the status quo.

There was a status quo option in every choice situation. The situation in 12 years' time was the same as today, both in the respondent's county and nationally, and was described in the form of today's proportion of water with low, medium and high water quality in the county and nationally, respectively, and a cost of zero kronor. In addition, in each choice situation, there were two different improvement options in the form of changed proportions of water with low, medium and high water quality in the county and/or nationally and the cost that each improvement option would entail for the household. In addition, there was information on what 1% water surface area means in $km^{2,}$ partly for the respondent's county and partly for the whole of Sweden.

In each choice situation, respondents make an assessment of whether any improvement option is worth the stated annual cost over twelve years, and which of the improvement options is the best. Econometric analysis can estimate the marginal willingness to pay for improvements. In the econometric model used, the underlying utility function was assumed to be linear in relation to the attributes, implying a constant marginal willingness to pay. In other words, the marginal willingness to pay is assumed to be constant for different shares of water of a certain water quality. This means, for example, that the willingness to pay for increasing the proportion of high-quality water from 4% to 5% is assumed to be the same as the willingness to pay for increasing the proportion of high-quality water from 94% to 95%.

Estimates were made using both county-specific models and a model where data for the six counties were aggregated. The payment terms estimated for percentage changes were converted into SEK per km^2. To illustrate the results, here is a calculation example based on the estimates for the average willingness to pay for the aggregated model (Carlsson et al., 2019, Table 6): For a reduced proportion of low-quality water in one’s own county, the annual willingness to pay is SEK

0.07 per household and $km^{2,}$ and for an increased proportion of high-quality water in one's own county, the annual willingness to pay is SEK 0.23 per household and km^2. The corresponding amounts for these changes occurring outside the county were estimated at SEK 0.03 and SEK 0.02 respectively. The value of improving a 1 km^2 water area with medium quality in, for example, Östergötland County to high quality can thus be estimated at 0.23 × 225 000 = SEK 51 750 per year for the 225 000 households in Östergötland. The corresponding value for this improvement in other households in Sweden is 0.02 × (4 275 000 – 225 000) = SEK 81 000 per year for the approximately 4 050 000 households in the rest of Sweden.

Respondents made their choices based on the premise that the improvements in their home county are 'distributed evenly over the whole county' and that the improvements throughout Sweden are 'distributed according to the size of the water areas in all areas except your own county'. It is not clear how the respondents interpreted this information on how the improvements would take place, but it should be clear that the estimated values should be seen as averages that are primarily possible to aggregate across counties, groups of counties or other large geographical areas. Such aggregation is applied in the Water District Authorities' programmes of measures, which are based on measures that will improve a total of 96 532 km^2 of surface water in Sweden. By using the results of the study, these improvements are valued at approximately SEK 145 billion (present value over 12 years, given a discount rate of 3.5 per cent (Water Authority of the North Baltic Sea Water District, 2022, p. 231). This value has been broken down for measures in various water districts, for example SEK 19.8 billion for 10 067 km^2 in the North Baltic sea water district (ibid, p. 270).

2.2 Discussion

The description above shows that the general study by Carlsson et al. (2019) did not evaluate specific water areas and the estimated values should therefore be used on a general level and not to evaluate improvements to specific water areas. To exemplify: Lake Tåkern in Östergötland is a 44 km^2 water body of medium quality. If the values in section 2.1 are used to value an improvement in Tåkern to high quality, a multiplication of 44 results in a value of SEK 2.3 million per year for households in Östergötland and SEK 3.6 million per year for households in the rest of Sweden. The total value is therefore just under SEK 6 million per year. But it is unknown whether this value is valid for Tåkern. To find out the value of improving Tåkern's quality, a valuation study is required based on the specific context that is valid for Tåkern.

The information from general valuation studies should therefore be used on a general level. This information is important in that it can signal the value individuals place on the improved environment on an aggregated level. This can be expressed as signalling the overall 'environmental budget' of individuals for the type of improvements described in the study. The results of a general study can thus be used as a warning signal if a summation of the results of specific valuation studies exceeds the 'budget' or approaches the budget even though the specific valuation studies concern only a subset of what was valued in the general study.

Thinking in terms of 'environmental budget' links to the fact that it is individuals' willingness to pay (WTP) that has been investigated, and it is also the most common approach. However, it should not be forgotten that the option of examining individuals' willingness to accept compensation (WTA) for not achieving an environmental improvement is also theoretically valid, especially if individuals believe they are entitled to the environmental improvement (Freeman et al., 2014). In the case of water quality, the WFD provides legal support for such a view, as its objective is, inter alia, a protection which 'prevents further deterioration and protects and enhances the status of aquatic ecosystems' (Article 1, point (a)). Investigating the individuals' WTA to not reach good status can therefore be theoretically justified. Although valuation studies using stated preference methods tend to examine WTP, it would therefore be interesting, when conducting new studies, to also examine the individuals' WTA as part of a sensitivity analysis.[6]

The interpretation of the warning signal that general studies can give must take into account the information that was communicated to the general study's respondents. The study by Carlsson et al. (2019) explained water quality in a very general way, without, for example, mentioning individual species or putting water quality in a broader ecosystem perspective with its importance for various ecosystem services. This is not surprising – in a general study, it is usually necessary to severely limit the information given to respondents, partly because the amount of information that respondents are able to take in is limited and partly because there is a risk that respondents will get caught up on any detailed information given and thus give excessive weight to it. But the obvious drawback is that the above-mentioned warning signal is not necessarily valid in a comparison with summation of results from specific studies where the consequences of improved water quality are described in more detail and the respondents may thereby, for example, have expressed preferences for individual species, such as important fish species for recreational fishing. This problem of the 'warning signal function' could potentially be reduced if general studies are carried out for geographical areas that are smaller and with regard to different water quality factors more homogeneous than entire counties, for example for municipalities, parts of municipalities, river basins or parts of river basins, but still without naming and describing specific water areas.

This brings us to specific valuation studies, which are thus generally required to put a valid economic value on improving a specific water area. Generally speaking, the higher level of detail of specific valuation studies should provide clearer information on individuals' preferences for water environment improvements compared to general studies. Therefore, it is a reasonable approach to use value transfer to generalise the results of specific studies to other water areas and then not only to another water area but also for upscaling to many other water areas, cf. scale-up in Eftec (2010, Figure 3.6).

A downside with the higher level of detail in specific valuation studies is the risk that respondents are led to empty out too much of their total willingness to pay for water environment improvements on improvements in the water area they are asked about (i.e. a kind of part-whole bias). To take the example of Lake Tåkern: Although a valuation study is limited to Tåkern, there is a risk that the respondents take from their willingness to pay for improvements to other water areas than Tåkern when they indicate their willingness to pay for improvements to Tåkern. The risk of overestimating the willingness to pay for specific waters in this way should be particularly high in the case of non-use values: If a respondent is a bird lover who places high existence values on the presence of bearded tit (Panurus biarmicus), is this respondent able to distinguish the existence value he or she attributes to this species in Tåkern from the existence value he or she attributes to the same species in other water areas? If this is not the case, a distortion arises, probably in the form of an overestimation of the value of existence of bearded tits in Tåkern.

This type of distortion is an example of problems that hamper the correct transfer of value. Another problem is the lack of information on marginal willingness to pay, cf. Eftec (2010, Box

[6] Johnston et al. (2017) point to the practical problems with the use of WTA that make WTP commonly used in stated preference studies even when WTA from a theoretical point of view would be the most relevant measure. Two examples of such problems are difficulties in formulating incentive-compatible questions and a relatively high proportion of respondents protesting against the valuation scenario. At the same time, Johnston et al. argue that WTA should be used when theoretically relevant and empirically reasonable and point out that ways of dealing with the practical problems have been suggested.

3.6). The more water areas benefiting from an improved aquatic environment, the less the willingness to pay is likely to be for the improvement of an additional water area. This problem can be expected to grow with the degree of upscaling, as the scarcity of availability of water areas with a good aquatic environment becomes less and less. The problem is not unique to value transfer, but is equally relevant whenever specific valuation studies are carried out for two or more different water areas: The willingness to pay to improve area 2 may be affected by whether the condition is that area 1 is already improved or not. It is therefore not possible to simply sum results from various valuation studies without taking into account how the reference alternative in the valuation scenarios was described. And if the same respondent should indicate their willingness to pay first to improve area 1 and then to improve area 2, the answer for area 2 may be affected by whether they should take into account that their willingness to pay for area 1 has reduced their disposable income. The WTP amounts for area 1 and area 2 can generally only be added together if such considerations are taken into account, i.e. the WTP questions are sequential in terms of income. Empirically, however, the problems described in this paragraph may be non-existent or negligible if there are only two or a few different areas, but when scaling up to many areas, the problems may be necessary to consider.

A potentially difficult problem mentioned above is that non-use values are exaggerated in specific valuation studies due to non-use values linked to other water areas being attributed to the water area subject to the specific valuation study. One way to avoid this problem is to delimit specific valuation studies to use values. This can be achieved in stated preference studies, but requires a well-formulated (and well-communicated) valuation scenario. Another possibility is to rely on travel cost studies and other valuation methods that only capture use values. It should be underlined that this may require the production of primary data that may currently be lacking or limited in access, such as travel patterns, number of visits and modes of use for different water areas, data to be related to different water quality levels.

The question then becomes, how should the non-use values be calculated? One possibility is to use general studies that focus on non-users. But then such studies must be able to convey relevant information – for example, if respondents have strong preferences for certain species in terms of existence values and the valuation scenario does not convey information about the consequences for these particular species, the results will be distorted. Thus, knowledge of what non-users care about is needed in order to design a valuation study of non-use values. See further section 3.2.

3 Evidence related to planned valuation studies

3.1 Planned valuation studies

This section describes a number of key future valuation studies related to the surface water environment in Sweden and comments on the increase in knowledge that these can be expected to provide in relation to the discussion in section 2.2 on general and specific studies. It is primarily the research project *Economic analysis of issues related to renegotiations of hydropower* (2023-2026, project manager Jesper Stage at Luleå University of Technology, funded by the Swedish Environmental Protection Agency through the Environmental Research Fund) that can be expected to result in a significant increase in knowledge.

The project's application states that in Sweden a relatively large number of valuation studies of use values from recreational fishing at different locations and of different fish species have been carried out, see also Safsing and Nordzell (2020), but that there are only a few valuation studies concerning other types of use values and non-use values from regulated water bodies (Stage et al., 2022).

In terms of knowledge needs, Stage et al. (2022) argue that the costs of environmental measures affecting electricity production from large hydropower plants can be expected to be significantly greater than the benefits of environmental measures if only use values are affected. The situation may be different if the environmental measures also increase non-use values that large parts of the Swedish population care about. In the case of small hydropower plants, cases where the benefits due to the increase in local use values are greater than the costs due to power generation losses are more likely, but the picture becomes more complicated if the environmental measures also have local effects that are negatively perceived, for example that boating can be made more difficult if a regulated lake becomes unregulated as a result of dam removal. The situation is summarised in Table 3.1 and gives a general picture without any definition of the difference between 'small' and 'large' hydropower plants. Stage et al. (2022) notes that the situation indicates a need for knowledge about use values, especially at small hydropower plants, and about both positive and negative effects on use values as a result of environmental measures, and about non-use values.

Table 3.1. Economic outcome of environmental measures affecting power generation in hydropower plants. After Stage and others (2022).

Small hydropower plants	**Large hydropower plants**
The increase in use values may be sufficient to exceed the power generation losses. Any increase in non-use values contributes to such a positive outcome. The situation can be turned into a negative outcome if environmental measures lead to local effects that are perceived negatively, such as reduced opportunities for boating if a regulated lake becomes unregulated.	The increase in use values is likely to be no greater than the power generation losses; for the outcome to be positive, an increase in non-use values with broad support in the Swedish population is required.

The knowledge needs identified by Stage et al. (2022) form the background to the various valuation studies that are planned to be carried out within the research project:

1. *Studies of use values of recreational fishing* using data from both previously conducted recreational fishing studies and new stated preference studies (CE).
2. *Studies of use values other* than recreational fishing and how these can be positively or negatively affected by environmental measures, this applies to changes both in the physical landscape and in the cultural landscape. These studies will be local and use stated preference methods (CE or CV).
3. *Replication of previous studies of non-use values* to study how non-use values may be affected by environmental measures leading to larger populations of plant and animal species. Results for the UK by Christie et al. (2004, 2006) indicate that individuals tend to prioritize increases in populations of threatened species and of well-known but rare species over increases in populations of other species. By replicating the study by Christie et al., the project will investigate whether this is also the case in Sweden, as it may be possible to narrow down which species need to be included in analyses of non-use values. Furthermore, the valuation study of non-use values linked to endangered species in different types of habitats of Kataria and Lampi (2008) will be replicated in order to investigate whether the results are stable. Which specific valuation studies are subsequently carried out within the project depends on the results of the replications. If these results do not provide clear guidance on how new valuation studies should be set up, Stage et al. (2022) suggest that one possibility may be to adapt the model developed by Carlsson et al. (2019) for valuation of non-use values to apply to quality factors affected by hydropower.
4. *Meta-analyses* with the aim of developing general models of both use and non-use values, which can be used in situations where there are no results from local studies. Stage et al. (2022) states that although more local studies are desirable, the number of water bodies is so numerous that it is unreasonable to conduct local studies for all water bodies. The meta-analyses will be based on data from both previously conducted valuation studies and new studies carried out during the project.
5. *Studies of specific conceptual issues,* for example that the valuation scenarios in stated preference studies usually have to describe relatively large changes in order for it to be practically reasonable for respondents to value them, but environmental measures in a specific water body can lead to much smaller changes. The question then is how such small changes can be valued based on information about how relatively large changes are valued.

As regards future valuation studies in addition to those carried out within the framework of the above research projects, the Swedish Agency for Marine and Water Management is preparing to finance valuation studies on the value of recreational fishing at specific salmon fishing destinations. These valuation studies will thus further increase the availability of information on recreational fisheries values and thus support the conduct of meta-analyses (cf. point 4 above). Furthermore, it seems highly likely that operators linked to the hydropower industry will have an interest in initiating valuation studies on regulated water.

3.2 Discussion

The planned valuation studies in section 3.1 are discussed below in the light of what was discussed in sections 1 and 2. To begin with, the importance of using an ecosystem services approach and spatial analysis tools (GIS) was strongly emphasised in the recommendations of Eftec (2010). This approach and such tools are not mentioned in the application by Stage et al. (2022), but the project regards the ecosystem services approach as fundamentally important and has the ambition to include spatial aspects with the help of GIS or in some other way.[7]

The amount of knowledge regarding the value of recreational fishing can be expected to grow further in the future. This may allow robust value transfers to be made using meta-analysis (cf. point 4 of Section 3.1). Such value transfers should take into account the summation issues discussed in section 2.2, including a non-constant marginal willingness to pay and the substitution ratios between different recreational fishing grounds, as it is not inconceivable that improved fishing opportunities in a given fishery may lead to the transfer of fishing activities from other fisheries.

The methodological problems of obtaining robust estimates of non-use values are significant. It is therefore important to examine what actually matters for individuals' preferences regarding plant and animal species in the way planned (point 3 of section 3.1). Nevertheless, non-use values related to biodiversity can be expected to remain elusive. There are obvious risks of distortions in different directions: Respondents in a specific scenario study may find it difficult to delimit their preferences regarding, for example, existence values associated with certain species to a specific water area (that is, existence values are overestimated), which provides arguments for valuation studies of non-use values to be general and apply to relatively large geographical areas (for example, counties, groups of counties or the entire country). A probably even more significant problem is that the importance of species for the provision of ecosystem services in a broader ecosystem perspective cannot be communicated satisfactorily to the respondents due to complexity, uncertainty and lack of knowledge. This can make estimates of non-use values difficult to interpret and therefore difficult to use for decision-making in water management. One possible way to tackle this problem is to use deliberative valuation exercises with experts and representatives of the public where knowledge, opinions and questions can be discussed.[8] However, the results of such exercises depend heavily on the expertise and interests represented. Although there is a desire for the public to be comprehensively represented, this is limited in practical terms by the fact that the number of participants must be relatively small in order for constructive discussions to be possible. A good and professional moderation of the exercises is also of paramount importance. What emerges from such exercises can facilitate the design of conventional valuation studies, whether they deal with use values or non-use values or both. This may involve being able to better interpret the respondents' responses in such studies, including identifying variables with potentially high explanatory power regarding the variation in willingness to pay. While group interviews (focus groups) are regularly used as necessary assistance in the design of stated preference studies (CV and CE), deliberative techniques can be of further help for particularly difficult valuation problems.

The difficulties in estimating non-use values make it interesting with studies that focus on estimating use values. Estimates of use values can always be expected to represent an underestimation of the total economic value, but in a management context it may be better to

[7] Jesper Stage, e-mail 2024-01-17.

[8] A brief description of deliberative valuation can be found in Söderqvist (2022).

know that a value is underestimated than not to know whether a value is an overestimation or an underestimation. By means of value transfer based on meta-analysis (point 4 of section 3.1), estimates of use values from specific studies can be scaled up to cover many different water areas. Using spatial analysis tools (GIS) and the increased availability of location data can facilitate such upscaling. To help evaluate the plausibility of the results of such upscaling, it would be a strength to have access to the warning signal that general studies can provide (see section 2.2). It may therefore be of great interest to supplement value transfers based on specific studies with the implementation of general studies. However, this presupposes that it is empirically possible to delimit the general studies to only estimate use values or that it is at least possible to distinguish use values from non-use values. Furthermore, the valuation scenarios of the general studies (given that stated preference methods are used) should not be too different from what has been studied in the specific studies. The chances of this are probably greater if the general studies are carried out for geographical areas that are smaller and from a water quality point of view more homogeneous than entire counties, cf. section 2.2.

A practical problem when conducting valuation studies, whether specific or general, is that even (seemingly) small differences in the design of the study can have a major impact on the results. An example of this is given by Carlsson et al. (2018), who used the water quality study described in section 2.1 to study the effects of different design regarding information that respondents may interpret as indications of what, according to the survey sender, is desirable or particularly important and which may therefore result in distorted answers that do not reflect the respondents' real preferences. Carlsson et al. (2018) compared the results from different survey versions that differed in how the importance of meeting environmental goals regarding water quality was conveyed. The version that was most careful to convey this neutrally resulted in half as much marginal willingness to pay as the other versions. This illustrates the importance of valuation studies that are to be used sharply in policy contexts having an ambitious approach in terms of studying the effects of different design of information texts and images, the description of what is to be valued, question formulations and so on, in order to get as clear a picture as possible of the uncertainty in the estimates of economic values. To this should be added all other sources of uncertainty, the influence of which should also be studied before using estimates in policy contexts. For example, uncertainty related to the choice of econometric model for the analysis of data and the statistical uncertainty resulting from the variation in collected data.

Recreational fishing is one of many uses of water areas, and it is therefore a major strength that other types of use values than recreational fishing values should also be estimated in planned valuation studies (point 2 of Section 3.1). But in a broad perspective on water quality (not only hydropower-related quality aspects) and ecosystem services, many more use values may be relevant than the project of Stage et al. (2022) is able to cover. It would therefore be beneficial if additional studies could be carried out in appropriate coordination with planned studies on e.g. methodology, in order to avoid problems of overlap and non-addability. The ecosystem services approach can be used as a framework to get an overall picture of which services need to be valued and which services are covered in which studies.

Most of the description and discussion above has been about the value of achieving an improved aquatic environment. Something that is perhaps easily overlooked is that this value can also be addressed by studying what environmental costs arise if the aquatic environment is not improved and how large environmental costs can thus be avoided if the aquatic environment is improved. Such environmental costs can be calculated as expected damage costs of not achieving good status, and avoided expected damage costs could roughly represent a minimum estimate of the benefit of achieving good status. Possibly this way of valuing is primarily relevant in cases where large concrete damage costs for society in the form of, for example, damage to buildings and impaired health (or large costs to avoid damage) may arise if a future sufficient provision of ecosystem services is not ensured, for example regarding the regulation of erosion and flood risks as well as opportunities for the extraction of drinking water.

4 Conclusions

Some important observations from the previous sections are as follows:

- The ecosystem services approach is a way to systematically demonstrate how improvements in the aquatic environment can have an impact on human well-being and to identify the multidisciplinary work required to gain sufficient knowledge of the links between the aquatic environment and well-being.
- Water areas provide a wide range of ecosystem services that can give rise to many different types of economic value.
- Economic values are context-specific and can therefore be expected to vary between different water areas. General valuation studies, which, unlike specific valuation studies, value water environment improvements without any specific water area being investigated, described or singled out, should therefore be used at a general level, for example as a signal of the individuals’ total ‘environmental budget’ for the type of improvements described in the study. This signal can be expected to be more precise if the general studies are carried out for geographical areas that are smaller and with regard to different aquatic environmental factors more homogeneous than entire counties.
- Generally speaking, specific valuation studies should be able to provide clearer information about individuals' preferences for water quality improvements compared to general studies. Therefore, it is a reasonable approach to use value transfer to generalize the results of specific studies to other water areas. Value transfers based on specific studies can usefully be supplemented by conducting general studies, given the aforementioned signal that general studies can give.
- It is difficult to cover in a single valuation study all known ecosystem services and all types of values and all methodological details that may play a role in the results, whether the study is general or specific. There is thus a need for several different studies and variants of studies to be conducted. Coordination with already planned valuation studies can save time and money.
- Location data (including data collected through mobile phone use) and spatial analysis tools such as geographic information systems (GIS) can be very helpful for both valuation studies and value transfers.
- There are major methodological problems in producing robust estimates of non-use values. There are ways to address these problems, but the problems make it interesting with studies that focus on estimating use values. While they only provide information on a subset of the total economic value, in a management context it may be better to know that a value is underestimated than not to know whether a value is an overestimation or an underestimation.

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Evidence for demonstrating the benefits of water quality improvements

Guidance to the Water District Authorities

The purpose of this guidance is to highlight and discuss aspects relating to the need for evidence that can provide support with regard to the benefit side of assessments of disproportionate costs when deciding on exemptions under Chapter 4, Section 10 of the Water Management Ordinance (2004:660). This is done by first looking back at previous recommendations on how the application of economic valuation should be strengthened in the implementation of the Water Framework Directive. Thereafter, general and specific valuation studies are discussed, where the former, unlike the latter, evaluate water environment improvements without any specific water area being investigated, described or singled out. As an example, the general valuation study that forms the basis for the benefit estimates in the Water District Authorities' programmes of measures for water 2022-2027 is used. Finally, the need for evidence is discussed on the basis of valuation studies that are planned to be carried out in the next few years with funding from the Swedish Agency for Marine and Water Management and the Swedish Environmental Protection Agency, respectively, and the knowledge needs that have led to these studies.

SwAM, The Swedish Agency for Marine and Water Management is the responsible government agency tasked to protect, restore and ensure sustainable use of freshwater resources and seas including fisheries management.

Swedish Agency
for Marine and
Water Management