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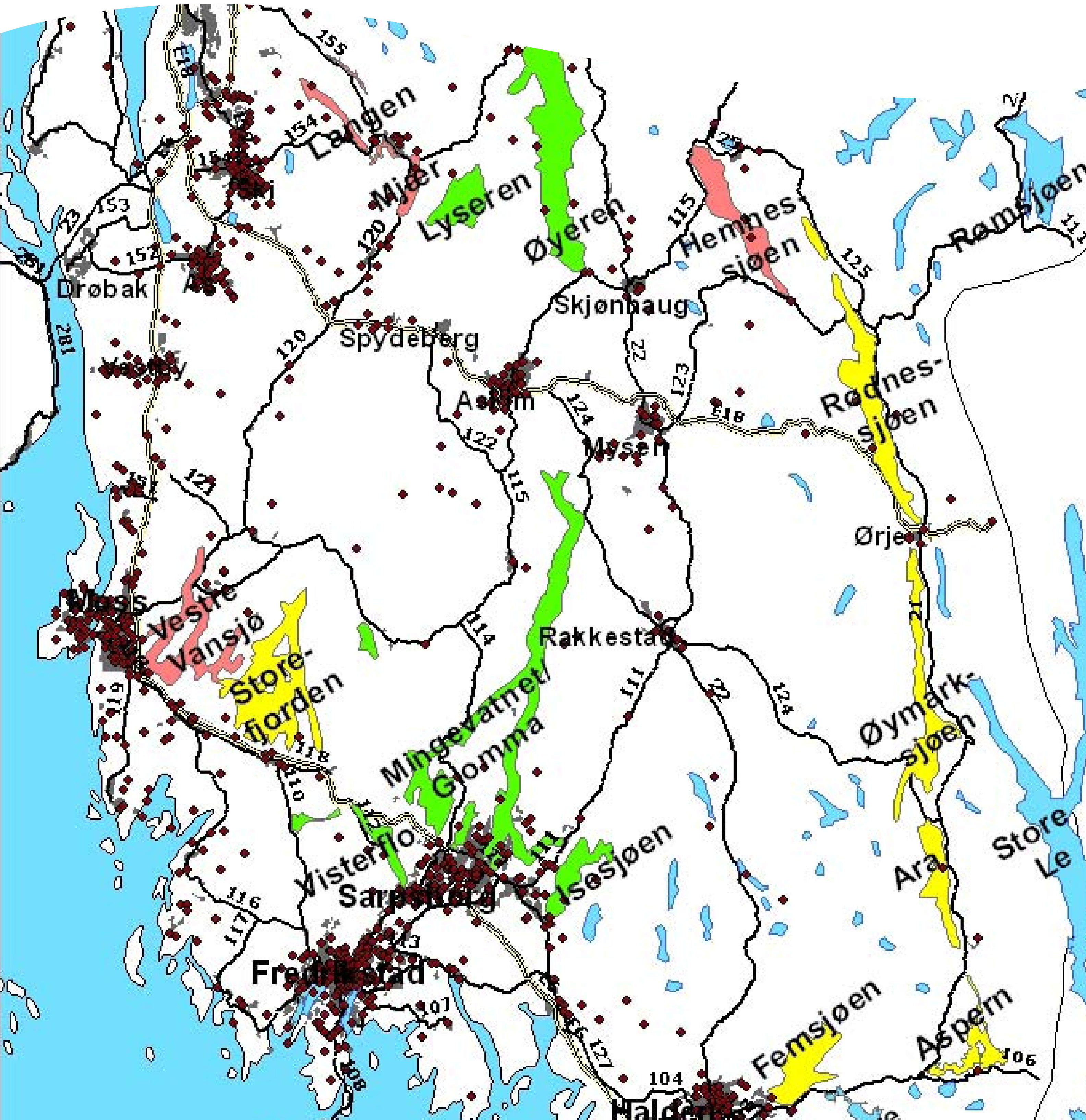
Assessing Economic Benefits of Good Ecological Status in Lakes under the EU Water Framework Directive.

Case study report. Norway.



Norwegian Institute for Water Research

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REPORT

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Abstract

An internet survey was conducted on 1113 households in Østfold County and southern municipalities of Akershus County in the summer of 2008. The survey focused on households' recreational use of water bodies and their willingness to pay for improvements in lake ecological status. The main objective of the study was to evaluate at what distance from improved lakes, households willingness to pay falls to zero. This is key to correctly determining how large a population has benefits from measures under the Water Framework Directive, and making correct estimates of total benefits of a programme of measures. Valuation methods aimed at capturing recreational use values and also non-use values. The largest lakes in Østfold in three different catchments (Morsa, Glomma and Halden) were considered, Alternative valuation methods are compared for two lakes in particular in this report (Vestre Vansjø and Storefjorden). The study was the Norwegian case study for the EUFP6 AQUAMONEY research project.

4 keywords, Norwegian	4 keywords, English
1. Økonomisk verdsetting	1. Economic valuation
2. Vannkvalitet	2. Water quality
3. EUs Vanndirektiv	3. EU Water Framework Directive
4. Valgeksperiment	4. Choice experiment

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Norway

Assessing Economic Benefits of Good Ecological Status in Lakes under the EU Water Framework Directive

CASE STUDY REPORT

Preface

The authors would like to acknowledge Helga Gunnarsdottir (Director of the Morsa Project/County Government Østfold), Knut Bjørndalen (Environmental Director, Moss Municipality), and Håvard Hornnæs (Coordinator for Water Region I, County Government Østfold) for valuable comments on the web-survey and in particular the water quality ladder.

We would also like to extend a special thank you to the boating, hunting and fishing associations that helped us conduct focus group meetings with their members in preparation of the pilot survey: Vansjø Båtforrening, Moss og Omegn Jeger og Fiskeforrening, Råde Jakt og Fiskeforbund.

We benefitted from discussions with Kristin Magnussen (Sweco) and Knut Veisten (TØI) on non-market valuation in web-surveys; Arild Vatn (Noragric-UMB) for advice on follow-up questions regarding validity of willingness to pay; Åge Brabrand (University of Oslo) regarding the accuracy of the description of ecological status regarding fish Østfold County, and Marit Mjelde (NIVA) for similar discussions regarding descriptions of aquatic vegetation in ecological status; Raymond Berggren (Aftenposten) for discussions on market survey research approaches to conjoint analysis, the use of Sawtooth software for experimental design and hierarchical Bayesian modelling.

The study would not have been possible without the efforts of the team working on the common survey design for water quality within EU FP6 Project AQUAMONEY. A special thank you to all the AQUAMONEY colleagues involved, and particularly to Roy Brouwer (IVM) and Ian Bateman (UEA) for coordinating the AQUAMONEY project and water quality common design group, respectively.

TNS Gallup coordinated the programming and implementation of the internet survey. A special word of thanks to Thomas Karterud and Mette Lundsby Jensen for having the patience to implement research ideas that went beyond standard market surveys.

David N. Barton (NIVA/NINA) lead the Norwegian case study and carried out analysis, Ståle Navrud (UMB) provided valuable input to survey design, data and policy analysis, Nina Lande carried out the data collection for the pilot survey which was used in her M.Sc. thesis (Lande 2008), and Anders Bugge-Mills helped design the maps and carried out the GIS-based distance calculations.

Thanks also to Magnus Søderberg and Isabel Seifert, NIVA, for comments and corrections to the final manuscript.

Oslo, February 15th 2010

David N. Barton

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Norwegian summary

Sammendrag for forvaltere

Studien

En internettundersøkelse ble gjennomført på 1113 husstander i Østfold og Akershus sommeren 2008. Spørreundersøkelsen fokuserte på fritidsbruk av innsjøer og betalingsvillighet for forbedringer i økologisk status. Hovedmålsettingen med studien var å evaluere hvor langt fra en innsjø man må være før betalingsviljen for å forbedre den innsjøen faller til null. Dette står sentralt i en nøyaktig vurdering av hvor stor befolkning som har nytte av tiltak under EUs Vanndirektiv, og beregningen av total nytte av en handlingsplan for forbedring av økologisk status. Vi anvendte økonomiske verdsettingsmetoder som tok sikte på å kvantifisere både bruks- og ikke-bruksverdier av vannkvalitet i innsjøer. Studien innbefattet de største innsjøene i Østfold i tre ulike delnedbørfelt (Morsa, Glomma og Haldenvassdragene). Alternative verdsettingsmetoder ble sammenlignet for to innsjøer for å vurdere sammenfall av betalingsvillighets-estimater (Vestre Vansjø og Storefjorden).

Verdsetting av nytten av EUs Vanndirektiv

Så vidt vi kjenner til er dette den første økonomiske verdsettingen av nytten ved å oppnå ”god økologisk status” i vannforekomster i Norge. Studien er også et eksempel på dokumentasjon av bruk av vannforekomster og relevant for rapportering av status for vannforekomster under EUs Vanndirektiv i Vannområdet Glomma.

Resultater

Eksempel på betalingsvillighet per husstand per år

Betalingsviljen for forbedring i vannkvalitet fra situasjonen i 2008 til ”god økologisk status” er vurdert til mellom kr. 1070-2000 per husstand per år for innsjøene Vansjø og Storefjorden. Til sammenligning betalte husstander i Østfold i snitt om lag kr. 4000 per år for kommunalt vann- og avløp. Rapporten inneholder verdsettingsresultater av denne typen for de andre store innsjøene i Østfold.

Reduksjon i betalingsvillighet med avstand fra innsjøene

Betalingsvillighet for forbedring av innsjøene faller med så mye som 72 kr/km eller så lite som kr. 25/km avstand fra innsjøene, avhengig av hvilken metode som brukes. Eksempelvis betyr dette for innsjøene Vestre Vansjø og Storefjorden at husstandenes betalingsvillighet faller til null når man kommer mellom 30 til 60 km fra innsjøene. Dette betyr igjen at befolkningen som har positiv betalingsvillighet for disse innsjøene er mellom 96000 og 130 000. Lignende beregninger kan gjøres for andre innsjøer i Østfold ved bruk av resultatene i denne rapporten.

Eksempel på total betalingsvillighet for Vestre Vansjø and Storefjorden

Et konservativt anslag på total betalingsvillighet i befolkningen for å nå ”god økologisk status” er 21 millioner kroner per år. Avhengig av verdsettingsmetoden man velger og andre antagelser kan betalingsvilligheten beregnes så høyt som 113 millioner kroner i året.

Følsomhetsanalyser

Beregnet betalingsvillighet er avhengig av antall innsjøer som forbedres samtidig, bare under visse omstendigheter: når en av innsjøene som forbedres er husstandens ”favoritt” til fritidsbruk; og når husstanden blir presentert for en forbedring av flere innsjøer først, og siden bedt om å vurdere forbedring av bare én innsjø. Betalingsvillighet avhenger med andre ord av sammenligningsgrunnlaget for spørsmålet. Fritidsbruk av innsjøer virker større enn ikke-bruksverdier. Betalingsvillighet er mest følsom i forhold til hvor stor vannkvalitetsforbedringen er i innsjøene nederst i de tre delnedbørfeltene. Det er store forskjeller i betalingsvillighet for innsjøer i Morsa sammenliknet med Glomma og Halden-vassdragene, selv om de ligger i nabovassdrag.

Brukerhyppighet og -egnethet ved ulik vannkvalitet
Husstander i Østfold-Akershus besøker innsjøer i fylkene 49 ganger per år i snitt. I sommermånedene er dette 1.5 ganger/måned til elver, 2.0 ganger/måned til innsjøer og 4.2 ganger per måned til sjøen. Spørreundersøkelsen viser at husstander har høyere tålegrense for lavt siktedyp når det gjelder bading og båtliv enn det SFTs veiledere for egnethet av vannbruk tilsier. Hvis Klifs (tidligere SFTs) veiledere for egnethet av vannbruk legges til grunn i nytte-kostnadsanalyse av tiltak, vil dette bety at verdien av vannkvalitetsforbedringer i hht. EUs Vanndirektiv vil kunne overvurderes.

Summary

Policy summary

The study
An internet survey was conducted on 1113 households in Østfold and southern municipalities of Akershus in the summer of 2008. The survey focused on households' recreational use of water bodies and their willingness to pay for improvements in lake ecological status. The main objective of the study was to evaluate at what distance from improved lakes, households willingness to pay falls to zero. This is key to correctly determining how large a population has benefits from measures under the Water Framework Directive, and making correct estimates of total benefits of a programme of measures. Valuation methods aimed at capturing recreational use values and also non-use values. The largest lakes in Østfold in three different catchments (Morsa, Glomma and Halden) were considered, Alternative valuation methods are compared for two lakes in particular in this report (Vestre Vansjø and Storefjorden). Valuation data are available for all lakes illustrated on the cover.

Valuation of the benefits of the Water Framework Directive
The present study is the first economic valuation of the benefits of attaining "good ecological status" in water bodies in Norway. The data provide documentation of the magnitude and benefits of water use required by WFD reporting and refer to the lower part of the Glomma Water Region.

Results
Willingness to pay per household per year
Willingness to pay for an improvement in lakes Vestre Vansjø and Storefjorden to "good ecological status" or better is estimated at between 1070-2000 NOK per household per year using two different valuation methods. Households in Østfold currently pay on average kr 4000/yr. per household for water and sanitation.

Distance decay and spatial extent of willingness to pay
Willingness to pay drops by as much as 72 NOK/kilometer or as little as 25 NOK/kilometre depending on what valuation method is used (for improvements from current status to good ecological status or better). For the lakes in lower Morsa catchment this means that the 'limit' to how far away households are willing to pay for a lake improvement lies between about 30 km and 60 km depending on the method. The number of households affected by this magnitude of improvement varies between roughly 96 000 and 130 000, respectively.

Total willingness to pay for improving Lakes Vestre Vansjø and Storefjorden
A conservative estimate of the annual willingness to pay for improvements to "good ecological status" is roughly 21 million NOK/year. Depending on the valuation method chosen and assumptions used, total willingness to pay for households affected by lake improvements can be estimated as high as 113 million NOK/year.

Sensitivity of willingness to pay to the scope of lake improvements
Households willingness to pay is sensitive to the number of lakes improved (one versus two lakes were tested) only in special cases: when the lake that is their favourite recreation location; when an improvement is promised, but then scaled down. Recreational values of lakes seem to predominate over non-use values. Households' willingness to pay is (highly) sensitive to how large the improvement in lake quality is for certain lakes, especially those in the lower part of the three cathcments. There are nonetheless great differences between willingness to pay for lakes in adjacent catchments such as Morsa, Glomma and Halden.

Use frequency and water quality suitability thresholds
Currently, households make an average 49 visits per year to water bodies in Østfold-Akershus; 1.5 visits/month to rivers, 2.0 visits/month to lakes and 4.2 visits/month to the seaside during summer months. Valuation studies using the official Norwegian (Klif, formerly SFT) guidelines for use suitability tend to over-emphasise the impact water quality improvements may have on suitability for recreational uses. We observed that household activities such as bathing boating and fishing were considerably more tolerant of poor water quality than assumed by official guidlines.

1. Background

As a non-EU member Norway is voluntarily implementing the Water Framework Directive (WFD). Norway is currently applying the Water Framework Directive (WFD) to a number of pilot river basins which will comply with the WFDs deadlines for implementation. By the end of 2008, a programme of measures, including justifications for derogations from the WFDs goal of "good ecological status" is to be completed. According to the programme for management plan preparation for the Glomma Water Region (http://www.vannportalen.no/hoved.aspx?m=36456&amid=2089416), the plan is to be approved by the third quarter of 2009 after a public hearing process.

The Norwegian Guidance Document on Evaluation of Measures under the WFD (http://www.vannportalen.no/Veileder-tiltak_36oVU.pdf.file) details the steps in assessing measures under the WFD:

1) Current status and Environmental objectives
2) Description of user interests and pressures
3) Evaluation of possible sectoral measures
4) Evaluation of measures effects and costs, prioritization of measures
5) Judgement-based assessment of benefits

Step 5 involves an assessment of the economic benefit of measures. The Guidance document recognizes the paucity of and expense in obtaining monetary estimates of benefits, and therefore advises that the assessment of benefits be based on local level expert judgement of how water user interests are affected. Local level, municipal assessments of measures should conclude whether the locally prioritized measures:

- are "disproportionately greater benefits than costs to society"
- are "disproportionaltely greater costs than benefits to society"
- in doubt whether benefits exceed costs

In the latter case, closer economic assessment should be carried out of the benefits of achieving good ecological status.

The AQUAMONEY case study for Norway demonstrates a regional approach to the assessment of benefits to households of achieving the WFDs goals of good ecological status. It is the first such study to be undertaken at a regional level and with the purpose of assessing the objectives of the WFD. The study should provide the Water Region Authority with a quantitative basis for improving what would otherwise be largely qualitative judgement-based assessment of benefits. It is also the first valuation study of water quality to be carried out using web-based surveys in Norway. The web-based format may be a cost-effective way of involving the public and obtaining representative data on public opinion on the improvements proposed by the WFD.

Two pilot river basins, Haldenvassdraget and Vansjø/Hobølvassdraget in the Glomma Water Region were selected as a focus of the AQUAMONEY case study. In addition, we assessed willingness to pay for improvements in lakes and coastal waters bordering these river basins, in order to assess the relative importance of the pilot river basins to water bodies that may be substitute sites for recreation. One of the main research aims of the AQUAMONEY case studies was to test for so-called "distance decay" in willingness to pay.

2. Description of the case study

2.1 Location of the case study area

Figure 1 shows an outline of the geographical coverage of the pilot survey and the main web-based survey. The pilot survey was conducted in-person on visitors to the Vestre Vansjø and Storefjorden Lakes during July-August 2007, in order to test the choice experiment valuation method. The results of the pilot study are discussed in Appendix 2. The web-based survey was conducted August-October 2008 and covered the whole of Østfold County and southern municipalities in Akershus County.

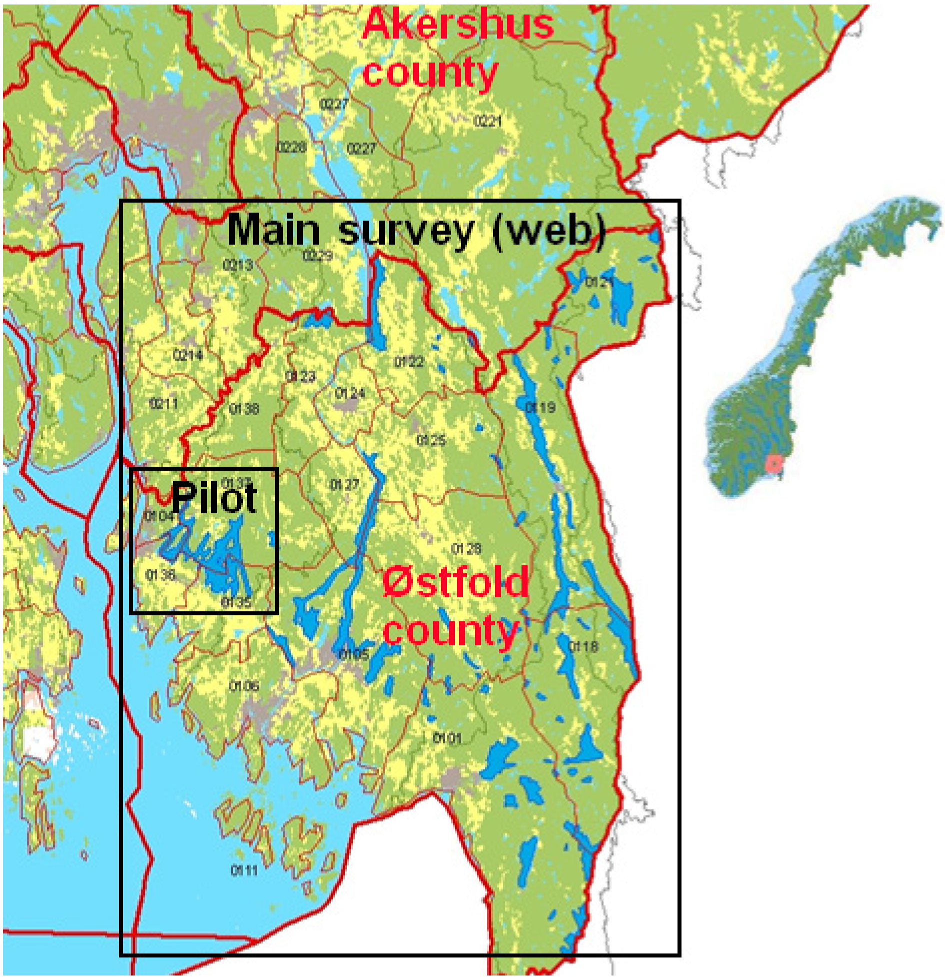


Figure 1. Geographical Coverage of Pilot Study and Main Web-Based Survey

The web-based survey was programmed and implemented by TNS-Gallup Norway based on a pre-recruited panel of some 3000 households from the municipalities shown in **Figure 2** (municipality included are indicated with numbers in map). Municipailities lying outside the main survey map frame were also sampled. Municipalities were chosen for the sample based on whether they had any land area within the Morsa, Glomma or Halden River Basins. The study focused on improvements in lake water quality. This was done in order to ease the identification of relevant water bodies in a web-based survey (rivers are difficult identify in a regional scale analysis).

The main reason for choosing such a large study area with so many lakes was to evaluate the effects that distance and substitute recreation sites might have on willingness to pay for improvements in water quality. Previous water quality studies in Norway have focused on populations living within single catchments.

2.2 Water system characteristics

In this section we look at the water status for the Halden and Morsa River Basins. As pilot WFD river basins their ecological status has been characterized according to WFD guidelines. The data is displayed using the Vann-Nett tool for WFD reporting **(http://vann-nett.nve.no/innsyn/-Default.aspx).**

Water Region Haldenvassdraget

The Haldenvassdraget Water Region has some 43% of its lakes by surface area in poor-moderate status, while more than half have not been characterised (**Figure 2**). More than half of the lake area in the river basin is at risk of not reaching good ecological status by 2015. Another 27% are possibly at risk. In total 82% of the lake areas would therefore be subject to supplementary measures under the WFD.

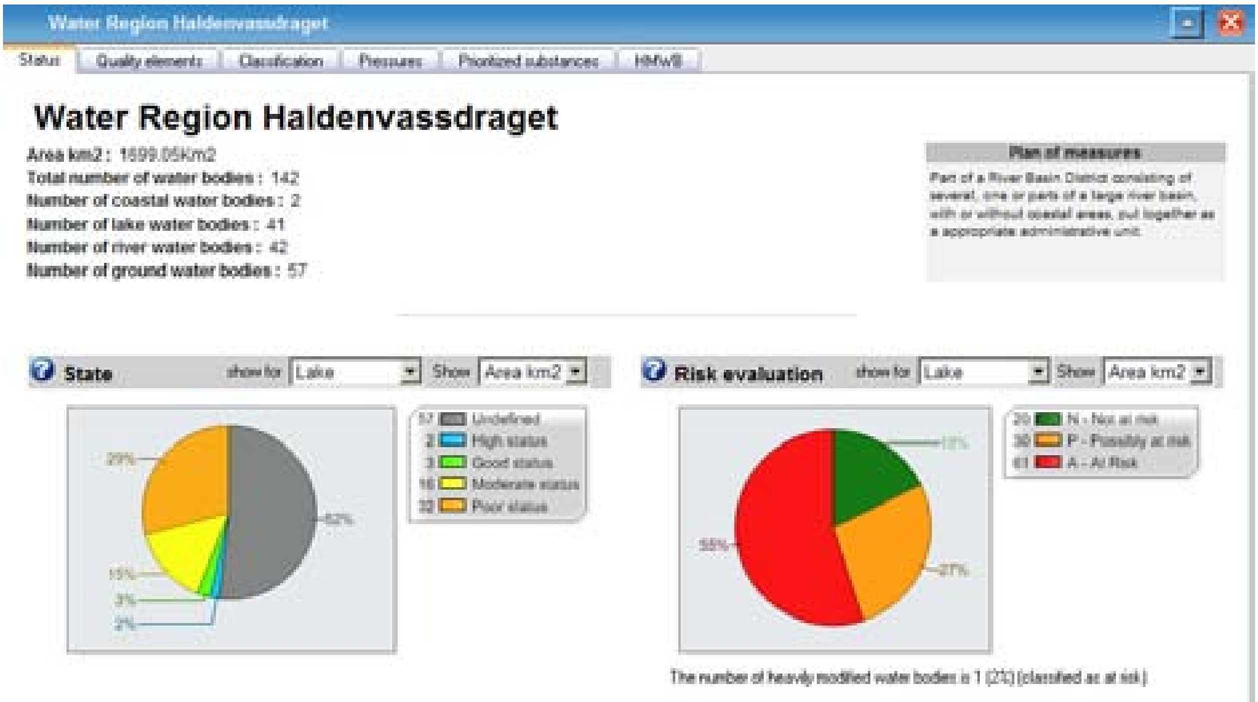


Figure 2. Ecological status of lakes in Halden Water Region. Source: Vann-Nett

This means that most of the river basin should also be subject to an economic evaluation of whether benefits of measures exceed costs.

Figure 3 shows that eutrophication is by far the most important reason for lakes in the river basin not achieving good ecological status. The pollution issues focused on the AQUAMONEY study are eutrophication-related impacts on ecological status.

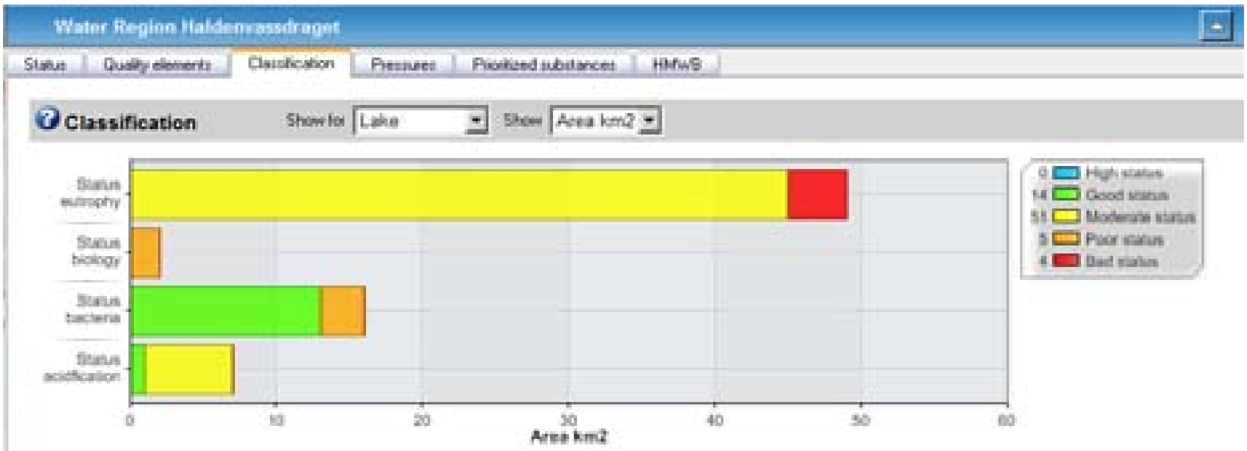


Figure 3. Classification of lakes in Halden Water Region. Source: Vann-Nett

Water Region Morsa

Figure 4 illustrates the status of lake area in the river basin. Practically all lake area is in current moderate status and at risk of not reaching good ecological status by 2015. Even more than Halden-vassdraget, Morsa's problems are entirely due eutrophication (**Figure 5**).

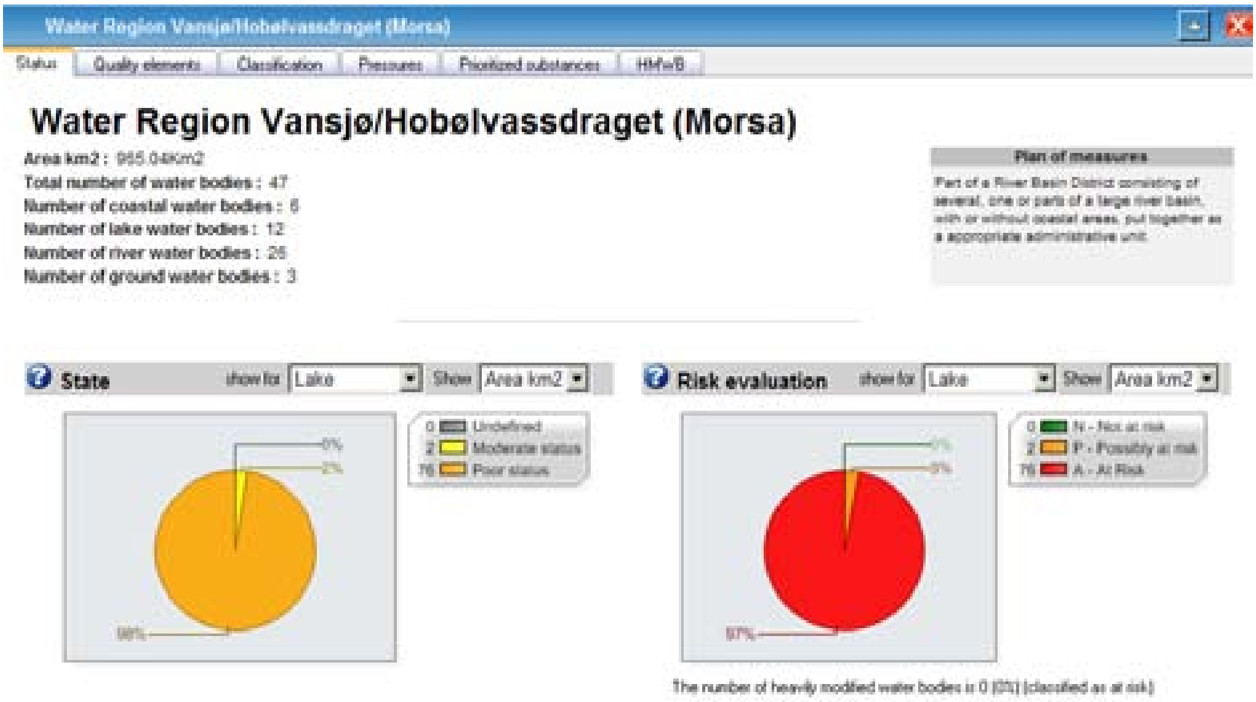


Figure 4. Ecological status of lakes in Vansjø/Hobøl Water Region. Source: Vann-Nett

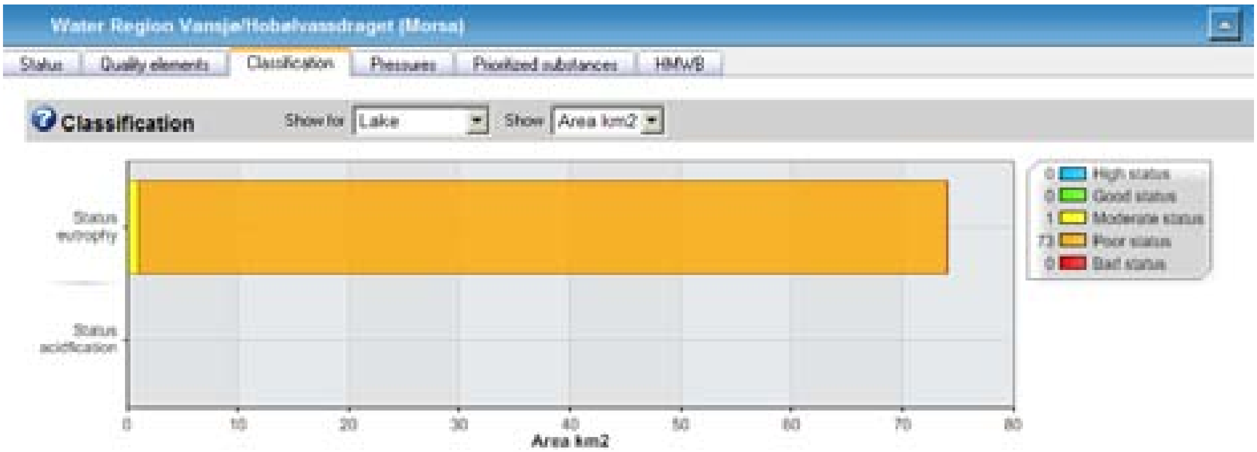


Figure 5. Classification of lakes in Vansjø/Hobøl Water Region. Source: Vann-Nett

2.3 Short characterization of water use and water users

A total of 160,952 households live within the 27 municipalities included in the study area. This is the potential population valuation estimates can be aggregated over based on our sample. Urban areas include the coastal towns of Moss, Sarpsborg-Fredrikstad and Halden. The population is location mainly along the coast and the outskirts of Oslo (**Figure 6**). In the context of willingness to pay for lake recreation households constitute the main water user.

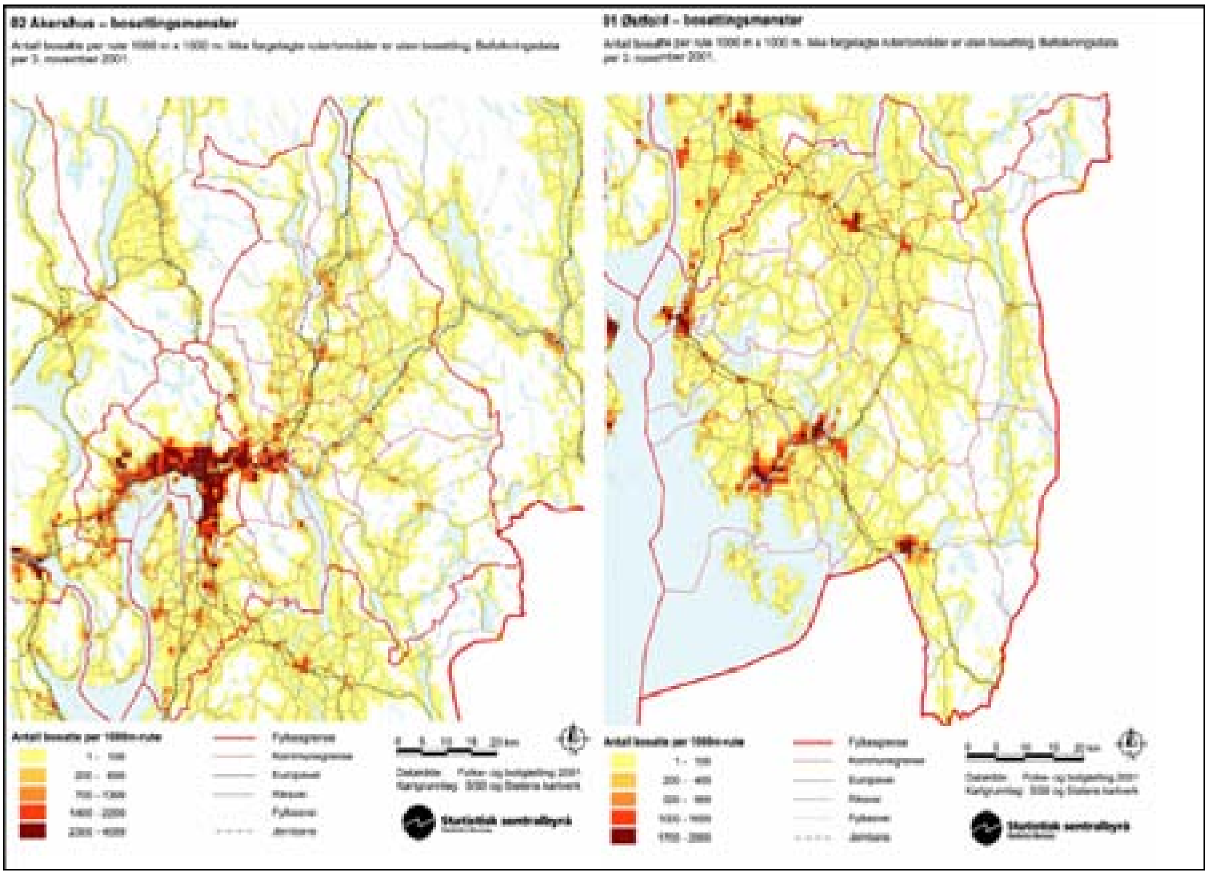


Figure 6. Population density of Akershus and Østfold Counties (Source: SSB)

All municipal water supply in the study area is from surface water. Storefjorden in the Morsa catchment is an example of a source of inter-municipal supply (MOVAR).

A description of "pressures" in the two catchments shows which sectors are users of lakes as sinks. In the Haldenvassdraget Water Region, agriculture is the most important source of water pollution in a third of the lake area (**Figure 7**). Dispersed and municipal sewage discharge make up the other pollution pressures with the widest influence on lake surface area.

Figure 7. Pressures in Halden Catchment. Source: Vann-Nett

In the Morsa Water Region agriculture is a significant pollution pressure on almost the entire lake surface area (**Figure 8**). Dispersed and municipal discharges constitute a moderate pressure in about half of the lake area.

Figure 8. Pressures in Vansjø/Hobøl Catchment Source: Vann-Nett

2.4 Main water management and policy issues in the context of the WFD

In Haldenvassdraget river basin there are large problems with nutrient loading and algal blooms, especially in the upper parts of the catchment. Haldenvassdraget conducted a full basin wide characterization according to the WFD in 2003. The characterization shows that there is a high risk of not achieving the WFD objectives by 2015 both in lakes and adjoining fjords[1].

Vansjø/Hobølvassdraget (Morsa) has similar problems to Halden with excessive nutrient loading and blue-green algal blooms, but principally in the Vestre Vansjø and to a lesser extent Storefjorden Lake in the lower part of the catchment.

Under-estimation of nutrient abatement benefits
Prior research linking cost-effectiveness of nutrient abatement costs in agriculture, dispersed and municipal discharge to household willingness-to-pay (contingent valuation[2]) studies in the Morsa catchment has shown that abatement costs are disproportional to benefits[3]. Limitations to this work were that the contingent valuation estimates were related to changes in official water status classes rather than subjective evaluation of observable water characteristics. This may have ignored the value of smaller improvements in water quality that however did not lead to water quality class improvements.

The prior valuation studies did not estimate whether household willingness-to-pay (WTP) decreases with distance from the lakes. Barton et al. (2008) aggregated mean household WTP estimates over the population in neighbouring municipalities to the lakes. They lacked information on whether there was WTP in the population in municipalities further away.

Over-estimation of nutrient abatement benefits
The Barton et al. (2008) study did account for the possible role of substitute surface water recreational sites such as the sea or other lakes. This may have lead to over-estimation of willingness to pay.

Ecological status
Nutrient abatement cost-effectiveness studies have been carried out in the study area, as well as willingness-to-pay studies. They have however not referred explicitely to good ecological status, but rather to water pollution quality classification. There is a need to evaluate to what extent water users place emphasis on ecological water quality elements in addition to the water quality issues.

Validity
Priori willingness to pay studies did not focus on respondent perceptions of whether WTP-estimates provided in a survey setting constituted a valid basis for decision-making on abatement measures.

[1] Planprogram for forvaltningsplan 2007-2009 Vannregion Glomma/Indre Oslofjord inkludert grensevassdrag på Østlandet – samarbeid for bedre vannkvalitet HØRINGSUTKAST (frist for uttalelse: 30. september 2007.) Fylkesmannen i Østfold.

[2] Magnussen, K., Bergland, O., Navrud, S., 1995. Overføring av nytteestimater:status i Norge og utprøving knyttet til vannkvalitet. Del II Utprøving knyttet til vannkvalitet, NIVA.

[3] D.N. Barton , T. Saloranta, S.J. Moe, H.O. Eggestad, and S. Kuikka, (2008) Bayesian belief networks as a meta-modelling tool in integrated river basin management — Pros and cons in evaluating nutrient abatement decisions under uncertainty in a Norwegian river basin. Ecological Economics 66, 91–104.

3. Set ut of the survey

3.1 Pilot survey

An in-person choice experiment pilot survey was conducted in the Vansjø Lakes in the summer of 2007. The pilot survey is presented in Appendix 6- Pilot study results. It is also documented in an M.Sc. thesis by Lande (2008)[4]. The pilot survey tested the use of a large number of choice experiment questions and detailed graphical descriptions of water quality.

3.2 Main survey design (common)

The questionnaire was composed of questions that were common to all the water quality case studies in the AQUAMONEY project, and some questions specific to the Norwegian case study. Appendix 5 – Web-survey (Norwegian) contains the full text without illustrations of the web-survey (**Table 1**).

Table 1. Web-survey sections

Survey topic	**Common design or case study specific**
Interactive map location of respondent home and recreational home locations	Specific
Water body type use frequencies	Common
Interactive map location of favourite lake	Specific
Water quality ladder interpretation	Specific
Water use suitability threshold interpretation	Specific
Water quality ladder information	Common
Check on map implementation of water quality ladder	Specific
CV scenario (two geographical subsamples)	Common
WTP questions and follow-up questions on motivation	Common
Choice experiment (12 choice sets, 4 blocks)	Specific
Follow-up questions to choice experiment	Specific
Attitudes to valuation questions	Specific
Respondent characteristics	Common
Respondent political voting record	Specific
Panel data on respondents included personal and household income, age, sex, education.	Common

Note: Appendix 5- Web-survey.

A number of socio-economic characteristics of the respondent panel pre-recruited by TNS-Gallup were known prior to the survey. They were left out of the survey, but are included in the common-design dataset.

[4] Lande, Nina Camilla (2008). Valuation of Thresholds in Willingness to Pay for Water Quality Attributes Using Choice Experiments: A Case Study on Eutrophication and Recreation in the Vansjø Lakes, Norway. Department of Economics and Resource Management, Norwegian University of Life Sciences (UMB), Master Thesis

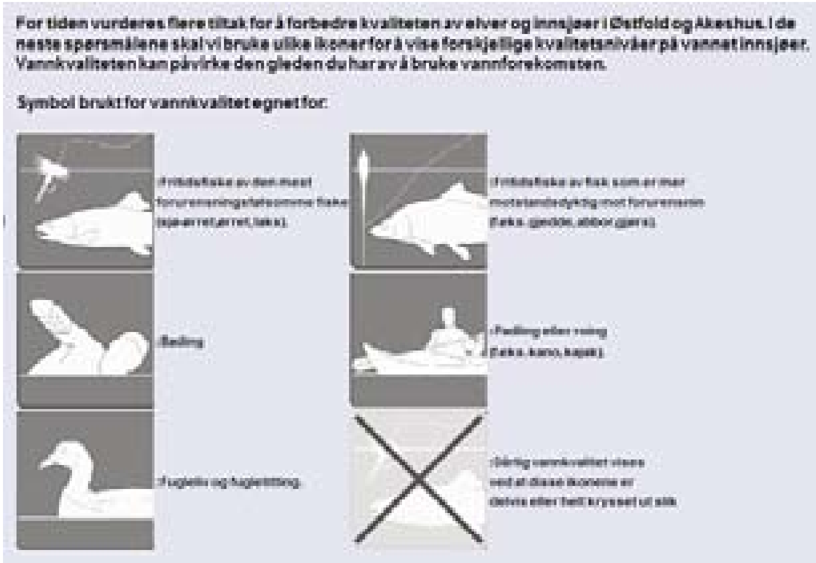


Figure 9. Water user icons in water quality ladder

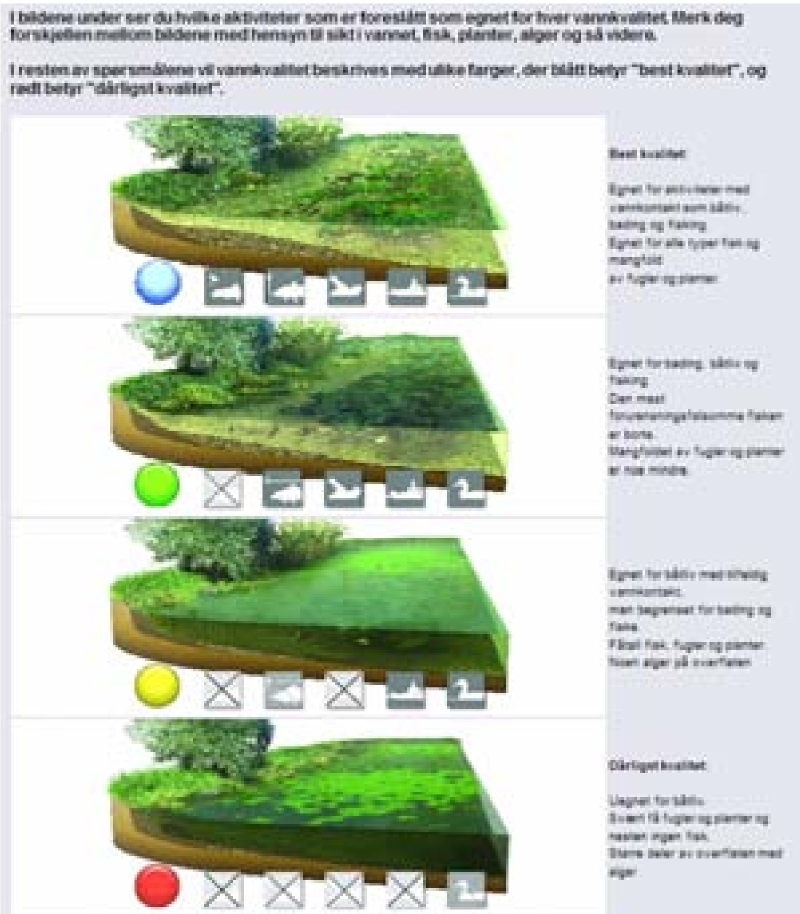


Figure 10. Water quality ladder depicting ecological status

Contingent valuation common design

A number of illustrations use in the survey were common to all the water quality case studies in AQUAMONEY.

Figure 9 gives a screen shot of the water use icons and their description used in the web-based survey. From top left to bottom right the icons were; game fish, coarse fish, swimming, boating, and bird watching. When a particular use was not suitable at a given water quality level it was crossed out as shown in the figure.

Figure 10 shows the water quality ladder illustration which depicts four levels of ecological status of a eutrophied freshwater shoreline. The illustrations were developed by Hime and Bateman (2008[5]). The illustrations were made generic enough to be applied to lakes or slow flowing rivers that were studied in the different water quality cases. "Good ecological status " as interpreted by the Water Framework Directive is depicted as "green" level in the maps. The only difference from the highest level is the absence of "game fish" such as trout. The inclusion of fish and vegetation elements, and their linkage to chemical water quality, is defined in detail in Hime and Bateman (2007).

[5] Hime, S. and Bateman, I.J. (2008) A transferable water quality ladder for conveying use and ecological information within public surveys, CSERGE, University of East Anglia.

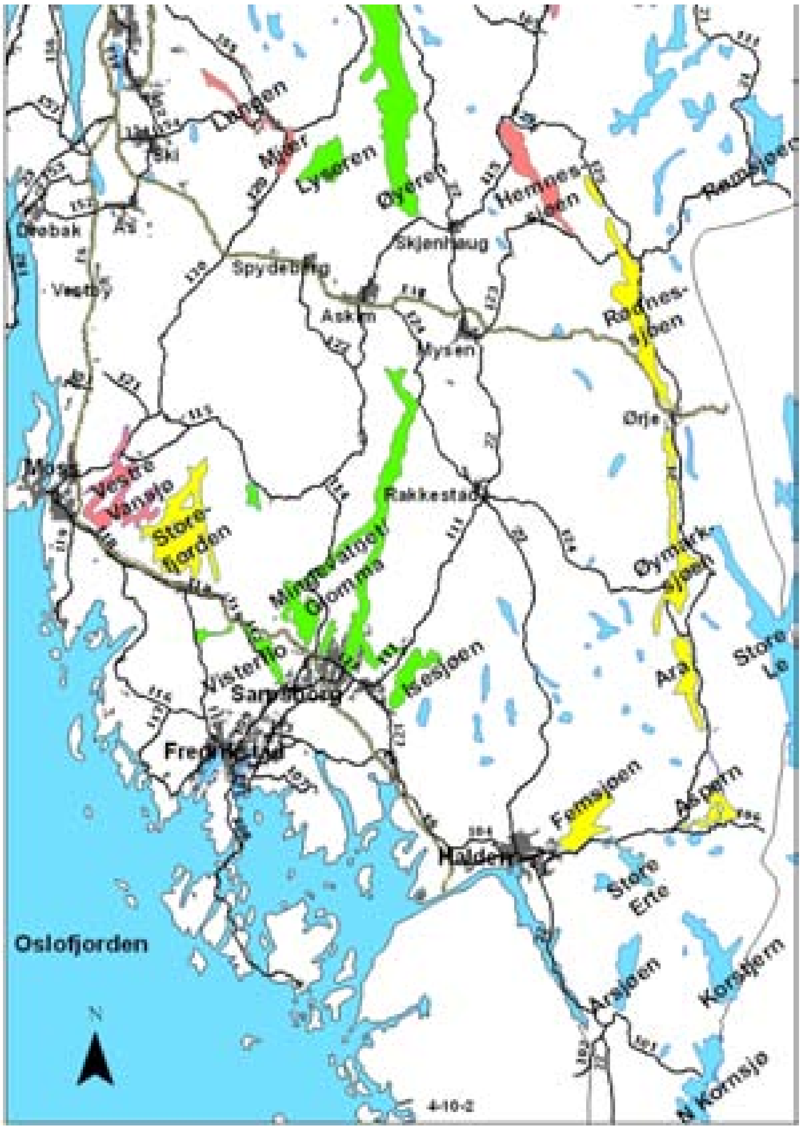


Figure 11 Portrayal of current ecological status in survey

Figure 11 shows current ecological status of water bodies in the study area as interpreted using the AQUAMONEY water quality ladder. The interpretation of the status quo water quality map was verified with environmental managers working from the Glomma River Basin Authority, the Morsa Project and Moss Municipality. While there was broad agreement that the illustrations were an acceptable graphical depiction of eutrophication status, there was some disagreement as to what uses were suitable, or corresponded, to each level. The managers commented that for example boating was considered feasible by some water users even in the worst ("red") status, and that suitability was subjective. For this reason a number of questions regarding respondent's interpretation of the water quality ladder and suitability for different uses were asked prior to using the maps for willingness to pay questions.

Another limitation of the map shown above is that only the main water bodies in the three river basins focused on in the study (Morsavasdraget, Glomma and Haldenvassdraget) were described using the water quality ladder. All other lakes were depicted as being in the "blue" or best status. For some smaller lakes outside the catchments in the study (such as Gjersjøen on the southern outskirts of Oslo) this is not the case. To check whether this simplification made any difference, follow-up questions were asked to see whether the maps were an accurate description of water quality status in the respondents' area. Also, to check respondent understanding of the map they were asked to locate their home and any recreational cabin in use by "clicking" on the map with the mouse.

Figure 12 shows a question where respondents were asked to rank the four visual descriptions of ecological status from best to worst, in order to check a priori understanding relative to the definition of water quality levels used in the water quality scenario maps.

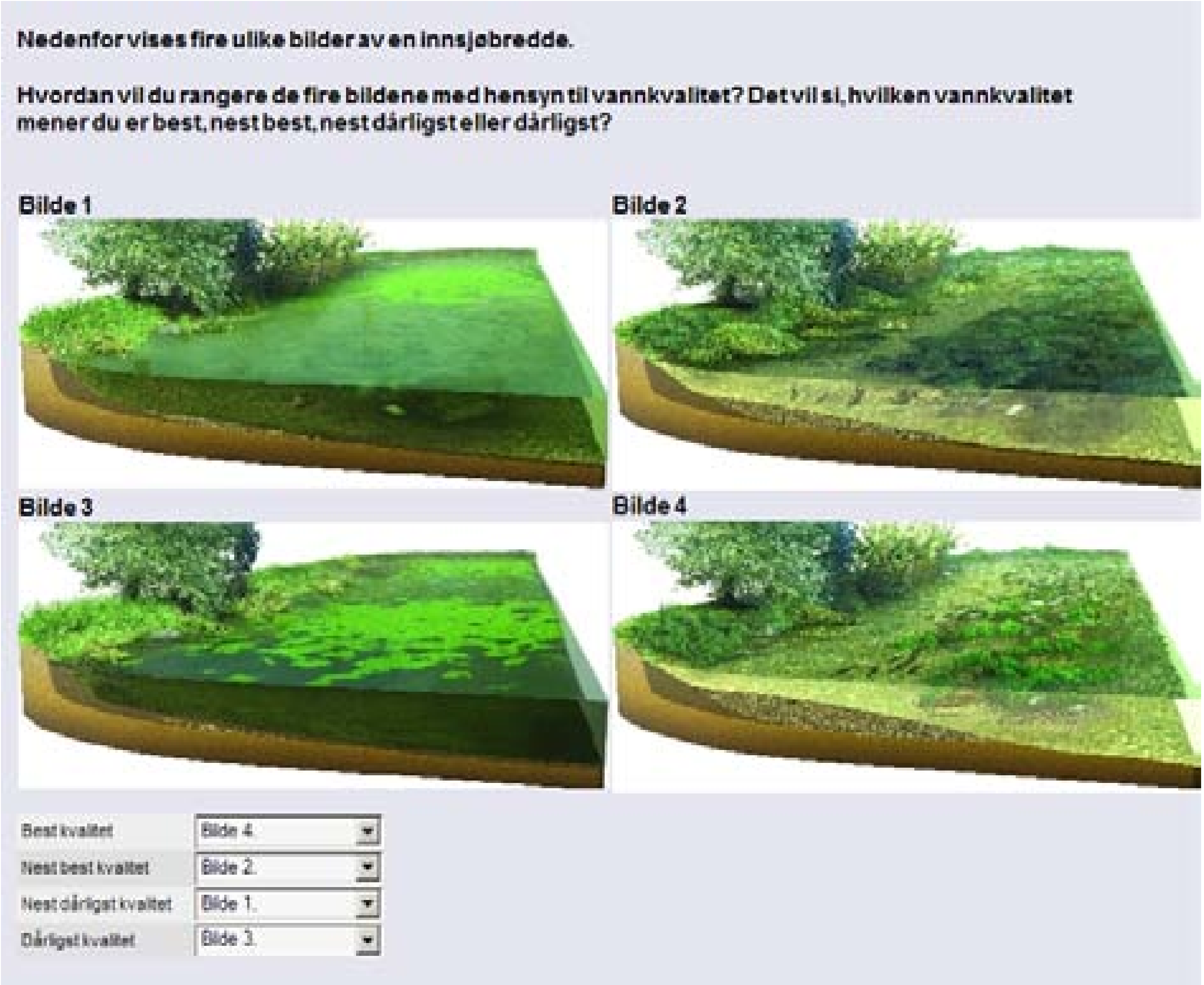


Figure 12. Subjective ranking of water quality levels in the water quality ladder

The differences between water quality descriptions covers water clarity, water colour, aquatic vegetation, fish species and abundance, and shoreline vegetation.

Figure 13 gives on example of questions regarding which water uses respondents “would not practice” for each of the four water quality illustrations. **Figure 13** shows an example for the third “yellow” level. The respondent has stated that they would not or could not game fish or swim at in this situation, but that they would practice the other activities shown. There is also an option for stating that “I would practice all activities” shown.

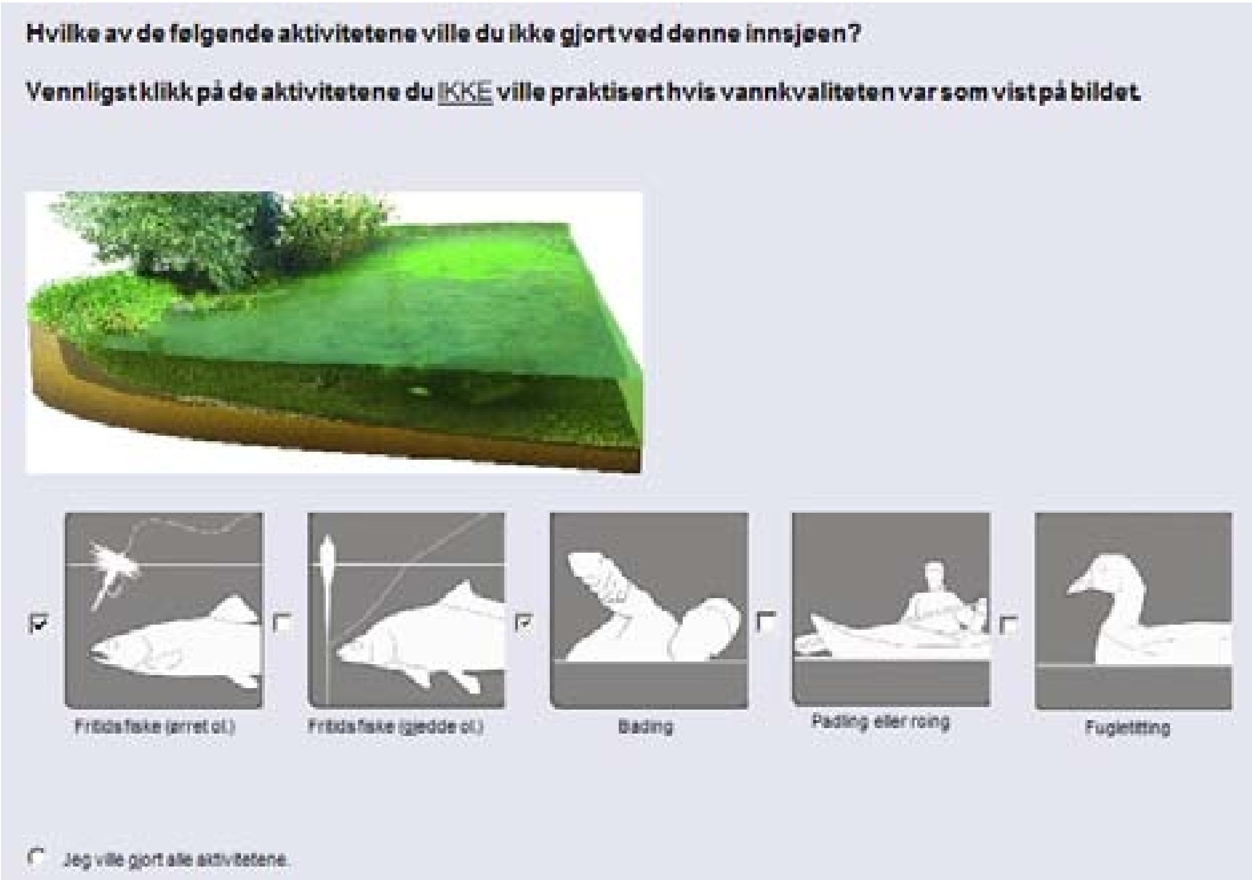


Figure 13. Use suitability questions

Figure 14 to **Figure 17** show the water quality status depicted in a map of the "current situation" (left hand side) and a "situation with measures" (right hand side). **Figure 14** and **Figure 15** show the valuation scenarios presented to respondents in the Morsa-Glomma geographical subsample. **Figure 16** and **Figure 17** show the valuation scenarios presented to respondents in the Glomma - Halden geographical subsample. The sub-samples were designed so that 50% of the panel living in the Glomma municipalities[6] were randomly assigned to one of the two subsamples Morsa or Halden. In this way we can study the effects of distance on Glomma residents' willingness to pay for improving lakes in Morsa or Halden catchments.

TNS-Gallup's panel was much smaller for municipalities in Glomma and Halden catchments than for Morsa, leading to a larger subsample in the latter than the former.

Notice that the respondent's home location is indicated with a "house icon" in the scenario maps in **Figure 14** to **Figure 17** This is the location indicated by the respondent earlier by "clicking" on the map.

[6]Morsa catchment municipalities: 0104,0211,0214,0213,0138,0137,0135,0136,
Glomma catchment municipalities : 0226,0227,0228,0229,0122,0124,0125,0127,0128, 0105, 0106
Halden catchment municpalities : 0221,0121,0119,0118,0101,0111.

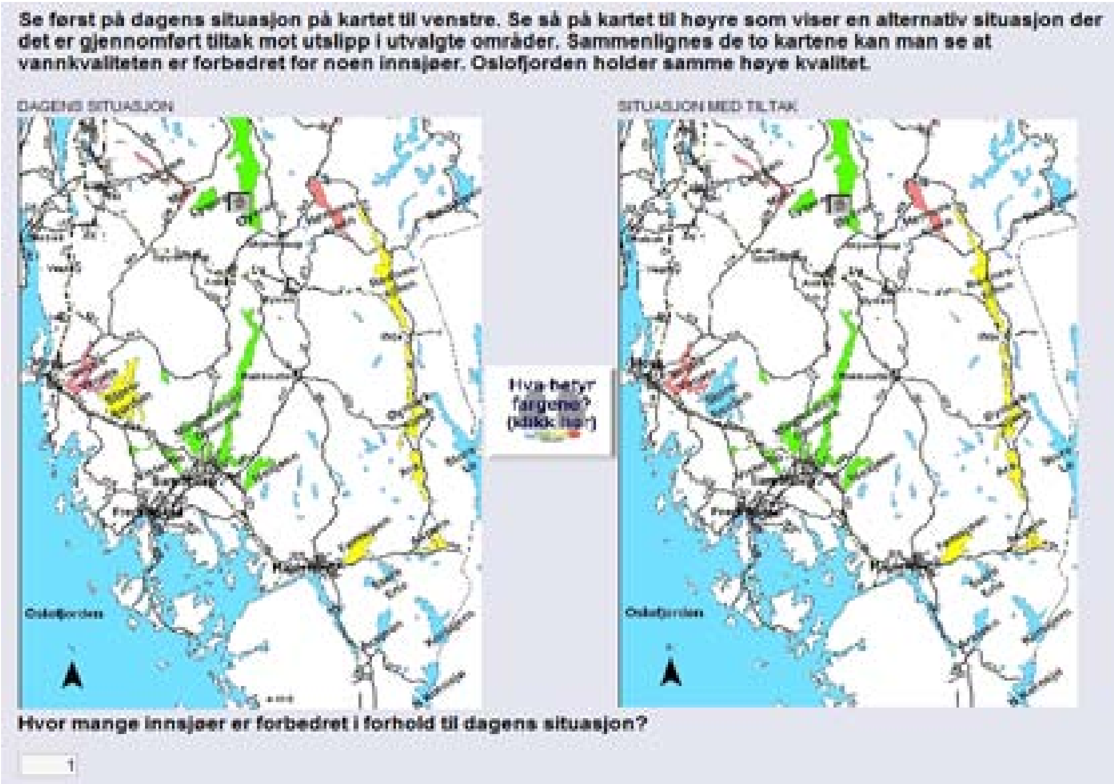


Figure 14. Water quality scenario – one lake improved – Morsa Glomma sub-sample

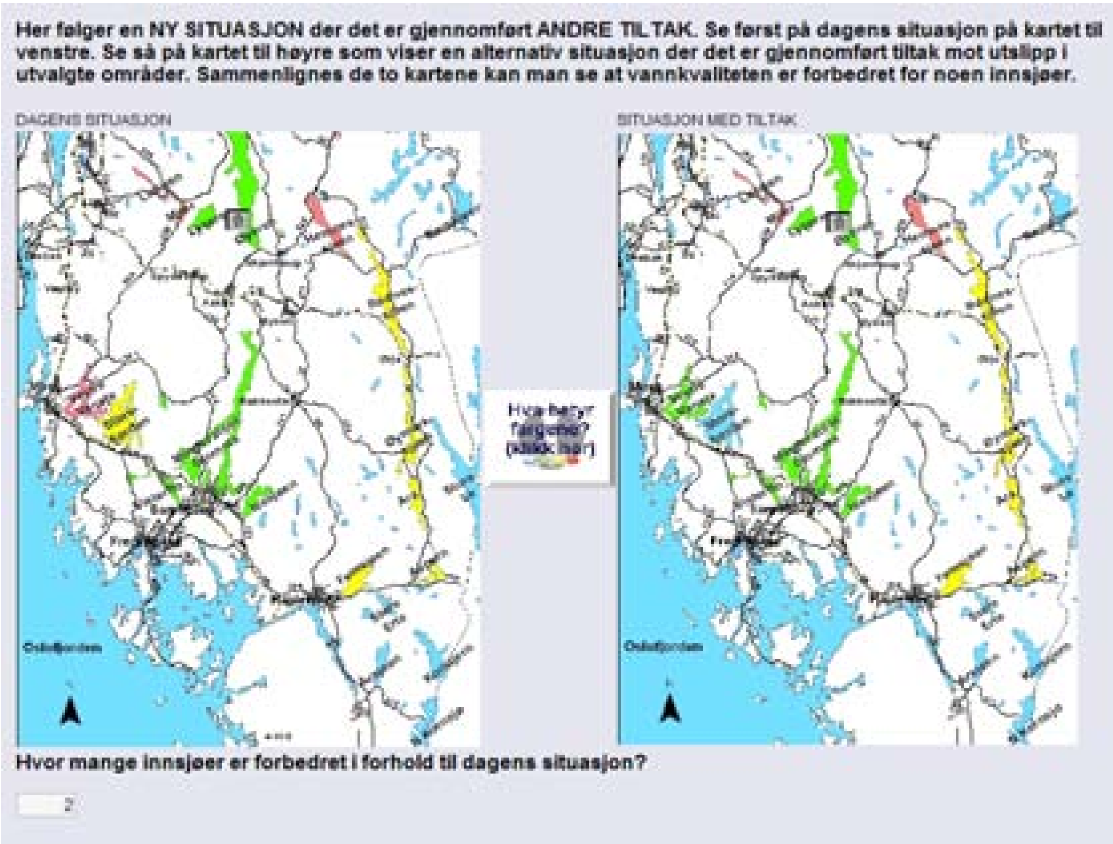


Figure 15. Water quality scenario – two lakes improved – Morsa Glomma sub-sample

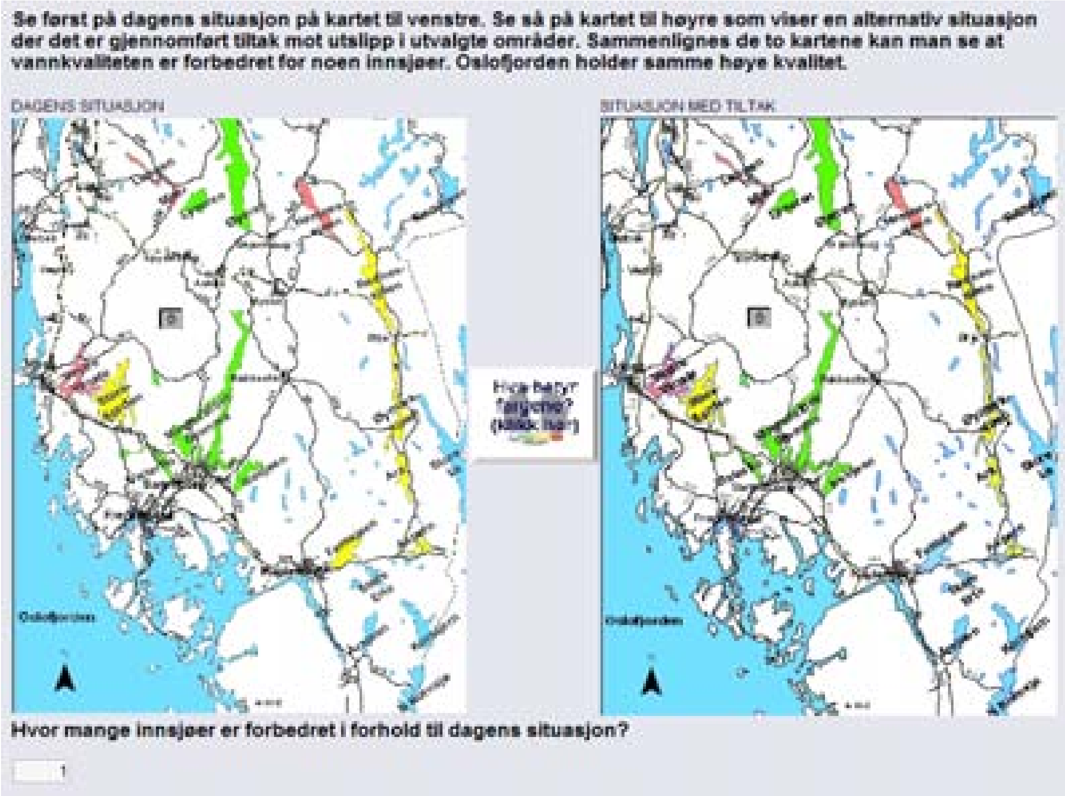


Figure 16. Water quality scenario – one lake improved – Gomma Halden subsample

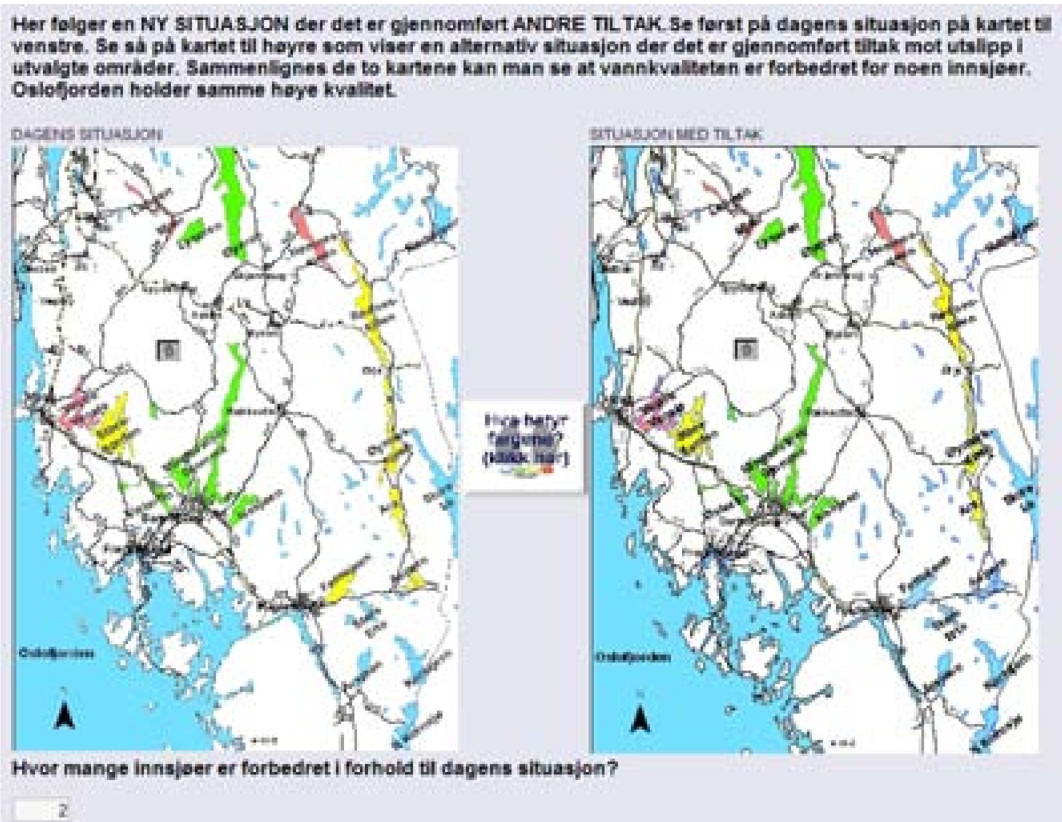


Figure 17. Water quality scenario – two lakes improved – Gomma Halden subsample

The “one lake improvement” and “two lakes improvement” scenarios were presented to respondents in random order, so that some respondents were first asked about willingness to pay if two lakes were improved, then one lake, and vice versa (**Figure 14** to **Figure 17**) . Two different magnitudes of improvement were suggested in order to test whether respondents’ willingness to pay was sensitive to the scope of improvements. This is referred to as the “scope effect”.

This was done in both geographical sub-samples (Morsa-Glomma and Glomma-Halden). The objective of this random ordering was to test whether the order in which improvements are suggested has an effect on respondents’ willingness-to-pay. This is referred to as the “ordering effect”.

The “scenario with measures” is described in the text box[1]:

Text box: Contingent valuation scenario description

<u>Scenario text page 1:</u>
“Let’s focus on the current situation in the big lakes/rivers in your area (left hand map). A second map (right hand) shows an alternative situation where sewage treatment and farm measures are undertaken in some areas. Comparing the two maps you can see that water quality has improved in some of the lakes/rivers. All other parts stay as they originally were. How many lakes/rivers have improved relative to the current situation? (select). (see maps in **Figure 14** to **Figure 17**)

<u>Scenario text page 2:</u>
Now water quality improvements cost money and these can be paid for by increases in household water and sewerage bills. Some people might be prepared to pay higher bills for this improvement while others would not.

I want you to think carefully about whether your household really would prefer to pay for this scheme, or would prefer to continue purchasing other things that are important to you. Remember that any increase in bills would mean there would be less money for you to spend on other purchases that you might like to make.

Also recall that these changes do not affect drinking water quality as that is always purified before being used for human consumption. The only things affected by changes in lake/river water quality are the types and quality of recreation that visitors can enjoy and the plants and animals that live there.

<u>Scenario text page 3:</u>
I would like you to consider the annual amount which, it were any higher, you would rather stay with the current situation. To help you decide please take a look at the amounts printed below and click on the amount that is the most you would be prepared to pay each year to get the alternative rather than the current situation.

After the explanation of the scenario with measures, respondents were asked to consider whether, and if so how much, they would be willing to increase water and sewage rates to co-finance the measures. **Figure 18** shows the “payment card” where respondents can state their willingness to pay. Both respondents who replied WTP > kr. 0 and those replying kr. 0, or “don’t know” were asked to follow-up questions to motivate their response.

For at du lettere skal kunne vurdere om eller hvor mye tiltakene er verdt for din husstand se på beløpene som er satt opp i listen under. For hvert beløp spør deg selv om din husstand ville være villig til å betale dette beløpet per år i tillegg til det du i dag betaler i VA-avgift for å få en forbedring som vist i kartene.
Klikk på det beløpet som tilsvarer det maksimale din husstand ville være villig til å betale PER ÅR for denne forbedringen i vannkvalitet.

Se kartene over forbedringer i vannkvalitet igjen.

kr. 0	kr. 320	kr. 680	kr. 1040	kr. 1600	kr. 3650	kr. 7600
kr. 24	kr. 360	kr. 720	kr. 1080	kr. 1800	kr. 4400	kr. 8000
kr. 40	kr. 400	kr. 760	kr. 1120	kr. 2000	kr. 4800	kr. 8400
kr. 80	kr. 440	kr. 800	kr. 1160	kr. 2200	kr. 5200	kr. 8800
kr. 120	kr. 480	kr. 840	kr. 1200	kr. 2400	kr. 5600	kr. 9200
kr. 160	kr. 520	kr. 880	kr. 1280	kr. 2600	kr. 6000	kr. 9600
kr. 200	kr. 560	kr. 920	kr. 1360	kr. 2800	kr. 6400	Annet beløp
kr. 240	kr. 600	kr. 960	kr. 1440	kr. 3200	kr. 6800	Vet ikke
kr. 280	kr. 640	kr. 1000	kr. 1520	kr. 3600	kr. 7200	

Figure 18. Payment card used to elicit willingness to pay

Table 2- Table 3 show the follow-up questions to the willingness to pay question.

		Most important	Second most important
The increase in bills is too high compared to the change in river water quality	0	☐	☐
This river is too far away	0	☐	☐
I don't use this river	0	☐	☐
The current situation is good enough	0	☐	☐
I don't think water quality will improve as described	P	☐	☐
I would rather that another river was improved	0	☐	☐
I would rather spend money on other things	0	☐	☐
I can't afford to pay extra	0	☐	☐
People that use rivers should pay for this	P	☐	☐
The water company should pay for this	P	☐	☐
The government should pay for this	P	☐	☐
Water bills are too high already	0	☐	☐
The question was too difficult to answer	P	☐	☐
Other reasons (please specify................................)	P/0	☐	☐

Table 2. Follow-up questions on reasons for not wanting to pay (0:coded as WTP=0; P:protest response not included in calculation of WTP)

	Most important	Second most important
This scheme would be good value for me and/or my household	❑	❑
I was interested in these improvements irrespective of cost	❑	❑
I was interested in benefits to other people outside my household	❑	❑
Other people should experience better rivers, irrespective of what they think is best	❑	❑
I want to improve rivers for other creatures and wildlife	❑	❑
I felt it was the morally right thing to do	❑	❑
I did not understand the question	❑	❑
Other/None of these – SPECIFY –	❑	❑

Table 3. Follow-up questions on reasons for wanting to pay

Choice experiment design

"Choice experiments" have the advantage of obtaining much more information from each respondent about how they balance price increases against environmental improvements. We wished to compare WTP results from "contingent valuation" and "choice experiment" methods.

Following the willingness-to-pay questions contingent on the two scenarios with and without measures (contingent valuation), respondents were asked to consider choices between a number of different water quality scenarios in the study area. This is a valuation method called "choice experiments" (see e.g. Bateman et al. 2002 for a detailed description of the method) Examples of choice questions are shown in **Figure 19**. Respondents were shown two situations with different additional water and sewage fees, and asked to choose between the two situations and the current water quality situation with no fee increase (3 alternatives in all).

The current situation had been shown earlier in the contingent valuation questions. It could also be reviewed by the respondent at any time during the following choice questions by clicking on the screen. The water quality ladder could similarly be called back for review at any time during the choice questions (square icon in the middle of the screen **Figure 19.**

The respondent was presented with a total of 12 such choice sets as shown in **Figure 19**. This is a relatively large number of choice questions relative to other environmental valuation studies, but quite usual in marketing research. The feasibility of asking this many questions had been tested extensively in an in-person pilot survey (see Appendix 6), and a web-based pre-test. The first and the last choice sets were identical in order to test whether respondents answered consistently.

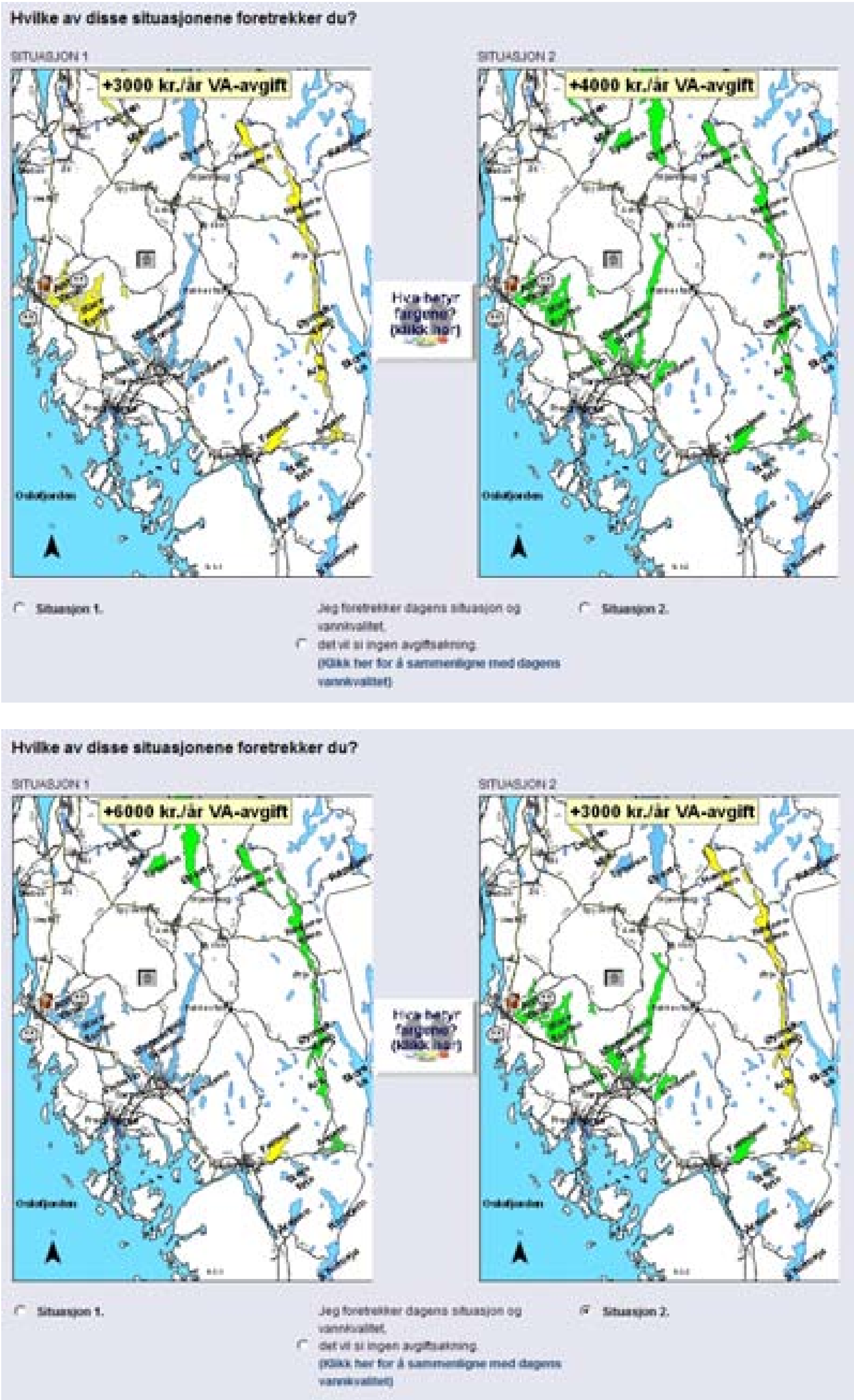


Figure 19. Examples of two choice sets.

The choice scenarios consisted, as in the contingent valuation questions, of water quality characteristics and an increase in municipal household water and sewage fees. The water quality characteristics – also called “attributes” in choice experiment methodology – were different groupings of lakes in the three river basins in the study area (Morsa, Glomma and Halden). Depending on what the current water quality status is the different water body groups could be in 2-4 different water quality levels as described in the water quality ladder (**Figure 10**). In other words, we only evaluated scenarios which entailed no change or an improvement in water quality. This is in accordance with the “no deterioration” approach of the Water Framework Directive.

Figure 20 shows how the lakes were grouped into 7 water quality characteristics of the study area. On the right-hand side the constraints placed on which water quality levels could appear in adjacent upstream-downstream lakes in the same river basin are shown. For example, yellow(L3) or red(L4) quality level in the Upper Morsa was never combined with blue (L1) quality level in Lower Morsa; while red quality level would not occur upstream of green quality level downstream. These constraints mirror the eutrophication dynamics of the three river basins. While lakes do play a role in nutrient retention (witness the Upper Halden river basin), retention is not so large sufficient to reduce eutrophication by two classes or more between adjacent lakes in these rather small river basins.

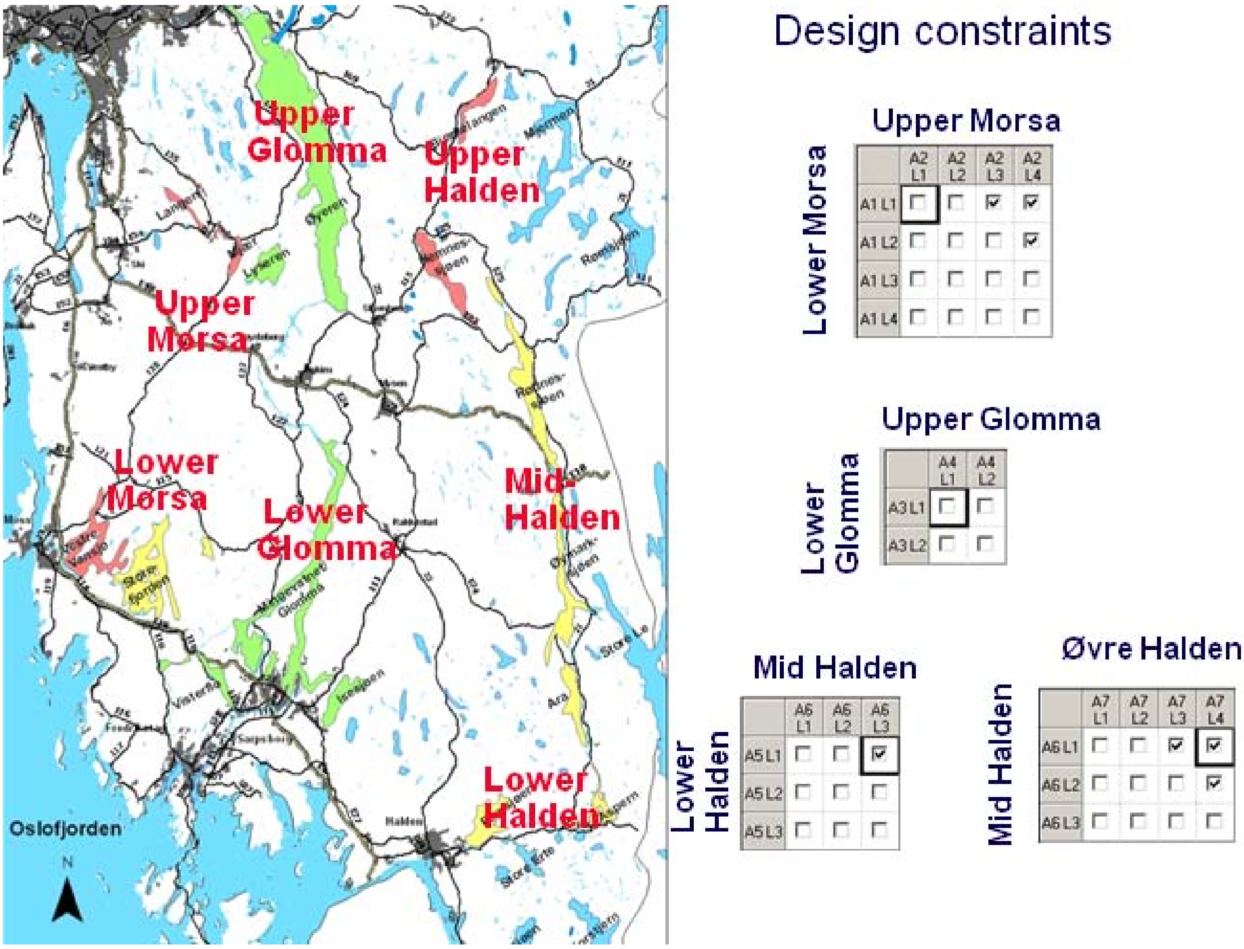


Figure 20. An overview of the 7 lake-group attributes and “experimental design constraints” in the choice experiment

The deisgn constraints provide realism to the scenarios at the expense of reducing the number water quality levels that can be evaluated. The resulting attributes in the different choice scenarios and their respctive number of levels is given below:

1) Lower Morsa (4 levels)
2) Upper Morsa (4)
3) Lower Glomma (2)
4) Upper Glomma (2)
5) Lower Halden (3)
6) Mid-Halden (3)
7) Upper Halden (4)
8) Increase in annual water and sewage fee (6)

3.3 Sampling procedure and response rate

The pilot survey (Appendix 6) was conducted using face to face interviews. A pre-test of the web-based survey was sent to 16 respondents, with follow-up interviews by telephone (July 2008). The web-based survey was on-line for 6 days in September. Two municipalities which were not included in the original sample frame by mistake (Moss and Rygge) were sampled in October for an additional week.

Survey response rates are given in Appendix 1. The web-survey was sent to the whole of TNS Gallups panel in the study area for a total of 3 358 households. Response rate after a week of fielding was 33.7% for a total 1133 respondents.

3.4 Perceptions of contingent valuation questions

Validity of WTP estimates using the contingent valuation and choice experiments was evaluated through follow-up questions regarding why respondents either had zero WTP or protested to the WTP question (**Table 4 to Table 6**). Positive WTP responses to the first and second contingent valuation questions were around 60% and 57% respectively (**Table 4**). Of the respondents who stated "zero WTP" or "don't know" around 11% were reclassified as being true zero WTP responses, and they were included in the estimate of WTP. Respondents classified as "true protests" were around 10% with around 4% remaining unclassified "protest or zero" responses (respondents who chose none of the explanations in **Table 2**, but gave an open ended text responses instead).

Table 4. WTP question responses (contingent valuation)

	First WTP question		Second WTP question	
	Freq.	Percent	Freq.	Percent
True Protest	107	9.44	123	10.86
True Zero WTP	125	11.03	131	11.56
Both protest & Zero WTP	169	14.92	189	16.68
WTP>0	677	59.75	650	57.37
Protest or zero(other)	55	4.85	40	3.53
Total	1,133	100	1,133	100

What were respondent's reasons for stating zero WTP or "don't know"? **Table 5** shows the distribution of reasons which were classified into "true zero WTP" (0) and "true protests" (P). The most important reason for protesting was that "authorities should pay" for water quality measures.

Table 5. Protest and zero reasons regarding WTP question (P:protest; 0:zero)(see **Table 2**)

	Most important reason		Second most important reason	
	Freq.	Percent	Freq.	Percent
Bill change too high (0)	29	2.56	26	2.29
Lake too far(0)	30	2.65	33	2.91
Dont use lake(0)	22	1.94	18	1.59
Status quo OK(0)	12	1.06	12	1.06
Won't improve (P)	30	2.65	26	2.29
Prefer other lake(0)	9	0.79	20	1.77
Other priorities(0)	8	0.71	8	0.71
Can't afford(0)	31	2.74	30	2.65
Users should pay(0)	6	0.53	24	2.12
Water company should pay (P)	24	2.12	36	3.18
Authorities should pay (P)	133	11.74	49	4.32
Current w&s bill too high(0)	59	5.21	38	3.35
Question difficult (P)	9	0.79	12	1.06
Other (P&0)	55	4.85	10	0.88
No answer (WTP>0 or skipped)	676	59.66	791	69.81
Total	1,133	100	1,133	100

Table 6 identifies respondents' reasons for expressing positive WTP. The most important stated motivations were not related to respondents' own use values, but to animal life, a moral imperative and value for other households'.

Table 6. Reasons for positive WTP (contingent valuation)

	Most important reason		Second most important reason	
	Freq.	Percent	Freq.	Percent
Measures valuable for my household	89	7.86	73	6.44
Interested whatever the cost	36	3.18	39	3.44
Value for others than own household	79	6.97	104	9.18
Value for others despite their views	81	7.15	94	8.3
Improve for the sake of animal life	256	22.59	171	15.09
Morally important	111	9.8	112	9.89
Didn't understand	3	0.26	10	0.88
Other reasons	25	2.21	13	1.15
No answer (Protests and zeros)	453	39.98	517	45.63
Total	1,133	100	1,133	100

Given that the water quality ladder focuses on suitability levels for different water uses, the fact that more than half of the respondents replied that their motivation for positive WTP was not primarily related to use values, indicates a possible problem for observing scope effects. We would expect WTP to be more sensitive to the changes proposed for respondents who expressed use value motivations.

3.5 Perceptions of choice experiment questions

Along the same lines as for the contingent valuation willingness to pay questions, we asked follow-up questions to the choice experiment. The results are summarised in **Figure 21** to **Figure 21** and **Table 7 to Table 8** below. Our choice experiment with 12 choice sets was considerably longer than many other studies in the environmental economics field. Despite a pilot study (Lande 2008) confirming that respondents were able to give considered answers to 12 repeated choice questions, a concern was still that respondents' attention to the scenarios would drop during the interview.

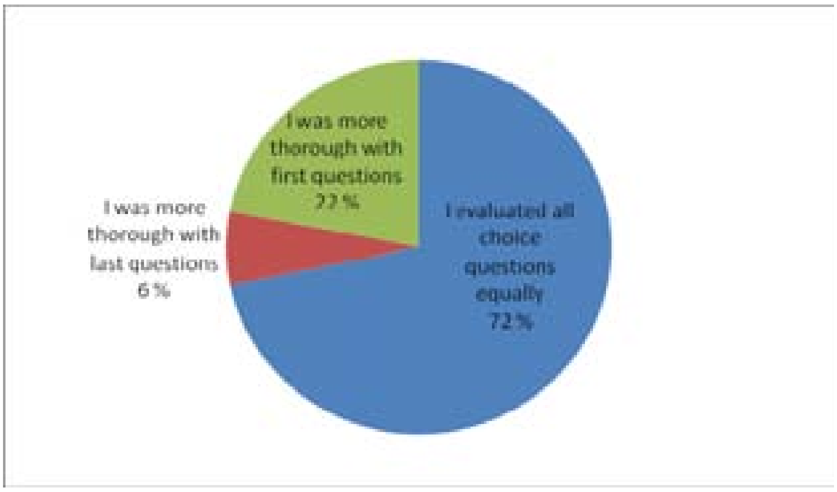


Figure 21. Respondent consideration of choice question sequence

In **Figure 21** respondents self-report how the evaluated the sequence of choice questions. A fifth of the sample reported problems with the length of the survey, while 6 % reported the opposite. Decreased attention, would either increase random choice selection or lead to more use of "rules of thumb" in making choices. These "biases" work in opposite directions regarding variance of the choice model parameters. Which effect dominates may be tested statistically (not reported here).

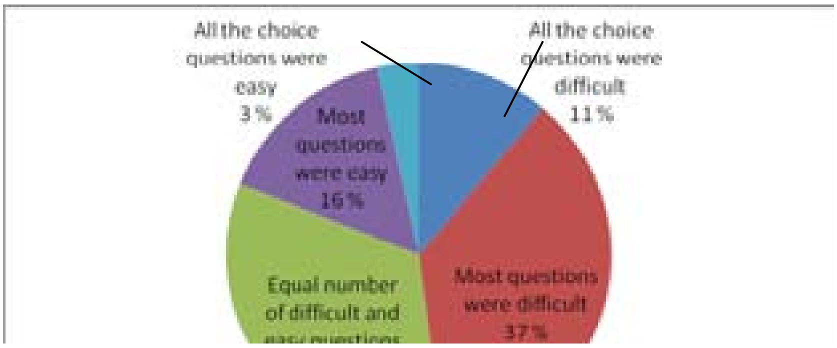


Figure 22 shows respondent's self-reported difficulty with the choice questions. Almost half the respondents found the majority of choice questions difficult to answer. While this is not a validity problem in itself (we know the questions are unusual and require serious reflection), it signals a potential problem for choice experiments with many choice questions, such as ours. It is a potential explanation for poor significance of lake-attributes, should that be found.

Table 7 reports on the reasons given by the respondents who found some or most of the choice experiment questions difficult. Three of the four most important reasons concern aspects of the choice experiment format (difficulty in making choices, number of questions, and similarity of choices). A bit more than twenty percent of respondents who found the choice experiment difficult reacted to the levels of the water and sewage fee increase being too high.

Table 7. Reasons for difficulty of choice task

	Most important reason		Second most important	
	Freq.	Percent	Freq.	Percent
Too many questions	59	10.87	67	12.34
Environmental improvements shown not realistic	36	6.63	60	11.05
Choices very similar	39	7.18	92	16.94
Difficult to read maps	25	4.6	22	4.05
Difficult to understand water quality symbols	4	0.74	6	1.1
Didn't understand questions	7	1.29	8	1.47
Increase in water and sewage fee too high	125	23.02	115	21.18
Difficult to choose; several things important	201	37.02	107	19.71
Should not pay on principle for environmental improvement	35	6.45	42	7.73
None of the above	12	2.21	24	4.42
Total	543	100	543	100

Table 8. Reasons for chosing status quo alternative in choice experiment at least once (P: protest reasons; 0: zero WTP reasons).

	Most important reason		Second most important	
	Freq.	Percent	Freq.	Percent
Improvement too expensive relative to gain in water quality (0)	139	18.66	103	16.59
Cannot afford higher fee (0)	101	13.56	82	13.2
Lake too far away (0)	54	7.25	77	12.4
Lake water quality not interest (0)	8	1.07	11	1.77
Don't use (0)	31	4.16	30	4.83
Current status satisfactory (0)	29	3.89	26	4.19
Not my responsibility (P)	37	4.97	53	8.53
W& S fees already too high (0)	204	27.38	132	21.26
Questions too difficult (P)	60	8.05	45	7.25
None of the above	14	1.88	27	4.35
Others	68	9.13	35	5.64
Total	745	100	621	100

The choice experiment asked respondents to select between the current "status quo" situation and two alternative scenarios with measures and higher fees. 67% of respondents picked the status quo option once or more. **Table 8** reports their reasons for doing so. The most important reason for choosing the status quo regarded water and sewage fee being too high already. Other reasons included lacking affordability and the improvements being insignificant relative to the fee increase. All these reasons can be interpreted as expressions of "true zero WTP" rather than protests to the valuation exercise. As such the status quo option in choice experiments identifies true zeros directly.

About 13 % of the sample expressed that the exercise was too difficult or that it wasn't their response-bility – both "protest" reasons. The choice experiment on the web gave respondents no option but to answer all the choice questions or abandon the survey. These "protest" respondents may still contri-bute to the calculation of positive WTP if they answered one or more of the choice questions with one of the alternative scenarios. In the choice experiment these "protests" are not initially excluded from the calculation of the implicit price of water quality as in willingness to pay calculations in contingent valuation. This means that choice experiment estimates are lower than they otherwise would have been.

Previous studies have also expressed concern that respondents do not know their own water and sewage expenses. **Figure 23** shows what respondents self-reported as their annual water and sewage fees. A little more than 20% of the sample did not know their sewage fees (and were only informed of this after the willingness to pay questions). The reported mean for those who gave a response was approximately 3900 NOK/yr.

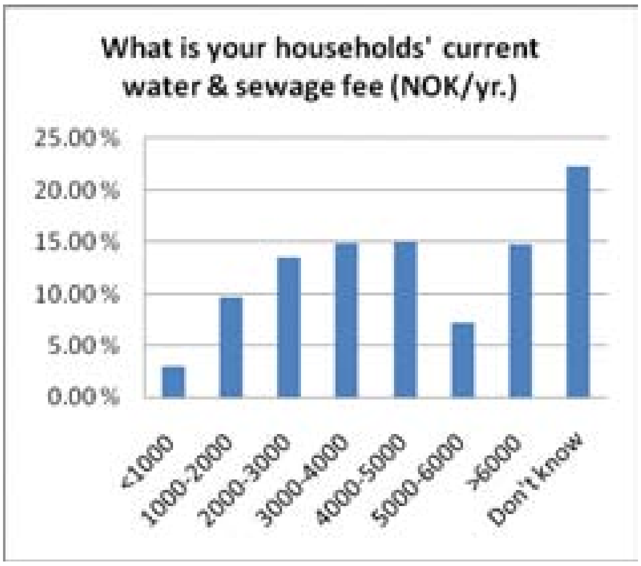


Figure 23. Reported water and sewage fees

Water and sewage fees in the major towns in the study area using a fixed annual fee are very similar (Sarpsborg 4070 NOK/yr; Fredrikstad 4865 NOK/yr; Halden: 3844 NOK/yr). From this we conclude that the large majority of respondents are familiar enough with water and sewage fees to relate to them in the choice experiment. Consequently, the roughly 20% of the respondents who found fees too high might be interpreted as "true protests". In terms of protest rates this is similar to the contingent valuation questions (the choice experiment on the web gave respondents no option but to answer all the choice questions or abandon the survey, so the comparison is not straight forward).

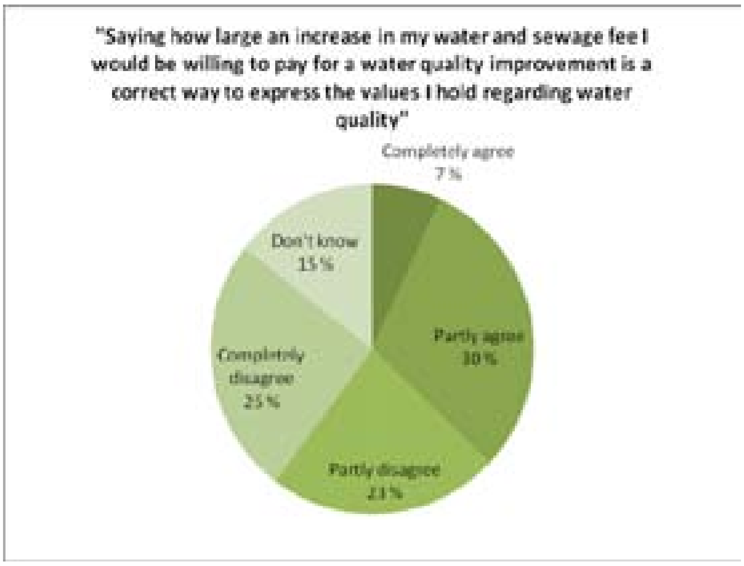


Figure 24. Respondent opinion regarding willingness to pay questions as a measure of values of water quality

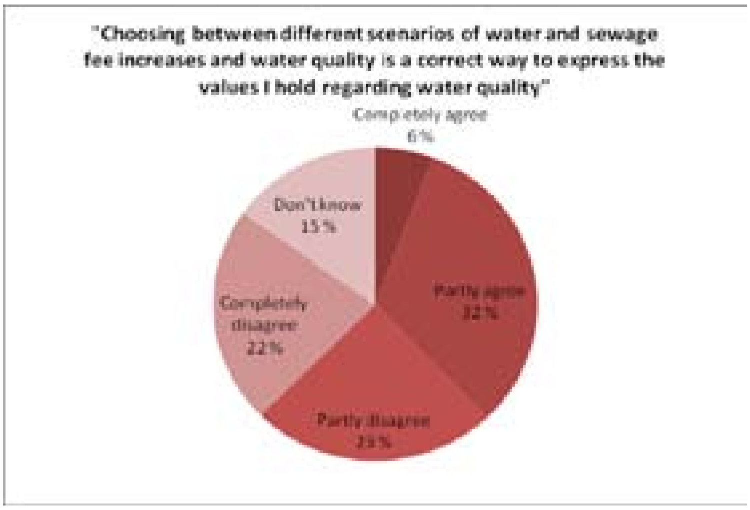


Figure 25. Respondent opinion regarding choice questions as a measure of values of water quality

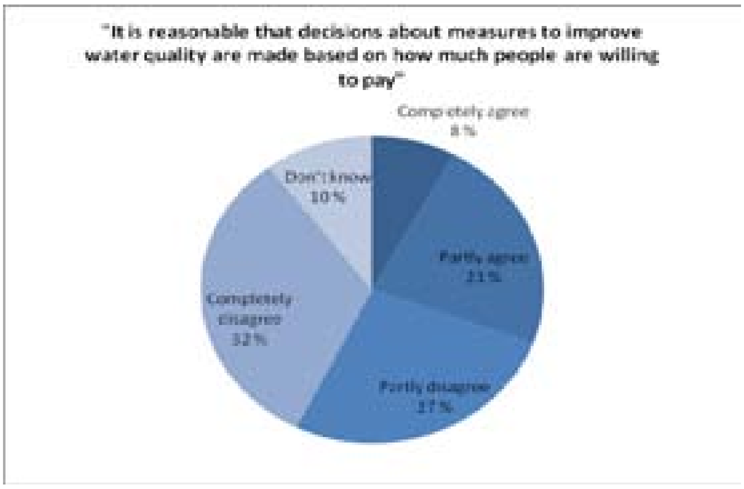


Figure 26. Respondent opinion regarding the use of willingness to pay as a basis for decision-making on water quality measures

3.6 Perceptions of valuation

Following the willingness to pay questions and the choice experiment questions respondents were asked to rate their agreement with a series of statements regarding the valuation tasks in the survey. **Figure 24** shows respondents' level of (dis)agreement regarding whether willingness to pay responses are a measures of the value they place on water quality. A little more than a third of the sample partly or strongly agrees that their willingness to pay responses express values they hold regarding water quality.

Figure 25 similarly asks whether the choice questions and trade-offs between water and sewage fees and water quality are a correct way to express values respondents hold regarding water quality. A similar proportion of the sample as above agrees or strongly agrees to these statements.

From these two questions we conclude that respondents see no difference in the content validity of contingent valuation versus choice experiments as methods for valuing water quality. It is notable that half the sample disagree that these valuation methods capture the values they hold regarding water quality. In defence of the methods we can argue that the water quality ladder was only meant to capture use values, and so respondents with non-use values (altruistic or existence values) could disagree with these statements (while accepting they are valid for use values only).

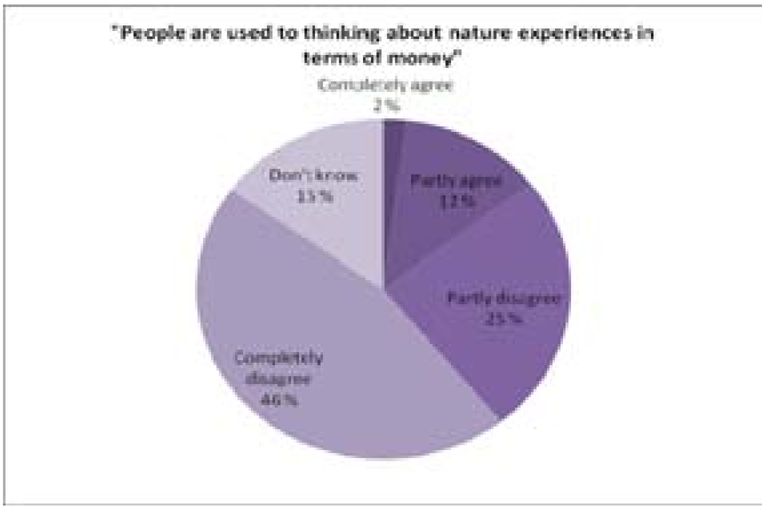


Figure 27. Respondent opinion regarding monetisation of nature experiences

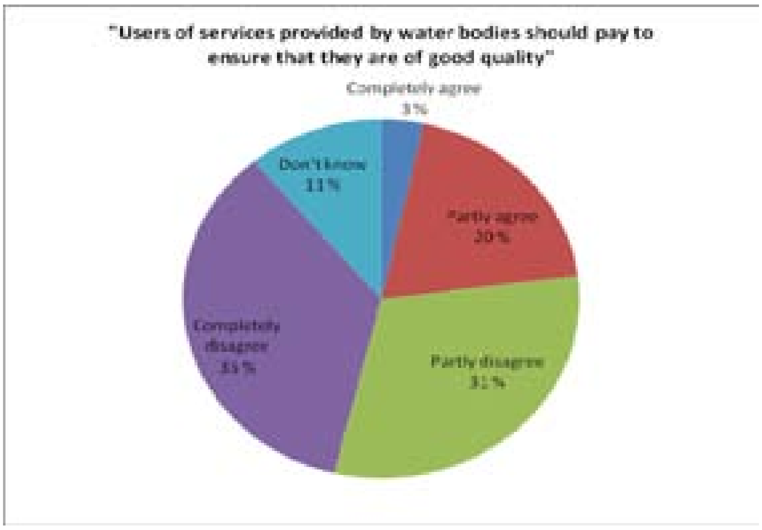


Figure 28. Respondent opinion regarding the "user pays principle"

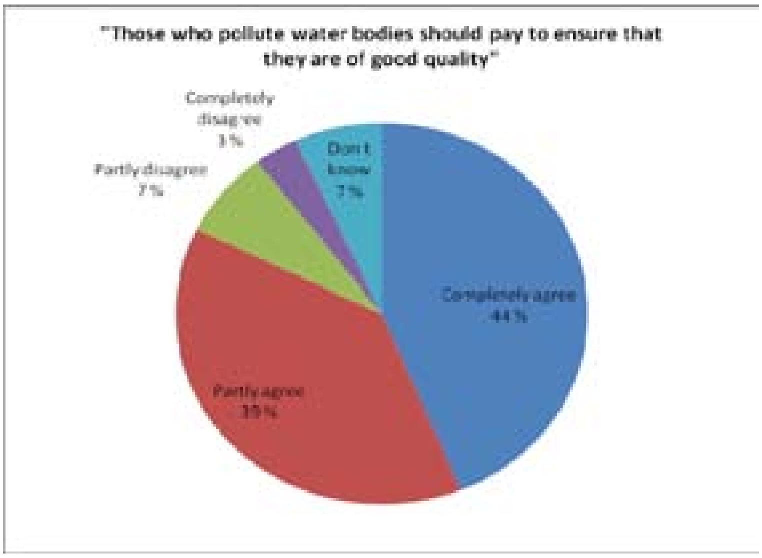


Figure 29. Respondent opinion regarding the "polluter pays principle

In **Figure 26** we ask a wider question of whether willingness to pay responses should be used by authorities as a basis for making decisions about water quality measures. A majority of respondents disagree with this statement. We would need to conduct follow-up interviews to discover whether this was synonymous with respondents not wishing authorities to use valuation methods for decision-making at all, or whether valuation results could be used for specific policy analysis purposes if they are explained (e.g. disproportionate cost analysis under the Water Framework Directive (WFD).

Figure 27 gives some explanation for the opinion of why willingness to pay should not be the basis for decision-making on measures. A large majority state that they disagree that people are used to thinking about nature experiences in terms of money. In defence of valuation methods we might argue that this is also true for decision-makers, and that economists by placing a monetary value for environmental quality make it more likely that environment is accounted for in decision-making. This argument assumes that water quality is not considered in any other decision-making process (let along cost-benefit analysis of measures).

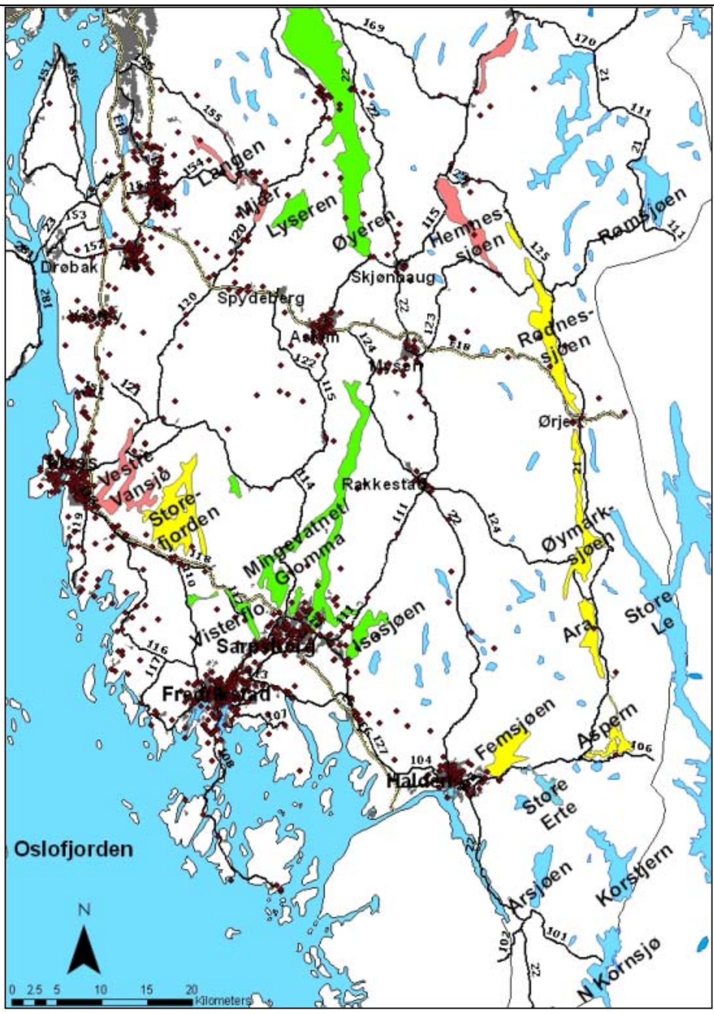
In **Figure 28** and **Figure 29** we ask respondents their opinion on whether the "user pays" or "polluter pays" principle should be applied regarding financing of good water quality. About a quarter of respondents agree that the "user pays" principle should apply, while 83% completely agree that the "polluter pays" principle should apply (some respondents partly agree to both propositions). This is a further explanation for why a majority of respondents disagree with the statement that WTP is a correct basis for decisions regarding water quality measures. The disagreement is fundamentally related to their interpretation of the distribution of rights to water quality.

In section 4.2 we also discuss a number of respondent perceptions about water quality, which also address validity issues.

4. Valuation results

4.1 Respondent characteristics and sample representativeness

Further details of response rates by different demographic characteristics are given in Appendix 1.



Municipality	Freq.	Percent
0101 Halden	73	6.45
0104 Moss	76	6.71
0105 Sarpsborg	130	11.48
0106 Fredrikstad	197	17.4
0111 Hvaler	6	0.53
0118 Aremark	3	0.27
0119 Marker	10	0.88
0122 Trøgstad	13	1.15
0124 Askim	45	3.98
0125 Eidsberg	28	2.47
0127 Skiptvet	7	0.62
0128 Rakkestad	17	1.5
0135 Råde	20	1.77
0136 Rygge	48	4.24
0137 Våler	9	0.8
0138 Hobøl	21	1.86
0211 Vestby	54	4.77
0213 Ski	126	11.13
0214 Ås	60	5.3
0221 Aurskog-Høland	42	3.71
0226 Sørum	33	2.92
0227 Fet	36	3.18
0228 Rælingen	51	4.51
0229 Enebak	27	2.39
Missing	1	
Total	1,132	100

Figure 30. Geographical distribution of households surveyed (black dots).

Figure 30 shows the distribution of households surveyed. The web-based panel we used clearly shows that responses reflect population distribution, with most respondents found in urban areas. The "lumpy" distribution of surveyed households also gives an indication of why it is difficult to observe a "smooth" or continuous reduction of WTP as distance increases from the improved lakes

4.1.1 Demographic characteristics

A comparison of the sample distribution by age with data for the population from Statistics Norway show that respondents under 30 and over 60 years of age are under-represented in the sample by 7 and 5% respectively. Persons between 30 and 49 years old are over-represented by 12 %. A comparison on education shows that people with primary or high school education only are udner-represented by 30% while people with higher technical or academic education are over-represented by the same percentage.

The observed biases in the sample regarding age and education can be corrected by weighting. If the data are weighted according to sex, age and education the sample is representative of the internet-population in the study area (about 90% of the population),

4.1.2 Socio-economic characteristics

Political Party	What would you vote if a municipal election were held today? (Sample) 2008	Municipal election results (Østfold) 2007
	%	%
Det norske Arbeiderparti	22.07	36.5
Fremskrittspartiet	18.09	22.9
Høyre	15.89	13.9
Kristelig Folkeparti	3.27	6.6
Rød Valgallianse	1.32	1
Senterpartiet	3.71	6.5
Sosialistisk Venstreparti	7.94	4.4
Venstre	3.97	4.2
Kystpartiet	0.09	
Other parties / lists	0.88	3.9
Would not vote	2.56	
Don't know	13.42	
Not disclose party preference	6.71	
Not elligible to vote	0.09	
Total	100	99.9

Table 9. Stated and actual municipal voting patterns

63,8% of the sample was salaried full time employed, 10,15% part-time employed, while 9,2% of sample were on some type of welfare benefits and 6,27% of sample were pensioners. In 2007 statistics show 65% of the population employed in Østfold County (SSB).

Mean respondent personal income before tax was NOK 365 321 (st.dev.168 145) and household income before tax was NOK 640 971 (st.dev. 277 271). Official statistics show mean personal income before tax of NOK 292 600 (SSB) in Østfold.

While the sample is representative of the employment situation of the population in Østfold County it over-represents high income households. 29% of the sample was a member of an environmental or outdoor recreation related organisation (scouts, fishing, hunting and environ-mental associations).

The political party preferences at municipal level were roughly representative of the last elections (**Table 9**), although the year between 2007 municipal elections and the survey saw some notable shifts in political preferences at national level.

4.1.3 Water use characteristics

The average respondent made 49 trips to water bodies in year of 2007-2008. The seaside was visited about once a week,, lakes once every second week , and rivers once every three weeks during June-August (**Table 10**). About half the sample used water bodies as much in the summer of 2008 as the year before, while 31% used them less versus 16% using them more. This is higly weather dependent (rainfall in June-August 2008 was 10% higher than the summer before, but July was also warmer with more intensive algal blooms). At any rate, this indicates that aggregate use values may not be stable over time.

Variable	Mean	Std. Dev.
Annual # visits to water bodies in Østfold 2007-2008	48.8	80.3
River visits per month (summer)	1.5	4.0
River visits per month (rest year)	1.0	3.5
Lake visits per month (summer)	2.0	4.2
Lake visits per month (rest year)	1.0	3.3
Seaside visits per month (summer)	4.2	6.5
Seaside visits per month (rest year)	1.5	4.2

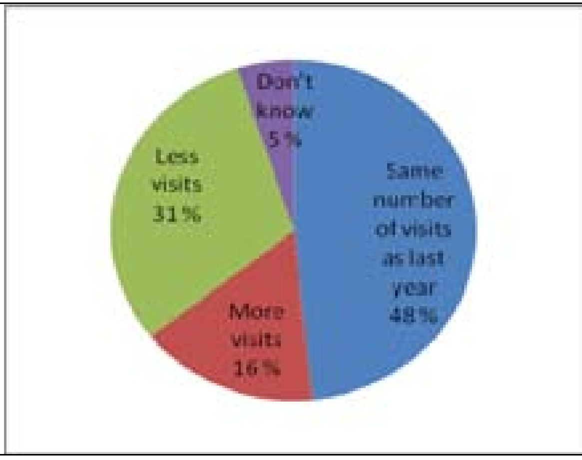


Table 10. Visitation frequency to water bodies in Østfold/Akershus summer 2007- summer 2008 and change between summers.

About 20% of the population goes (mostly coarse) fishing and motorised boating on about half of the trips to water bodies in the study area. Almost 60% of the population goes swimming on half of their trips to water bodies. About 75% of the population practices some form of waterside activity on land on more than half their trips (walking, biking, jogging) (Figure 31).

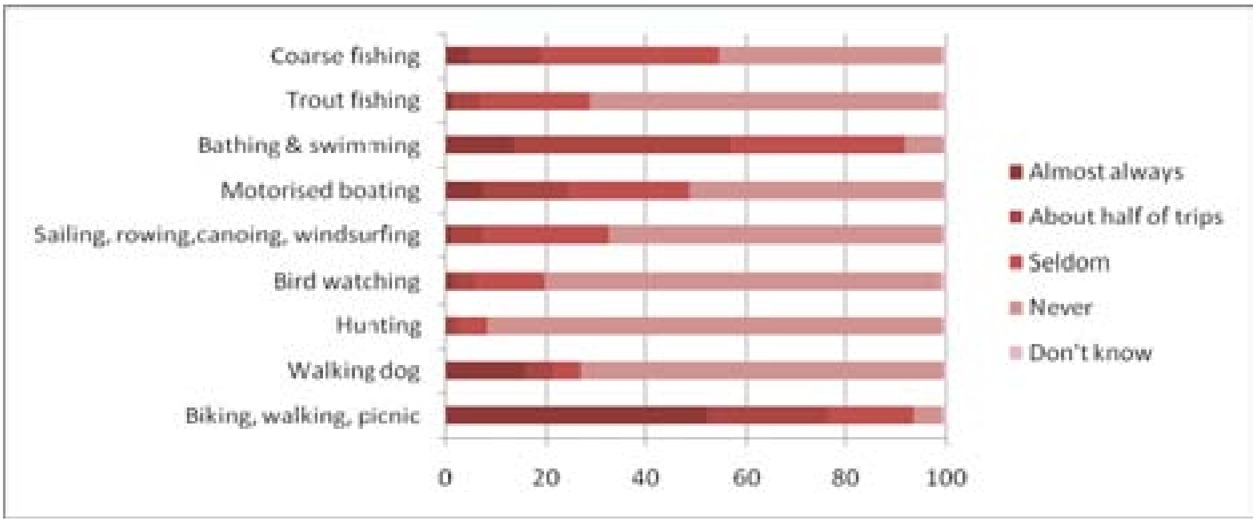


Figure 31. Recreational activities at water bodies in Østfold/Akershus

4.2 Public perception of water management problems

Water quality descriptions for lakes in Østfold/Akershus corresponded largely to respondent's expectations with about 20% finding the descriptions either better or worse than expected (**Figure 32**). There was a close correspondance between respondents' closest and favourite lakes.

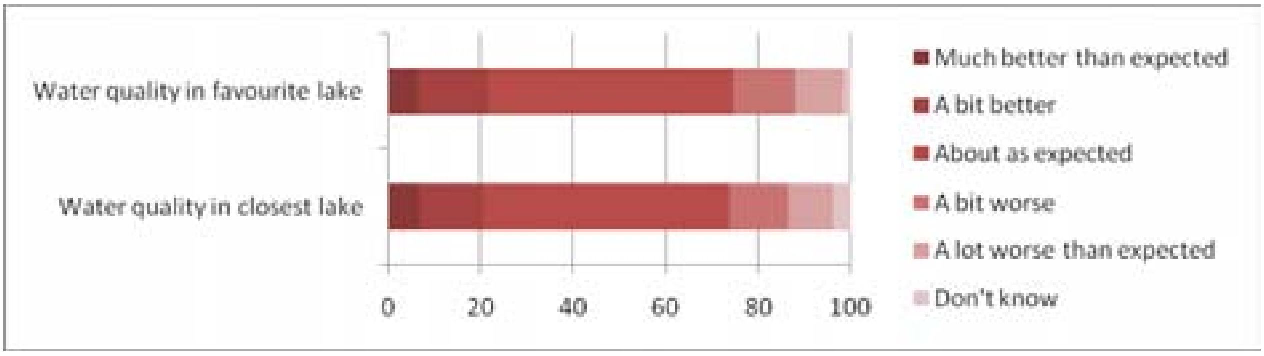


Figure 32. Current lake water quality presented in status quo scenario compared to prior perception

Respondent understanding of the water quality ladder was tested by asking them to rank the water quality illustrations from best to worst (see **Figure 12**). The results are shown in **Figure 33**. Between 65-70% of the sample correctly ranked the water quality descriptions from best to worst ("correct" section of the columns in the figure). About 20% confused the best and second best levels, about 25% confused the worst and second worst levels, and finally about 10% confused the best or next best with the worst or next worst and vice versa.

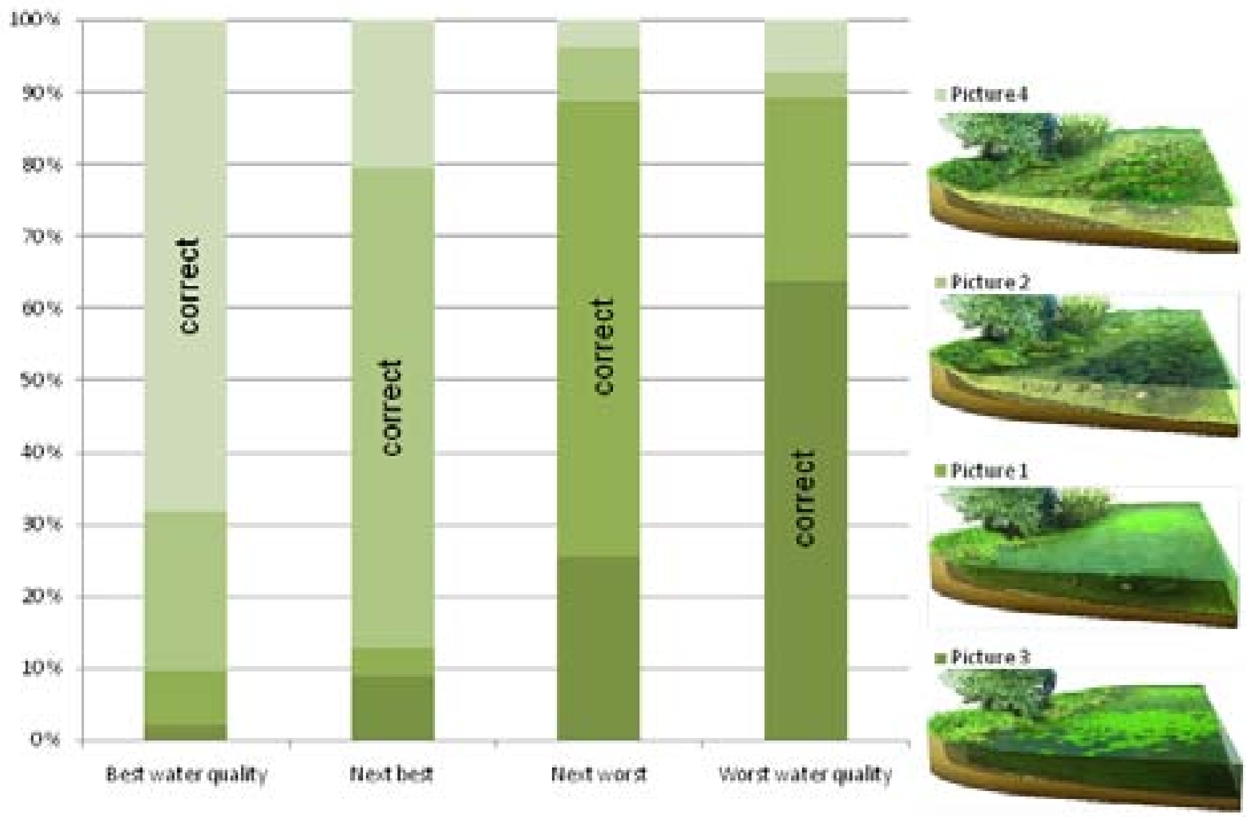


Figure 33. Respondent ranking of water quality levels (the picture shows the order in which they were numbered to respondents – the numbering gave no clues as to quality).

The results in **Figure 33** suggest one reason as to why some respondents' WTP may fail to show sensitivity to the scope of changes – we might expect such a result for about 10% of the sample regarding changes of 2 water quality levels, and for up to about 25% of the sample for changes in 1 water quality level. **Figure 34** shows the results of the respondent's answers to the question "which of the following activities would you not practice at this lake? Please click on the uses you would NOT practice if the water quality was as shown on the picture" (the question was asked for each picture separately, see Figure 13). The water quality ladder definition of suitable uses at each water quality level was only shown to respondents after this question. The responses show that the pictures were broadly interpreted as intended, with highest use suitability across all uses in the "blue" level, and lowest suitability in the "red" level. Also, uses which were most in contact with water (bathing) were deemed least suitable at each level, while uses with the least contact with water (bird watching) were most suitable at any given water quality level. Again, the results show the large change in suitability between "green" and "yellow" quality levels. Notably, at the worst "red" quality level, 40% of the sample would still practice coarse fishing, and 60% boating, in stark contrast to suitability suggested by the water quality ladder.   The water quality ladder also captures some unintended difference between "blue" and "green" quality level regarding swimming, possibly due to increased aquatic vegetation in the picture.

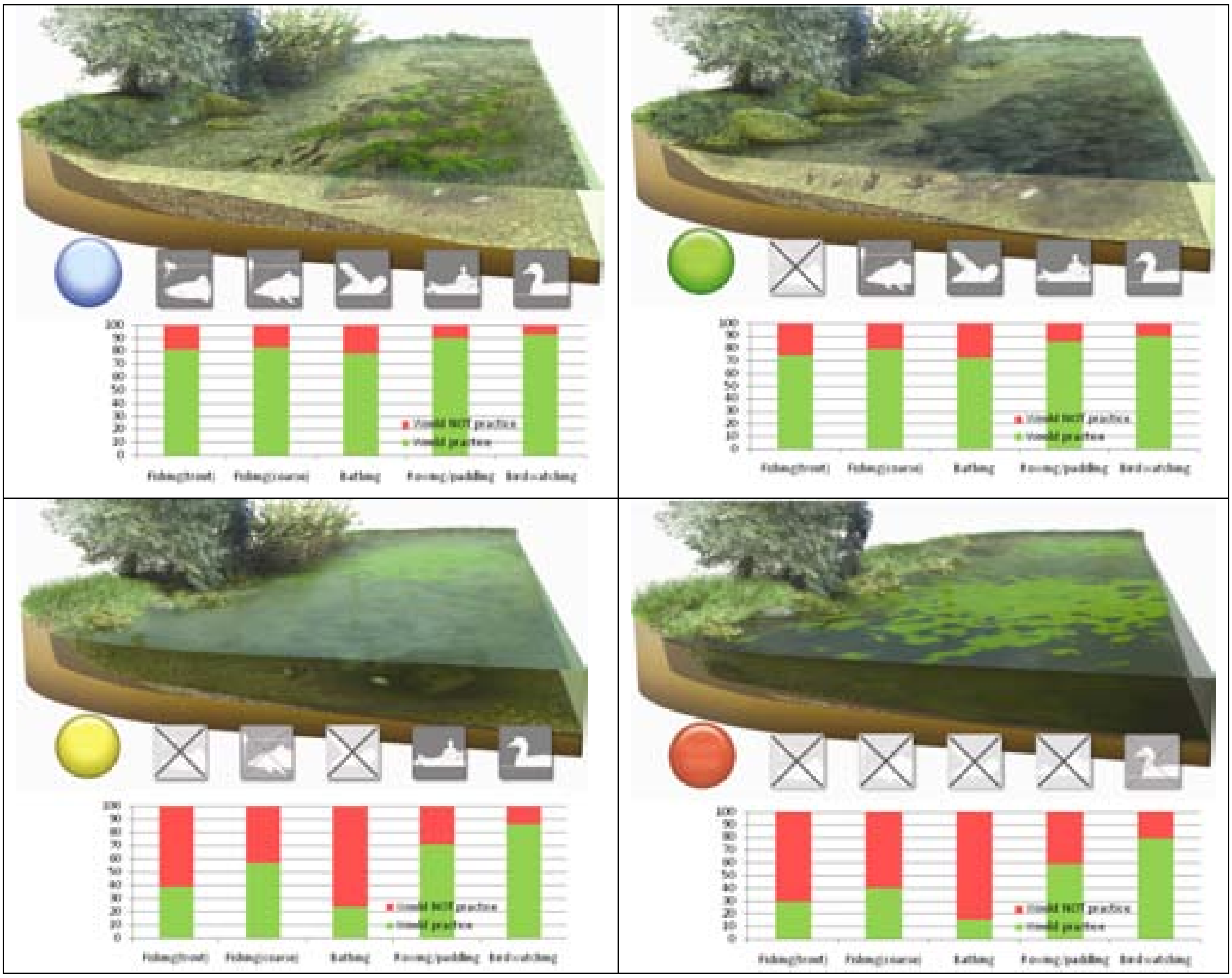


Figure 34. Comparison of respondent perception of suitability of water uses with water quality ladder definition. (based on a sample of N=1113 respondents)

In summary, **Figure 34** gives a further two reasons for less significant differences in WTP for different water quality levels (scope effect):

1) small differences in user suitability between “red” and “yellow”, and “green” and “blue” water quality levels
2) higher acceptability of eutrophication for certain uses such as fishing and rowing/paddling than what was suggested by the water quality ladder.

4.3 Estimated economic values for water resource management

In this section we look at the estimates of willingness to pay derived from the contingent valuation and implicit prices for water quality derived from the choice experiment.

4.3.1 Willingness to pay based on contingent valuation

One of the main research aims of the AQUAMONEY case studies was to test for so-called “distance decay” in willingness to pay. This is based on the assumption that if willingness to pay is related to use values, and increasing distance to lakes is associated with increasing user costs, then WTP should fall with increasing distance to lakes being improved. In **Figure 35** we see the individual household WTP responses (upper panels), and a comparison of mean and 95% confidence interval of WTP for an improvement in two lakes (lower panels). WTP on the vertical axis is compared to the distance to the second lake improved along the horizontal axis.

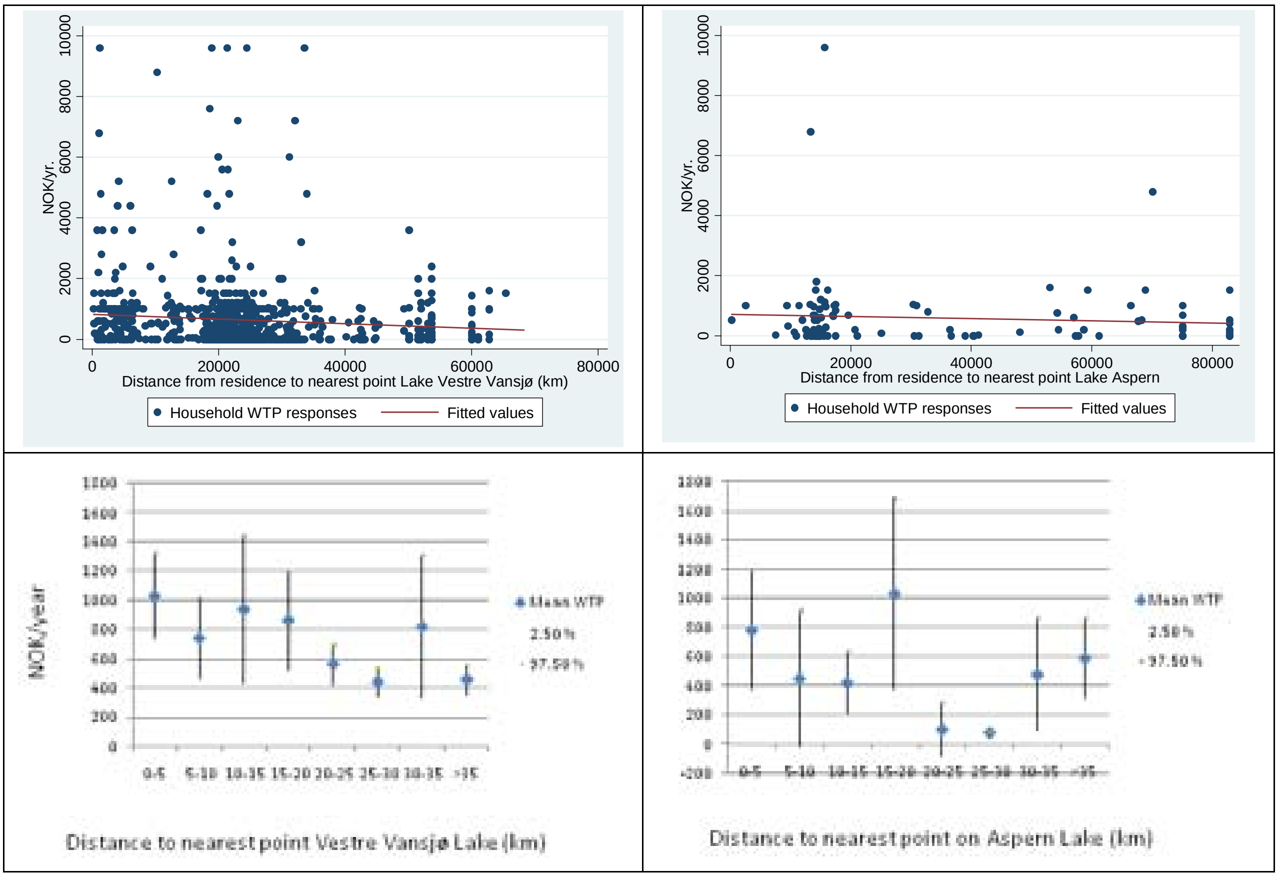


Figure 35. WTP/year per household for two lake improvement scenario for Vansjø & Storefjorden Lakes (left upper-lower panel)(red/yellow to green/blue improvement) and Femsjøen & Aspern Lakes(right upper-lower panel) (yellow to blue improvement).

We see that WTP for households regarding Vestre Vansjø-Storefjorden (left panel) shows weak, but significant distance decay. In the case of Femsjøen-Aspern, there does not seem to be significant distance decay. Variance is also larger, due in part to the small sample size who regarded improvements in these lakes. Recall that the sample responding to the questions was much larger in the case of Vestre Vansjo-Storefjorden *(N=999)* than for Femsjøen-Aspern (*N=134*) due to the unequal geographical distribution of the internet panel.

Taken together the mean WTP of the Morsa-Glomma sub-sample for improvement of the Vestre Vansjø and Storefjorden Lakes was 660 NOK/year per household (95% confidence interval of 578-742 NOK/year). For the Glomma-Halden sub-sample mean WTP was 649 NOK/year per household (confidence interval 388- 909 NOK/year) for the Femsjøen and Aspern lakes. These figures have to be seen in light of the area in which households were interviewed for each set of lakes (keep in mind that the Halden-Glomma sub-sample included only households from the Halden catchment). Previous studies (Magnussen et al. 1995) reported mean WTP (in 2007 NOK) of municipalities bordering the Vestre Vansjø and Storefjorden Lakes (Moss, Våler, Råde, Rygge) of around 2400 NOK/year per household. In our study the mean for households in these municipalities is 1070 NOK/year per household (confidence interval 803-1337 NOK/year; N=132 respondents).

4.3.2 Implicit price for water quality based on choice experiments

Because willingness to pay is estimated based on observed choices, rather than directly stated by respondents as in contingent valuation, they are sometimes called the “implicit prices” of whatever environmental quality aspect is being evaluated. **Figure 36** shows average implicit prices generated from the choice experiment for the “Nedre Morsa” lakes Vestre Vansjø and Storefjorden. Implicit prices for improvements from “blue”, “green”, and “yellow” water quality levels respectively are shown in the **Figure 36**. The implicit prices derived from the choice experiment shown in this section are based on a conditional logit model with effects coding. See **Table A3.1** in appendix for the model).

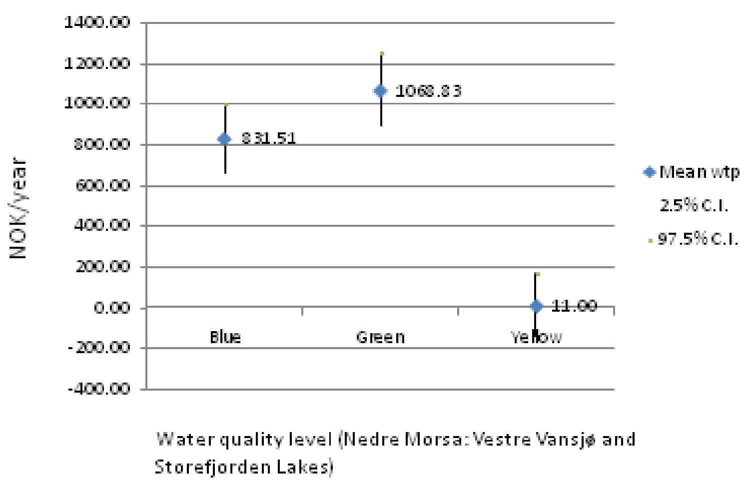


Figure 36. Confidence intervals for mean implicit prices from choice experiment for Vestre Vansjø and Storefjorden Lakes (Nedre Morsa).

IT IS IMPORTANT TO NOTE THAT IMPLICIT PRICES FROM CHOICE EXPERIMENTS CANNOT BE COMPARED DIRECTLY TO WILLINGNESS TO PAY ESTIMATES FROM CONTINGENT VALUATION.

It is the differences between implicit prices for different water quality levels (changes) that represent welfare changes (as measured by WTP). The implicit prices can be taken as indicators of relative utility of the different quality levels, measured in money terms. WTP estimates based on implicit prices from the choice experiment are discussed in section 4.5.

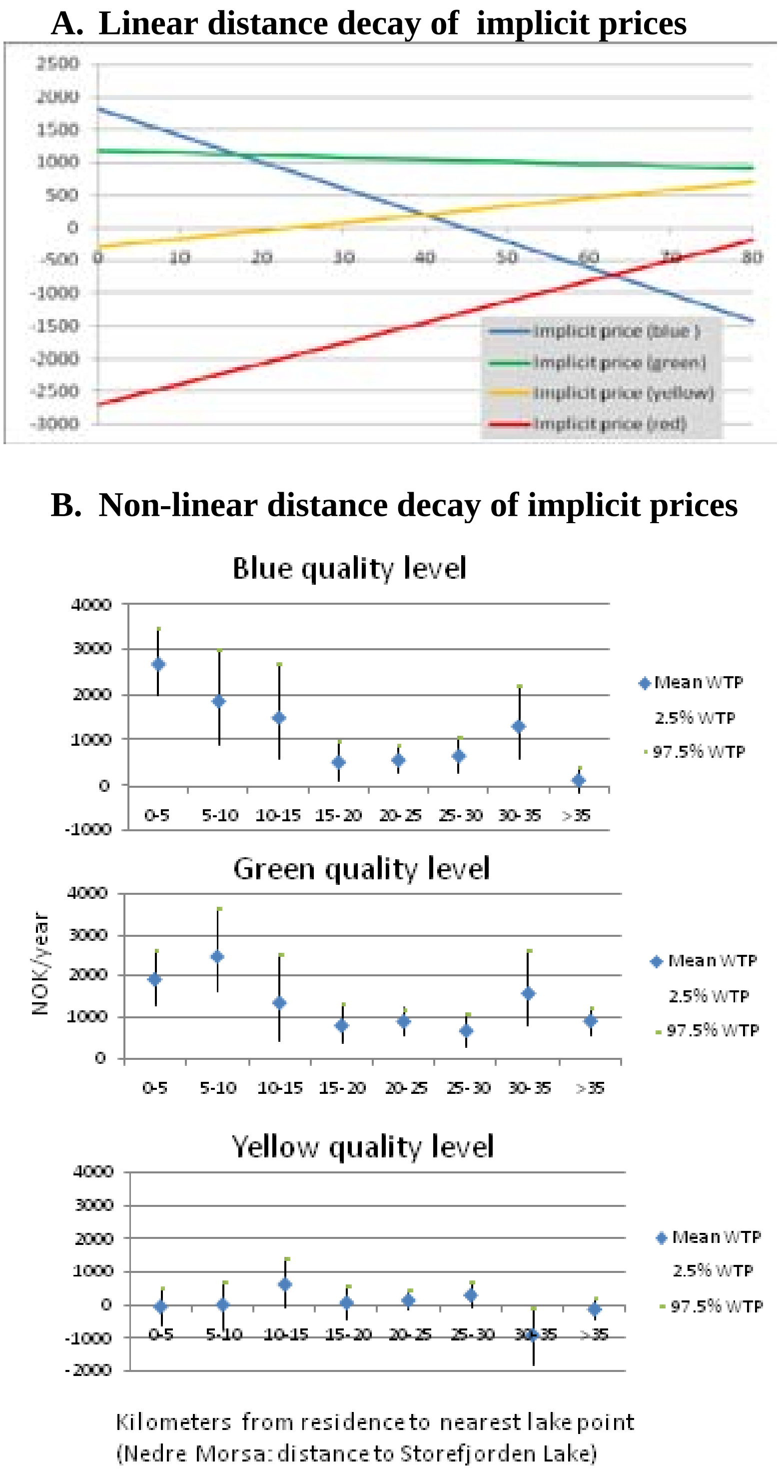


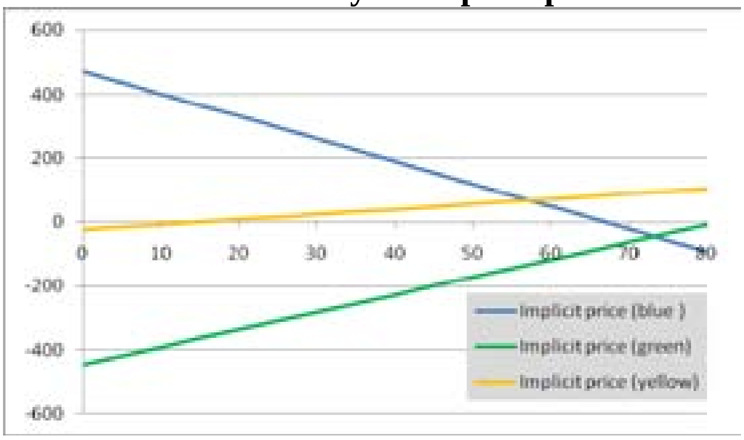
Figure 37. Confidence intervals for mean implicit prices from choice experiment for Vestre Vansjø and Storefjorden Lakes (Nedre Morsa). (estimated using A: a single conditional logit model for the whole study area; B: a conditional logit specific to each distance interval)

Lower Morsa catchment

Figure 36 shows implicit prices for 'blue' quality level is actually significantly lower than for an improvement from red-green. This is unexpected, but possible since **Figure 33** and **Figure 34** showed that respondents have difficulty differentiating blue and green quality levels with respect to water uses. One explanation for such a result would be if respondents prefer water quality levels that are "good enough", because they implicitly are factoring in the likelihood of the scenarios actually happening. Given Vestre Vansjø's recent history of algal blooms despite the authorities' measures, this is a plausible though untested hypothesis. Finally, implicit prices for yellow level area not significantly different from zero.

Figure 37 is based on the same data, but evaluated for distance decay of implicit prices. The upper panel A shows implicit prices calculated based on a single model (shown in **Table 13** below) which generates linear distance decay of implicit prices, while the lower panel B shows implicit prices calculated with individual models
for 5 km distance concentric rings from the Storefjorden Lake.

A. Linear distance decay of implicit prices



B. Non-linear distance decay of implicit prices

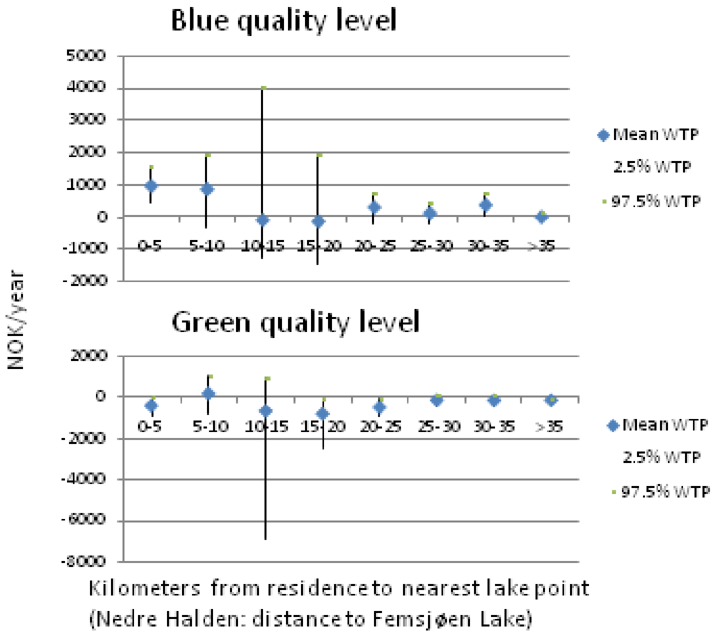


Figure 38. Confidence intervals for mean implicit prices Nedre Halden

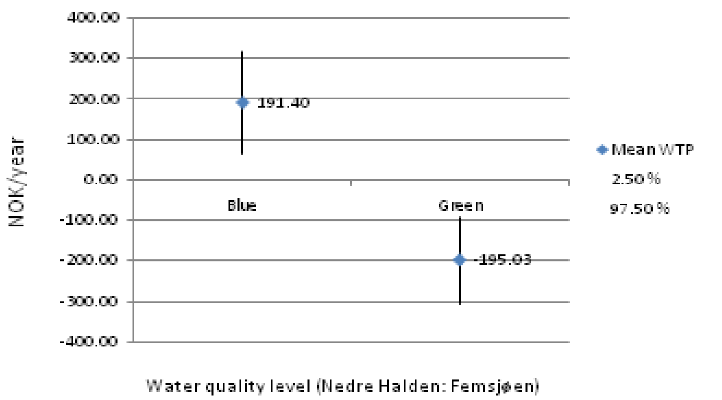


Figure 39. Confidence intervals for mean implicit prices from (Nedre Halden/Femsjøen)

Both approaches show the clearest distance decay for the blue quality improvement, but less clear for green quality level. Implicit prices for yellow level are not significantly different from zero. Implicit price for red level is calculated so that total utility is centered at zero (this is a feature of the effects coded choice model we used). This is an illustration why implicit prices give information about relative values of quality levels, but not their absolute values. We also see that the respondents living closest to the lakes (0-5 km) rank blue quality as more desirable than green quality, whereas respondents further from Storefjorden-Vestre Vansjø lakes prefer 'green' quality level to 'blue'.
The comparison of the two approaches shows that linear distance decay is an oversimplification of the data. For "blue" level implicit prices we see a significant increase in WTP for respondents living 30-35 kilometers from Storefjorden (and Vestre Vansjø). This corresponds to respondents in small towns in the upper catchment. The population living closer (15-30 km), live largely in Sarpsborg-Fredrikstad, which are towns outside the catchment and show significantly lower WTP. This would seem to indicate that WTP does not decay at an equal rate in all directions, but is catchment specific. These non-linearities makes the potential for error greater when aggregation WTP across households at any given distance from the lakes.

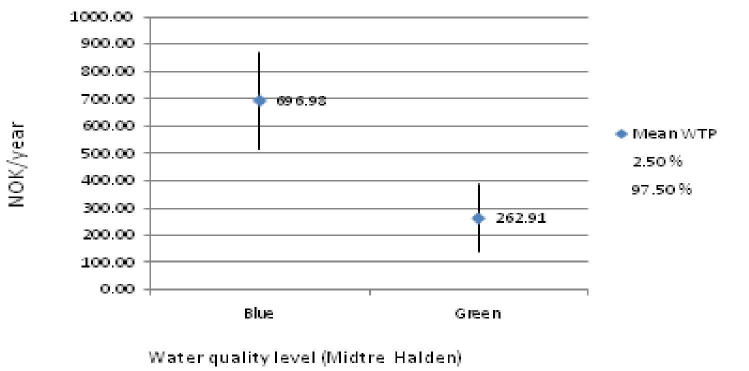
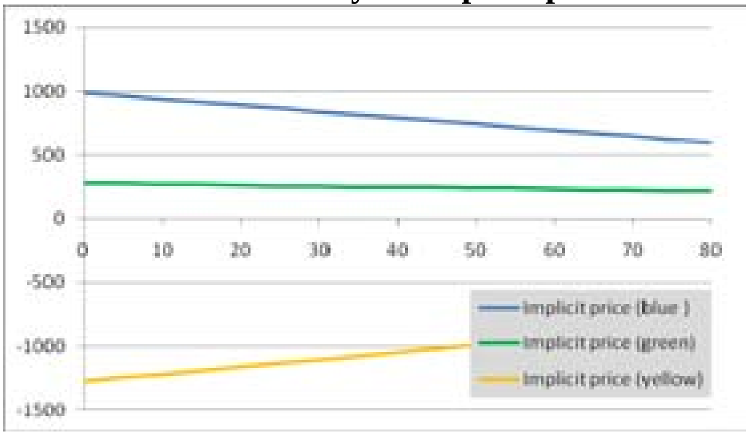


Figure 40. Confidence intervals for mean implicit prices from choice experiment for Midtre Halden

A. Linear distance decay of implicit prices



B. Non-linear distance decay of implicit prices

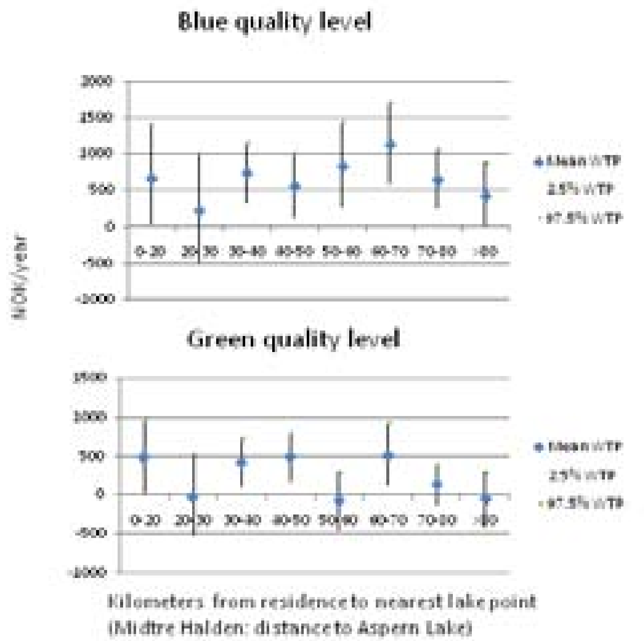


Figure 41. Confidence intervals for mean implicit prices from choice experiment for Aspern by distance

Figure 40 shows results for Nedre Halden /Femsjøen Lake in the choice experiment. Because its current status is yellow, the choice experiment was limited to considering improvements to green and blue quality levels. In Femsjøen, only blue level quality shows positive implicit prices and significant distance decay. Green level quality has a negative implicit price in the Glomma-Halden subsample. This provides a striking difference to the preferences regarding Storefjorden and Vestre Vansjø shown above.

One explanation is that the baseline status quo water quality is better in Femsjøen, but the result is notheless surprising as it clearly shows respondents distinguishing blue and green quality levels. A hypothesis would be that game fishing is much more important in the Halden catchment than in the Vansjø-Storefjorden catchment.

Figure 40 compares the linear and non-linear implicit price estimations for improvements in Femsjøen. In the linear model implicit price for the yellow level is calculated (as above) as a residual to balance total utility at zero. Respondents preferred the status quo "yellow" level to the "green" level.
The non-linear approach shows significant distance decay between residents living within 5 km of Femsjøen and residents living more than 20 km away. For intermediate distances the sample was too small to explain any trends (note the large variation in estimated mean implicit prices for 10-20 km).

Figure 41 displays implicit prices for lakes in Midtre Halden catchment, including Lake Aspern which was shown in the contingent valuation earlier. Here, both blue and green level implicit prices are positive and in the expected order. The distinction with Femsjøen (lower catchment) may be that Aspern is more popular for other water uses than game fishing, including swimming, paddling/boating and coarse fishing. Implicit prices are also significantly higher than for Femsjøen.

Figure 41 shows implicit prices for Midtre Halden catchment disaggregated by distance. There is a weak distance decay effect picked up in the linear model. The non-linear representation of implicit prices confirmes the lack of distance decay. Lacking distance decay may be explained by the predominance of non-use values.

4.4 Factors explaining economic values for water resource management

Hypotheses regarding explanations for variation in WTP (contingent valuation) and choices between lakes (choice experiments) are evaluated in this section.

4.4.1 Contingent valuation

Table 11 shows the results of a multi-variate tobit regression use to explain which survey and household characteristics explained WTP in the contingent valuation question. A tobit model is used to handle the correlation in WTP responses between the first and second lake improvement scenarios. Three models are shown; one for the small Glomma-Halden subsample (52 household responses had complete data); one for the larger Morsa-Glomma subsample (408 responses) and a second model for the Morsa-Glomma subsample with a reduced set of explanatory variables (766 responses). Variables shaded green are significant at the 10% level in at least one of the models – green shaded parameters indicate which models. The following describes the significant results only:

WTP scope and ordering tests. When a one lake improvement is shown first, WTP is on average 141-153 NOK *lower* in all three models than when a two lake improvement is shown first (the point of comparison). This is a so-called ‘within sample scope test’ showing that respondents care about the size of the improvement shown them first, but only when it is two lakes and then one lake improved. The other two related dummy variables are not significant indicating that; respondents do not have significantly higher willingness to pay when a one lake improvement is shown first, followed by a two lake improvement. Also there is not significant difference in willingness to pay whether a one-lake or two-lake improvement is shown first. To summarise, this shows that it is the relative change in scenarios that makes a difference to respondents, rather than the absolute difference, and that only a change implying a loss relative to the first scenario has a significant effect (loss aversion). In economists language, the data passed the “internal scope test”, failed the “external scope test”, and shows “information ordering effects/bias”. In other words, the contingent valuation data is sensitive to the framing of the water quality improvement scenario

Table 11. Multivariate factors explaining WTP (contingent valuation question; Tobit model)

		1.Glomma-Halden subsample		2. Morsa-Glomma subsample		3. 1 Morsa-Glomma subsample	
Variable	**Unit**	**Coef.**	**P>z**	**Coef.**	**P>z**	**Coef.**	**P>z**
One lake improvement 2nd	dmy	-387.9676	0.014	-147.099	0	-141.801	0.000
One lake improvement 1st	dmy	166.9083	0.604	-66.545	0.621	-7.87293	0.952
Two lake improvement 2nd	dmy	185.3272	0.564	9.306821	0.945	52.42772	0.686
Household in lake catchment	dmy			212.2834	0.121	199.406	0.132
Distance to 1st lake improved	meters	0.0126049	0.150	-0.0134	0.159	-0.01332	0.062
Lake improved is favourite	dmy	168.0752	0.621	528.4491	0.005	566.6337	0.002
Household income before tax	NOK/year	0.0018219	0.006	0.000472	0.042		
Gender	0= male	-291.3911	0.370	143.2876	0.291		
Age	years	19.56634	0.097	-1.50074	0.782		
Urban	dmy	417.0989	0.236	130.9893	0.451		
River visits (June-Aug.)	#	44.10333	0.000	7.208932	0.215		
Lake visits (June-Aug.)	#	-12.18986	0.213	1.144888	0.834		
Sea visits (June-Aug.)	#	-3.865456	0.658	3.381865	0.321		
Bather	dmy	363.1341	0.243	170.4591	0.209		
Boater	dmy	714.2408	0.104	-40.3599	0.874		
Fisher	dmy	191.3852	0.769	175.0705	0.559		
Member env. /recreat. NGO	dmy	146.8985	0.665	364.589	0.010		
Municipal vote (Ap)	dmy	-112.6789	0.733	152.109	0.375		
Municipal vote (Frp)	dmy	285.1736	0.490	-549.759	0.003		
Municipal vote (H)	dmy	-362.119	0.470	-179.925	0.346		
Municipal vote (SV)	dmy	369.8862	0.660	381.3877	0.254		
Constant		-2505.596	0.006	-176.673	0.688	342.2176	0.102
/sigma_u		959.1799	0	1511.517	0	1556.111	0.000
/sigma_e		557.9231	0	437.13	0	435.6804	0.000
Rho (st.error)		0.7471964	0.014	0.922819	0.0102	0.927309	0.00615
# respondent observations		N groups=79		N groups=696		N groups=766	
Wald Chi2 (Prob > chi2)		80.08	(0.000)	87.16	(0.000)	48.08	(0.000)
Log-L		-894.58018		-8206.74			-8893.5006
	[green]	= significant at 10%					

Distance decay and spatial effects. In the Morsa-Glomma subsample there is a significant drop in WTP as distance from the first lake improved increases (on average across the whole Morsa-Glomma study area). On average every kilometer increase in distance of the household from the closest shore-line of Vestre-Vansjø-Storefjorden changes WTP by an average -13.3 kroner (multiplying the para-meter value in model #3 the by 1000 meters). However, this distance decay of WTP may be non-linear – households also identify more with lakes in their own catchment, making WTP values 'jump' between the Morsa and Glomma catchments. The catchment specific dummy variable shows that households located in municipalities within the Morsa catchment that drains to Vestre Vansjø-Store-fjorden have a higher WTP by 199-212 NOK/year (although not quite significant at 10%). The difference between models is due to multiple correlation with other household characteristics. Although the estimate can be biased it shows that not accounting for whether the household is in the improved catchment or not, can lead to an error in WTP estimation that is comparable to mis-specifying household location by 15 kilometers or more (i.e.199 NOK / 13 NOK/km). This 'catchment effect' indicates that WTP also depends significantly on households identifying with their catchment, independently off use levels. Such an effect may be due to households relating to 'locational responsibility', in addition to use value. As we will see below, lake use frequency has an insignificant or negative effect on willingness to pay, indicating that 'locational responsibility' may be a dominant effect (consistent with the 'polluter pays principle'). Non-linear distance decay functions were tested (not reported), but not found to perform
Significantly better than a linear specification,

Another reason for distance decay in WTP being non-linear is related to recreational preferences – the closest lake is not necessarily the respondent's favourite. If the lake being improved is the respondent's self-declared favourite, WTP is on average 528-567 NOK/year higher than otherwise. Table 12 shows a simplified linear WTP-decay model with only a dummy coefficient for whether the household is the 'lake-improved catchment (Morsa) and distance decay parameter.

Comparing Model 3.2-3.3 (**Table 12**) with Model 3.1 (**Table 11**) we see that distance decay is highly correlated with whether a lake is the households favourite (the distance decay parameter increases to -22.36 NOK/km when the variable for favourite lake is excluded). This indicates that lakes close to household are often favourites.

Table 12. Linear WTP-distance decay model with catchment specific dummy variable. Note: a variable for distance to substitute was not significant and is not included.

	Model 3.2 Catchment dummy variable			Model 3.3 No catchment dummy variable		
	Coef.	St. error	P>z	Coef.	St. error	P>z
Household in lake catchment municipality	288.2865	130.31	0.027			
Distance to 1st lake improved	-0.02236	0.006514	0.001	-0.02501	0.006429	0.000
Constant	587.1012	182.6086	0.001	782.0025	159.7396	0.000
	Wald chi2(2) = 20.23 Log likelihood = -8907.3945			Wald chi2(1) = 15.14 Log likelihood = -8909.9196		

Without considering whether a lake is favourite WTP decays by NOK 22.36 per kilometre from the improved lake. This suggests that a pilot study asking just this question could significantly improve the accuracy of transfers of estimates between study locations (also called benefits transfer).

Household socio-demographic characteristics. Of household income, gender and age of respondent and whether the household is in an urban area or not, age is significant in the Glomma-Halden subsample. Household income is significant in both the Glomma-Halden and Morsa-Glomma subsamples (WTP increases by 1.82 and 0.47 NOK, respectively for every 1000 NOK increase in annual gross household income).

Household recreational characteristics. Respondents with more frequent summertime river visitation rates have higher WTP in Halden-Glomma subsample. The rate of visitation to lakes and the sea is not significant. This kind of response would be consistent with respondents who had substituted river recreation for lake recreation due to lake water quality problems (there are other explanations). The sea does not seem to be a substitute to lake recreation. Respondents in the Glomma-Halden subsample who practice boating (rowing/paddling) have a significantly higher willingness to pay (714 NOK/year on average).

Household organisation affiliation and political preferences. Membership in an environmental or recreation association (hunting, fishing) is significant in Morsa-Glomma subsample (members WTP is 364 NOK/year higher than non-members). In the Morsa-Glomma subsample, households who would vote the Progress Party (Fremskrittspartiet) have an average WTP which is 550 NOK/year lower than households that vote for other municipal parties. The Progress Party was the second largest party in Østfold county in the previous municipal elections.

4.4.2 Choice experiment

In this section we look at the coefficients of the conditional logit used to model households choices between improving different lakes.

Table 13 shows a model including only the lake quality attributes and their interactions with a variable for distance between lake and household.

Table 14 shows a different model including interactions between different household characteristics and a dummy variable indicating if the respondent chose the status quo or "do nothing" scenario.

Table 13 shows that most of the water quality levels for the different lake groups in Østfold are either significantly negative or positive. It also shows that the interactions of these water quality attributes with distance to the respective lakes are also mostly significant, and that their sign indicates significant distance decay of the utility of the water quality levels. Only about half of the distance interaction effects are significantly different from zero. Notably these are found in the lower parts of the Morsa and Halden catchments, and in both upper and lower Glomma catchment.

Table 13. Choice experiment attributes (conditional logit model)

Attributes of choice alternatives:	Coef.	Robust Std. Err.	z	P>z
W&S fee increase	-0.00032	1.07E-05	-29.82	0.000
Blue Nedre Morsa	0.584268	0.055485	10.53	0.000
Green Nedre Morsa	0.376522	0.047033	8.01	0.000
Yellow Nedre Morsa	-0.09536	0.045616	-2.09	0.037
Blue Øvre Morsa	0.143098	0.051717	2.77	0.006
Green Øvre Morsa	0.029389	0.046147	0.64	0.524
Yellow Øvre Morsa	-0.25543	0.050678	-5.04	0.000
Blue Nedre Glomma	0.113538	0.031753	3.58	0.000
Blue Øvre Glomma	0.256704	0.032216	7.97	0.000
Blue Nedre Halden	0.151	0.047655	3.17	0.002
Green Nedre Halden	-0.14306	0.041571	-3.44	0.001
Blue Midtre Halden	0.31763	0.070907	4.48	0.000
Green Midtre Halden	0.090287	0.053859	1.68	0.094
Blue Øvre Halden	0.188966	0.081518	2.32	0.020
Green Øvre Halden	0.041822	0.070936	0.59	0.555
Yellow Øvre Halden	-0.18944	0.071841	-2.64	0.008
Attribute distance interactions:				
Blue Nedre Morsa * distance Storefjorden	-1.3E-05	1.83E-06	-7.09	0.000
Green Nedre Morsa * distance Storefjorden	-1.07E-06	1.51E-06	-0.71	0.478
Yellow Nedre Morsa * distance Storefjorden	4.00E-06	1.51E-06	2.64	0.008
Blue Øvre Morsa * distance Langen	-1.87E-06	1.25E-06	-1.49	0.136
Green Øvre Morsa * distance Langen	-1.60E-06	1.10E-06	-1.46	0.145
Yellow Øvre Morsa * distance Langen	2.54E-06	1.21E-06	2.1	0.036
Blue Nedre Halden * distance Femsjøen	-2.26E-06	8.62E-07	-2.62	0.009
Green Nedre Halden * distance Femsjøen	1.75E-06	7.46E-07	2.34	0.019
Blue Midtre Halden * distance Aspern	-1.57E-06	1.16E-06	-1.36	0.175
Green Midtre Halden * distance Aspern	-2.21E-07	9.13E-07	-0.24	0.809
Blue Øvre Halden * distance Hemnessjøen	-1.78E-06	1.90E-06	-0.94	0.348
Green Øvre Halden * distance Hemnessjøen	-2.06E-06	1.65E-06	-1.25	0.211
Yellow Øvre Halden * distance Hemnessjøen	-8.36E-07	1.68E-06	-0.5	0.619
Blue Nedre Glomma * distance Glomma	-5.25E-06	8.61E-07	-6.1	0.000
Blue Øvre Glomma * distance Øyeren	-2.21E-06	1.23E-06	-1.79	0.073

Conditional (fixed-effects) logistic regression Number of obs = 40383
Wald chi2(31) = 2061.74 Prob > chi2 = 0
Log pseudolikelihood = -13420.471 Pseudo R2 = 0.0925

Table 14. Choice experiment attributes (conditional logit model)

Attributes of choice alternatives:	Coef.	Robust Std. Err.	z	P>z
W&S fee increase	-0.0002	1.65E-05	-12.22	0.000
Blue Nedre Morsa	0.822735	0.053529	15.37	0.000
Green Nedre Morsa	0.531154	0.045533	11.67	0.000
Yellow Nedre Morsa	0.153585	0.045405	3.38	0.001
Blue Øvre Morsa	0.071591	0.042728	1.68	0.094
Green Øvre Morsa	0.257941	0.034799	7.41	0.000
Yellow Øvre Morsa	-0.08412	0.047876	-1.76	0.079
Blue Nedre Glomma	0.261722	0.020146	12.99	0.000
Blue Øvre Glomma	0.185852	0.020967	8.86	0.000
Blue Nedre Halden	-0.13529	0.037265	-3.63	0.000
Green Nedre Halden	0.240912	0.028099	8.57	0.000
Blue Midtre Halden	0.318687	0.055672	5.72	0.000
Green Midtre Halden	0.039915	0.032707	1.22	0.222
Blue Øvre Halden	0.402994	0.053794	7.49	0.000
Green Øvre Halden	0.250501	0.056625	4.42	0.000
Yellow Øvre Halden	0.303265	0.054899	5.52	0.000
Interaction of status quo * household characteristics				
SQD * age	0.618504	0.033367	18.54	0.000
SQD * gender	6.535378	0.715268	9.14	0.000
SQD * household income	1.49E-05	1.96E-06	7.61	0.000
SQD * household in morsa catchment	1.64638	1.025805	1.6	0.109
SQD * boater	-4.18959	0.862825	-4.86	0.000
SQD * bather	2.942762	1.226852	2.4	0.016
SQD * fisher	7.198535	1.458922	4.93	0.000
SQD * river visits	0.633885	0.205606	3.08	0.002
SQD * lake visits	-0.06497	0.038575	-1.68	0.092
SQD * sea visits	-0.09722	0.014162	-6.86	0.000

Conditional (fixed-effects) logistic regression Number of obs = 36531
Wald chi2(26) = 9611.45
Prob > chi2 = 0.000
Log pseudolikelihood = -4136.4954 Pseudo R2 = 0.6908

Table 13 gives some indication of problems with using the choice experiment results for calculating distance decay of implicit WTP. The interaction term "Blue Nedre Morsa * distance Storefjorden" is negative and significant as expected, indicating that implicit WTP falls significantly with increasing distance. The interaction term "Green Nedre Morsa * distance Storefjorden" is not signficantly different from zero. The interaction term for "Yellow Nedre Morsa * distance Storefjorden" is positive and significant, indicating that WTP for a small lake improvement decreases with distance (because the attribute "Yellow Nedre Morsa" is negative and significant). This is a counter-intuitive result and possibly an artifact of the type of choice model (effects coded models centre total utility of an attribute at zero).

Table 14 shows the choice experiment attributes again, but this time including interactions between a dummy variable coded SQD=1 if the respondent chose the status quo or "do nothing" scenario, and different household characteristics. We see that accounting for household characteristics vastly improves the explanatory power of the choice model (compare Pseudo R2).
The choice model in **Table 13** and **Table 14** capture multiple spatial dimensions of WTP, and reasons for respondent choice of the "status quo. The interactions show that older people, women and wealthy households chose the status quo significantly more often, as did households who were frequent bathers and fishers. On the other hand, households practicing boating significantly chose the status quo less than others. Households that visit rivers frequently chose the status quo significantly more often, while households visiting lakes and the sea chose the status quo significantly less often.

The models reveal a luxury of detail regarding spatial patterns of WTP and how household preferences vary depending on who they are and where they live. The following section aggregates results from the contingent valuation and choice experiments for different policy scenarios and administrative units.

4.5 How biased are WTP estimates from a simpler choice experiment model?

Colombo et al. (2006) find that using a model that accounts for heterogeneity in respondents preferences may reduce errors when that model is used to predict WTP at other sites (called benefits transfer in the literature). Train (2003) discusses that the mixed logit – also called random parameters model – can approximate any random utility function and obviates three limitations of the standard (conditional) logit function we have used thus far in this report. Mixed logit allows for:

1) random taste variation across respondents - we already know that respondents value lakes differently (heterogeneously) according to how far they live from the lake. We would expect them to be different in other ways as well, and so a model that can account for this should be less biased. We look at this below.

2) unrestricted substitution patterns – looking at the map of Østfold and Akershus counties again we see that the large number of lakes could easily be substitute recreational sites for households located within similar distance to 2 or more lakes. A model that accounts for substitution should reduce errors of double counting – or exaggerating – the value of water quality improvements in the area. In some cases, households may visit and/or care about more than one lake located close to their household. If lakes are so-called complements, improving the water quality of one will improve the value of the other. A model that accounts for this complementarity would avoid undervaluing improvements across several related lakes. We look at this in the next section.

3) correlation of unobserved factors over time – this might be useful if we want to test whether respondents' successive choices between water quality improvement scenarios are correlated – for example because they are learning about or discovering what their own preferences are. This is a methodological issue in choice experiments which is not addressed in this report, but can be evaluated with the data we have collected.

Despite these advantages of a mixed logit model it is more difficult to estimate with the number of water quality attributes and their levels. We tried estimating a mixed logit model with distance effects interacting with quality levels (similar to the model in **Table 13**) [7]. The model takes several hours to run without producing a solution. We were only able to simulate a model without distance using the

[7] We used a mixlogit command programmed for STATA by A.R. Hole (2007)

mixed logit approach. Furthermore, the mixed logit model with correlations could not be estimated with water quality attributes that were non-linear (effects coded).

We concluded that we could only use a standard conditional logit model such as reported in **Table 13** to generate GIS maps of WTP (because we need a model that includes distance). We are therefore interested in evaluating how biased our WTP estimates may be if we use a conditional logit model to predict WTP instead of mixed logit. Furthermore, we evaluate how biased WTP estimates may be is we fail to recognize correlations between water quality of different lakes when respondents make choices.

In order to make a consistent comparison, we use a simpler choice model where all water quality attributes are linear. This model estimates an average WTP across all water quality improvements. We already know from Table 13 that WTP for water quality improvements is non-linear. However, the simpler linear model will allow us to evaluate how biased WTP estimates will be “on average” if we use the conditional logit model instead of the mixed logit (with correlations).

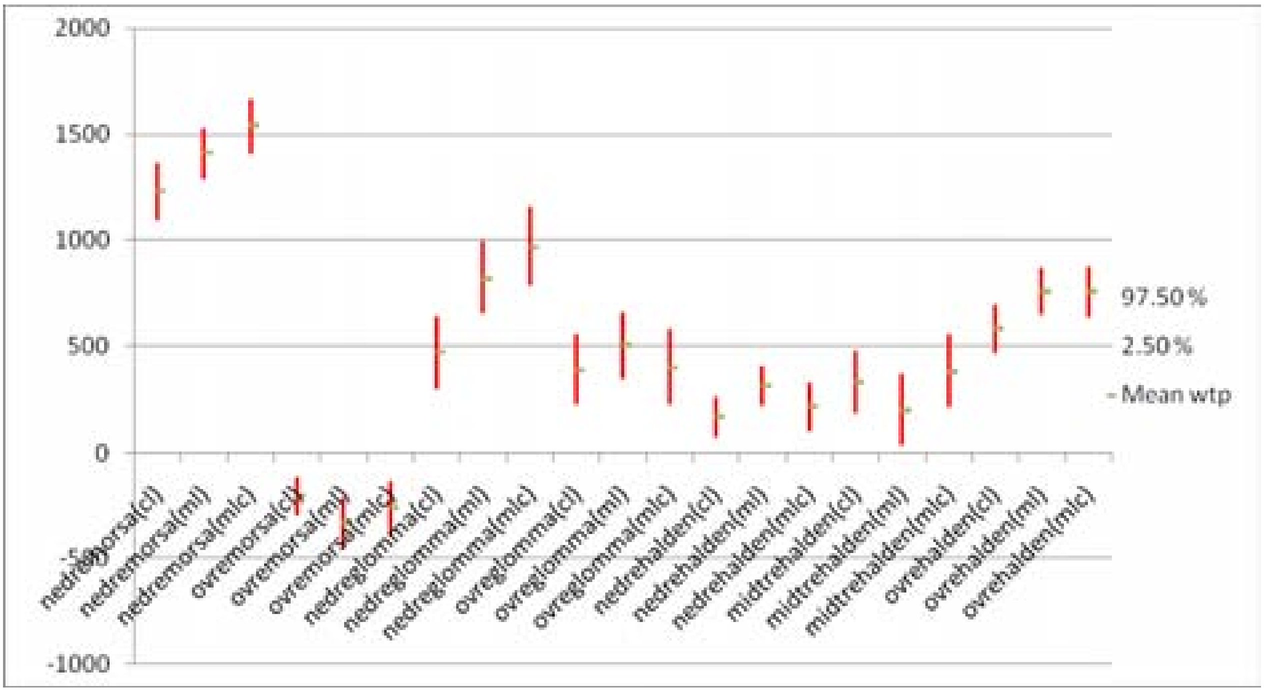


Figure 42. Comparison of implicit prices in conditional logit(cl), mixed logit (ml) and mixed logit with correlation (mlc). See Appendix 3 for models results: Table A3.3 (conditional logit); Table A3.4 (mixed logit); Table A3.5 (mixed logit with correlation).

Figure 42 plots average implicit prices for a single water quality class improvement, estimated using the three different choice models across the seven lake groups. We see that conditional logit estimates are generally lower than mixed logit estimates. Table 15 summarises the percentage error of conditional logit and mixed logit relative to our reference model; the thoeretically more correct mixed logit with correlation effects. The error for conditional logit is consistenntly negative and on average -22% , while the mixed logitmodel without correlation has no consistent bias.

Table 15. Average WTP estimation error relative to mixed logit model with correlation

	Conditional logit	Mixed logit	Mixed logit correlated*
Nedre Morsa	-20 %	-9 %	ref.
Øvre Morsa	-22 %	27 %	ref.
Nedre Glomma	-51 %	-15 %	ref.
Øvre Glomma	-3 %	24 %	ref.
Nedre Halden	-23 %	46 %	ref.
Midtre Halden	-13 %	-47 %	ref.
Øvre Halden	-23 %	0 %	ref.
Average error	**-22 %**	**4 %**	

*using normally distributed parameters

We can conclude that using the conditional logit model for mapping WTP across Østfold will lead on average to conservative estimates. We prefer to err on the side of caution and not overstate the benefits from our survey and so continue using the conditional logit model for mapping purposes further below.

4.6 Are different lakes substitutes or complements?

Various correlation patterns, and hence substitution patterns, can be obtained by appropriate choice of variables to enter as error components in the mixed logit model. In this section we allow all the lake groups in the choice model to be correlated. In Table 16 we report the covariances and their significance levels from the mixed logit model with correlation.

Table 16. Covariance across lake groups in the choice experiment.

	Nedre Morsa	Øvre Morsa	Nedre Glomma	Øvre Glomma	Nedre Halden	Midtre Halden	Øvre Halden
Nedre Morsa	0.41548***						
Øvre Morsa	0.04696	0.60376***					
Nedre Glomma	0.04380	0.56682***	1.19548***				
Øvre Glomma	0.30251***	0.32506***	0.49116***	0.84243***			
Nedre Halden	0.04404	0.31543***	0.39059***	0.17652***	0.20185***		
Midtre Halden	0.09053**	0.3394***	0.41937***	0.30952***	0.18761***	0.41927***	
Øvre Halden	0.03676	0.11166***	0.16744***	0.10223***	0.07872***	0.15837***	0.07333***

Note: Low covariance means that improvements in these lakes were not preferred together
See appendix 3 Table A3.5 for full model details. Significance: ***1%; **5%;*10%

Lake water quality is a good. Framed in the context of a choice experiment respondents preferred better water quality to worse for all lakes, hence all covariances are positive in **Table 16**. Some other broad patterns emerge. Lakes in Øvre Halden are relatively uncorrelated with other lakes in Østfold. Preferences for better water quality in Nedre Morsa lakes covary most with Øvre Glomma and somewhat with Midtre Halden, but are otherwise not significantly different from zero. This indicates respondents have particular and joint preferences for Vestre Vansjø and Storefjorden Lakes (Nedre Morsa) and Øyeren (Øvre Glomma). We can draw two broad conclusions from this:

- survey design: respondents to seom extent based their choices on an evaluation of water quality improvements in the whole county, rather than exclusively focusing on particular lakes in their areas.
- We would therefore expect distance decay of WTP broadly speaking to be so weak that no households within Østfold have no WTP for county wide water quality improvements. However, quality in Nedre Morsa has particular focus.
- benefit transfer of estimates for Nedre Morsa to other parts of Østfold are likely to produce higher than average transfer errors.

4.7 A rough estimate of total economic value of WFD compliance

In this section we illustrate aggregation of WTP to assess the total benefits of attaining at least "good ecological status" (green or blue quality level) in Vestre Vansjø and Storefjorden Lakes (Morsa catchment). We illustrate this using both contingent valuation and choice experiment estimates. Similar calculations can be carried out for other lakes in Østfold, but for the sake of illustration we limit the discussion to the Morsa catchment.

A number of potential problems can be encountered when wanting to calculate the total economic value of moving from current ecological status to good ecological status in lakes. Some aggregation problems include:

- aggregation by multiplying a mean WTP with the number of households in the "affected area" amounts to benefits transfer for households who both gave valid WTP as well as those who protested to the valuation questions, and or stated that they did not agree that their WTP responses could be used as a basis for decision-making on measures.

- Determining the affected area leads to widely different aggregate results. Possible approaches to aggregation are:
    - All households in municipalities bordering the affected lakes
    - All households in municipalities intersecting catchment
    - All households interviewed (some municipalities did not have any observations)
    - Market extent determined by linear WTP-distance decay function
    - Market extent determined by no-linear WTP-distance decay function

4.7.1 TEV based on contingent valuation

Figure 43 shows how important the specification of WTP-distance decay can be for determining where the "market" for the improved lakes stops, and consequently what area WTP is to be aggregated over. In a simple linear model, without a catchment effect, the average household more than 30 kilometers from Vestre Vansjø and Storefjorden has zero WTP. This would be interpreted as the extent of the 'market' for the improvement. With a catchment specific effect (Model 3.2) this drops to around 25 km. We also looked at a natural log transformation of distance which extends the "market" to about 45 kilometers. Revisiting the WTP data in **Figure 35** we see that this is relative to the "average household". There is considerable variation with some households have high positive WTP at 60 kilometers, while other households adjacent to the lakes have WTP=0.

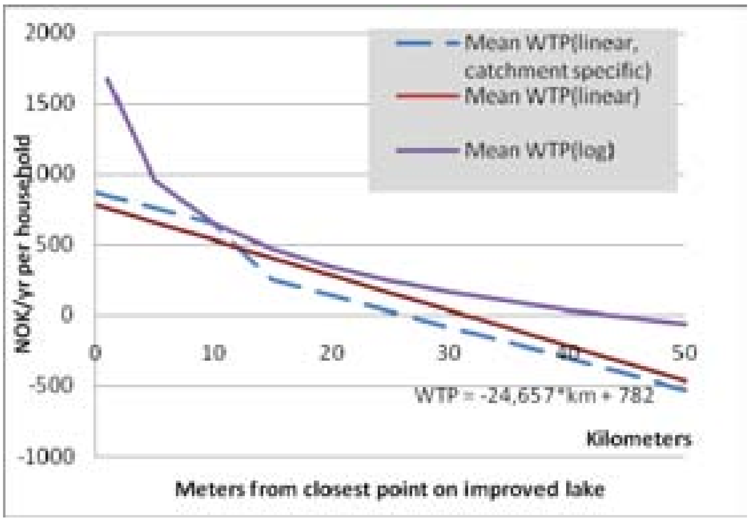


Figure 43.Different distance decay functions of WTP for a two lake improvement by 2 quality classes (linear-distance with and without a catchment effect for Morsa; log-distance). The Morsa catchment boundaries are assumed to be 10 km from the lake shore in this example (see discussion below).

The complication with the catchment specific effect is that the catchment is not at a 10 kilometer concentric distance from the Vestre Vansjø and Storefjorden lakes, but is in the south-east not more than 2-3 km from Storefjorden and in the north more than 40 kilometers from the both lakes. Further-more, linear distances may not be appropriate when access is severely limited – several municipalities are within 20 km of the improved lakes, but on the other side of the Oslo Fjord. Finally, a distance decay function showing positive WTP up to 50 km would include the outskirts of Oslo, adding a large number of households to the affected population (while we do not have any information about their preferences because they were not included in the study area).

To achieve an aggregation of WTP that minimises error we need to use GIS maps of household distribution in the catchment and test linear distance against access time. Creating a more detailed "value map" based on exact distances/access times to households in the study area is work in progress.

By way of illustration we show what the assumptions about accounting for a catchment and distance decay effects can mean for estimates of aggregate WTP using some simplifying assumptions. In **Table 17** below we have calculated distance decay of household WTP based on the distance to the approximate centre of populated areas in each municipality (rounded to the nearest 5 km). **Table A2.1** (in appendix) shows detailed WTP results by municipality and catchment. For calculating distance decay estimates of WTP used the definition of whether the municipality belongs to the Morsa-catchment subsample in **Table A2.2** (appendix).

Table 17. Aggregate WTP/year for improvement of Vansjø and Storefjorden to Good Ecological Status or better ('green' and 'blue' quality levels respectively). "Excluding protests": does not include households who protested to the WTP question and/or had "other" unidentified reasons for not being willing to pay (see **Table A2.1** for details of response rates by municipality).

			Assumptions about willingness to pay per household			
		House-holds (#)	Municipal mean WTP (1)	Morsa sub-sample mean WTP (2)	WTP distance decay (3.2, without catchment specific variable)	WTP distance decay (3.3, with catchment specific variable)
Assumptions about affected population	All households in municipalities surveyed	137 520	87 680 474	90 769 031		
	Catchment municipalities	26 089	27 628 083	17 219 846		
	(excluding protests)	21 024	22 264 517	13 876 879		
	Lakeside municipalities	22 419	24 250 649	14 767 893		
	(excluding protests)	17 942	19 408 375	11 842 786		
	Households in municipalities with mean WTP>0	74 397			30 537 649	
						26 256 559
	(excluding 14% protests)	63981				22 580 641

Table 15 illustrates how important the definition of the relevant households is for the aggregate WTP estimate. It can be much more important than the assmptions about mean household WTP.
The first row illustrates an overvaluation; multiplying all households in the municipalities surveyed by mean WTP leads to the highest estimates of total economic value. Mean WTP is not representative of all households in the area surveyed.

The distance decay WTP estimates (3.3) produce estimates that are very similar to the estimates using observed mean WTP per municipality (1). This shows that the distance decay function fits the municipally disaggregated data well. Both these estimates are considerably higher than the estimate using the mean WTP calculated across the whole Morsa-Glomma subsample. This is as expected because a large number of these households live well outside the Morsa catchment and have lower average WTP than households within the catchment.

We recommend decision-makers use the value indicated in green in **Table 15**, as it accounts for distance decay, adjusted for a catchment specific effect, and excludes the proportion of households protesting to the WTP question(roughly 20%).

4.7.2 TEV based on choice experiment

In this section we use the conditional logit model in **Table 13**, and the resulting implicit prices for different quality levels shown in Figure 37 , to calculate the willingness to pay for an improvent in quality level from the current level to green and blue quality level.

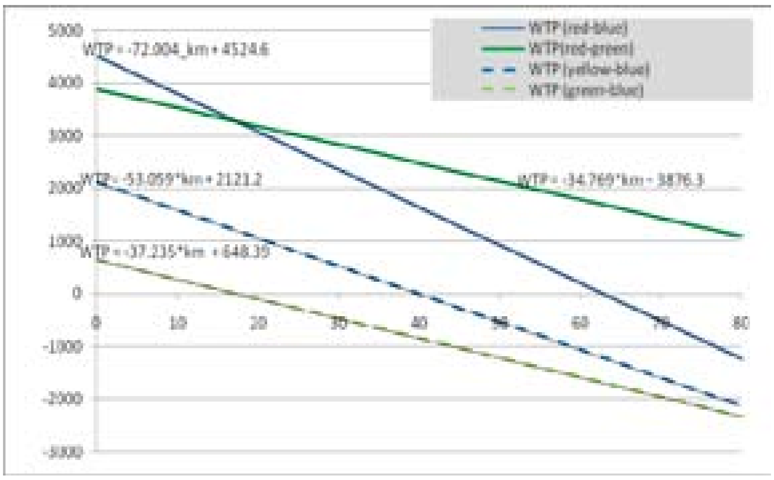


Figure 44. Distance decay of implicit WTP for different quality improvements (Nedre Morsa lakes; distance from Storefjorden Lake)

Figure 44 shows the resulting implicit willingness to pay and how it falls with distance from Storefjorden Lake. Implicit WTP for an improvement from red to blue quality levels (3 class improvement) falls to zero at a bit more than 60 kilometers. For an improvement from yellow to blue quality level (2 level improvement) implicit WTP falls to zero at around 40 km. For an improvement from red to green quality level distance decay is weaker and does not drop to zero within the study area. Returning to Figure 37 and Table 13 we see that the explanation is that distance decay for green quality level is not significantly different from zero.

Table 18 below shows total WTP for 'red-blue' (3 levels) and 'yellow-blue'(2 levels) improvements in the two lakes in Nedre Morsa. We have not computed total WTP for 'red-green' given the lack of significance of distance decay for the green quality level – the total WTP estimates would be much higher than those shown in **Table 18** .

The total WTP estimates from contingent valuation and choice experiment are not strictly comparable for the lakes in Nedre Morsa. In the choice experiment Storefjorden and Vestre Vansjø lakes were given the same quality levels in the choice sets. In some of the scenarios respondents were to choose between, Storefjorden was assumed to be in "red level", whereas in the contingent valuation scenario it improved from a yellow level baseline. In general terms the choice experiment evaluated a wider range of quality levels (3 levels maximum) than the contingent valuation scenario (2 levels). Nevertheless, both the 'red-green' and 'yellow-blue' estimates of total implicit WTP based on the choice experiment exceed even the most optimistic total WTP estimate from the contingent valuation exercise.

The lowest estimate for a two level improvement is NOK 114 million per year. We have not subtracted "protest" respondents from this estimate because the choice experiment only let respondents chose the "status quo" if they disagreed with any particular choice question.

Table 18. Aggregate WTP for improvements in Nedre Morsa Lakes based (choice experiment).

Municipality	Approx. distance lake	Sub-sample (1= Morsa)	Population (# hh)	Household implicit WTP (red-blue) (NOK/yr.)	Household implicit WTP (yellow-blue) (NOK/yr.)	Total WTP (red-blue) (NOK/yr.)	Total WTP (yellow-blue) (NOK/yr.)
0101 Halden	45	0	12417	1284.4803	-266.45724	15 949 392	-
0104 Moss	0	1	12642	4524.6489	2121.18321	57 200 611	26 815 998
0105 Sarpsborg	30	0	21593	2364.5365	529.422909	51 057 437	11 431 829
0106 Fredrikstad	20	0	30414	3084.574	1060.00968	93 814 233	32 239 134
0111 Hvaler	45	0	1489	1284.4803	-266.45724	1 912 591	-
0118 Aremark	60	0	583	204.42416	-1062.3374	119 179	-
0119 Marker	60	0	1435	204.42416	-1062.3374	293 349	-
0121 Rømskog	75	0	276	-875.632	-1858.2175	-	-
0122 Trøgstad	40	0	2138	1644.4991	-1.1638577	3 515 939	-
0123 Spydeberg	25	1	1889	2724.5552	794.716292	5 146 685	1 501 219
0124 Askim	25	0	6002	2724.5552	794.716292	16 352 781	4 769 887
0125 Eidsberg	35	0	4332	2004.5178	264.129526	8 683 571	1 144 209
0127 Skiptvet	20	1	1327	3084.574	1060.00968	4 093 230	1 406 633
0128 Rakkestad	35	0	3052	2004.5178	264.129526	6 117 788	806 123
0135 Råde	5	1	2525	4164.6301	1855.88983	10 515 691	4 686 122
0136 Rygge	5	1	5677	4164.6301	1855.88983	23 642 605	10 535 887
0137 Våler	5	1	1575	4164.6301	1855.88983	6 559 292	2 923 026
0138 Hobøl	20	1	1781	3084.574	1060.00968	5 493 626	1 887 877
0211 Vestby	15	0	4832	3444.5927	1325.30306	16 644 272	6 403 864
0213 Ski	35	0	10277	2004.5178	264.129526	20 600 429	2 714 459
0214 Ås	25	0	5733	2724.5552	794.716292	15 619 875	4 556 109
0221 Aurskog-Høland	70	0	5445	-515.6133	-1592.9242	-	-
0226 Sørum	80	0	4841	-1235.651	-2123.5109	-	-
0227 Fet	65	0	3606	-155.5946	-1327.6308	-	-
0228 Rælingen	65	0	6232	-155.5946	-1327.6308	-	-
0229 Enebak	45	0	3496	1284.4803	-266.45724	4 490 543	-
Mean (all municipalities)	30.95			2295.8917	478.839365		
Mean (Morsa-Glomma subsample)	28.96			2439.3231	584.532197		
Mean (Vansjø municipalities)	2.18			4367.6435	2005.48789		
Totals			155609			367 823 121	113 822 377

Note: mean WTP for the whole study area is calculated using a population weighted average household distance from Storefjorden Lakes, based on the data in the table. This estimate can be made more accurate using GIS of population density.

Willingness to pay for a red-green improvement in the Morsa-Glomma subsample was 2870 NOK/-year for the average household distance (based on the model in **Table 13**). The calculations for red-green improvements have not been included in the table above due to the lack of significance in the distance decay for green quality level.

4.8 A map-based approach to aggregate value of WFD compliance

One of the main methodological developments of GIS-based valuation methods was the expectation that the “extent of market”, or “area of economic concern” for water quality improvements could be calculated with greater accuracy than simplifying assumptions commonly used to aggregate WTP estimates. Another main objective was to evaluate the estimates of choice experiments compared to contingent valuation for similar improvements. In both cases, estimation of distance decay of WTP was expected to play a key role in accurately determining to aggregate WTP to attribute to measures improving a specific lake to good ecological status.

Figure 45 shows contingent valuation (map 1) and choice experiment (map 2) estimates for a similar water quality improvement in the Nedre Morsa lakes; one of the two lakes considered in the contingent valuation, and one of the seven lake groups considered in the choice experiment. Map 3 overlays map 1&2 to illustrate whether the “extent of market” is similar for the two methods. We also compare the choice experiment estimates for two different improvements: the yellow-blue (map 2) and red-blue (map 4). These distance decay functions were also shown in graphical form in Figure 44.

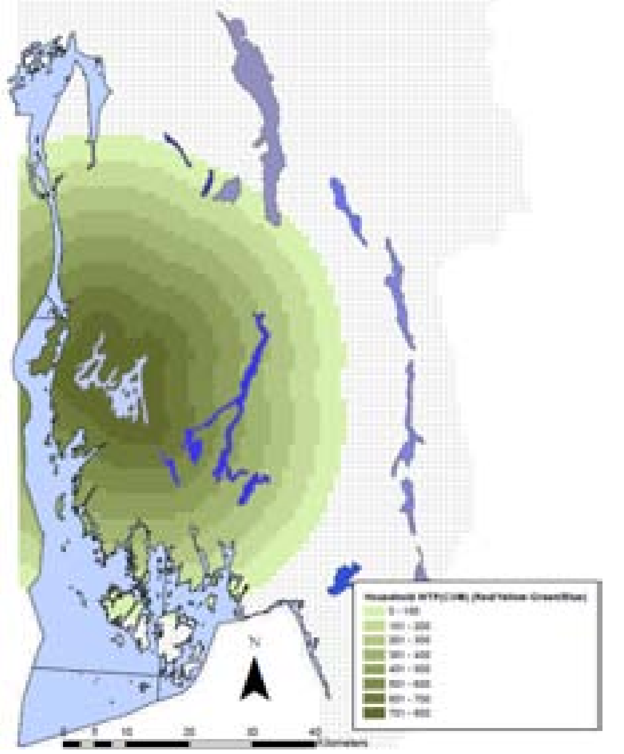
The maps and distance decay functions show that the CE method leads to higher WTP for any given grid cell, and also calculates a larger “area of economic concern”. The area of concern stretches a little more than 10km further in the CE model than the CVM model. The large difference in aggregate WTP estimates is however due to much higher mean WTP/hh estimates. We can conclude that there is no convergent validity between the methods for similar water quality improvements. What is striking however is that the area of concern is quite similar, despite the very large differences in WTP levels. We conclude that WTP works quite well as an indicator of “economic concern”. However, the choice of valuation methodology has a very large impact on absolute WTP estimates. It remains to be evaluated whether water managers in the area will accept the more conservative CVM estimates as a reliable indicator of benefits of WFD compliance. **Table 19** compares the aggregate WTP estimates using different valuation method and aggregation assumptions discussed earlier.

Table 19. Comparison of aggregate WTP estimates by valuation and aggregation method.

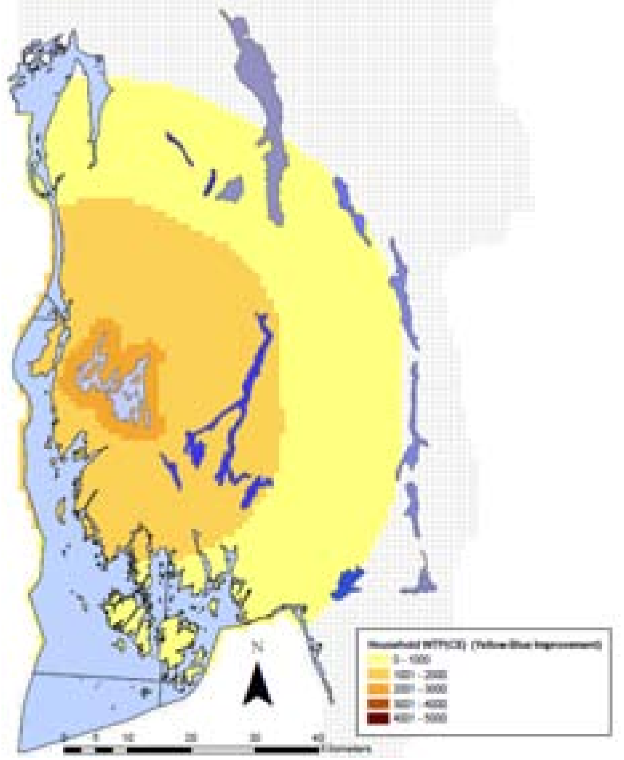
	Aggregate WTP by valuation method (water quality improvement)	
Summation method	CVM (red/yellow-green/blue) Aggregate WTP (NOK/yr.)	CE (yellow-blue) Aggregate WTP (NOK/yr.)
Mean WTP and population >0 by municipality	26 256 559	113 822 377
Mean WTP and population >0 by grid cell (GIS)	47 675 280	166 517 553

Note: CE estimates do not include protests. For comparison, CVM estimates assuming mean willingness to pay per grid cell is multiplied over all households in the grid cell (protests not subtracted).

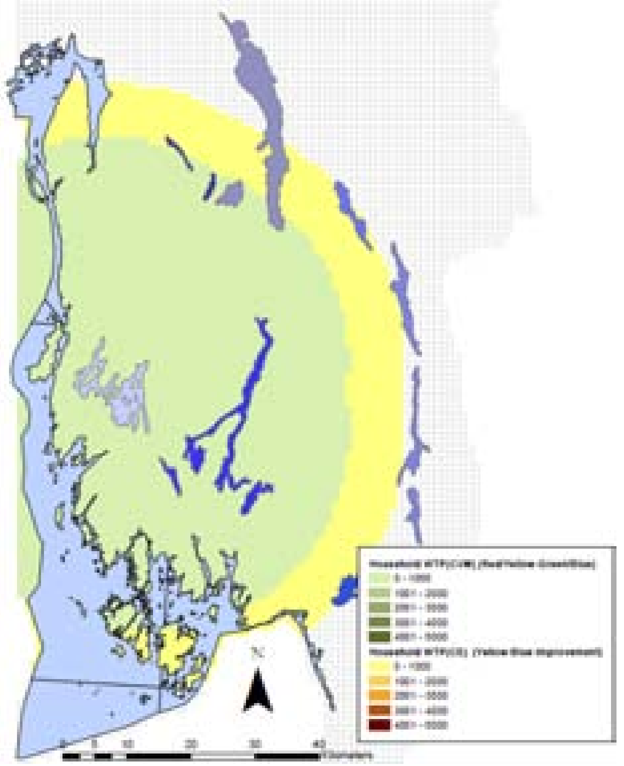
An accepted practice in Norwegian CVM studies hitherto has been to survey populations living in municipalities adjacent to the water bodies in question (Magnussen et al. 1995). The results of the present study show that populations further afield should also be interviewed, also outside the hydrological catchment boundaries.



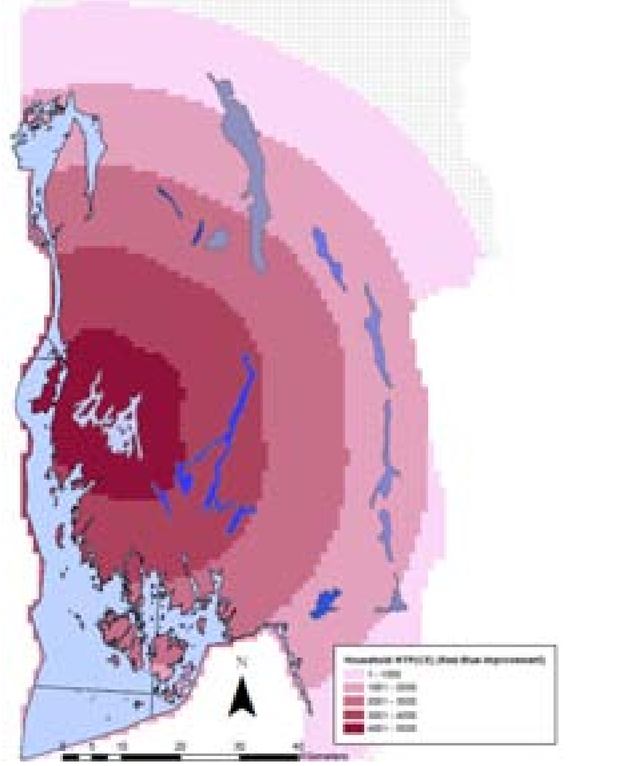
Map 1.Contingent valuation(CVM, Model 3.3) (red/yellow-green/blue)



Map 2.Choice experiment(CE) (yellow-blue)



Map 3. Comparison CVM and CE (maps 1&2)



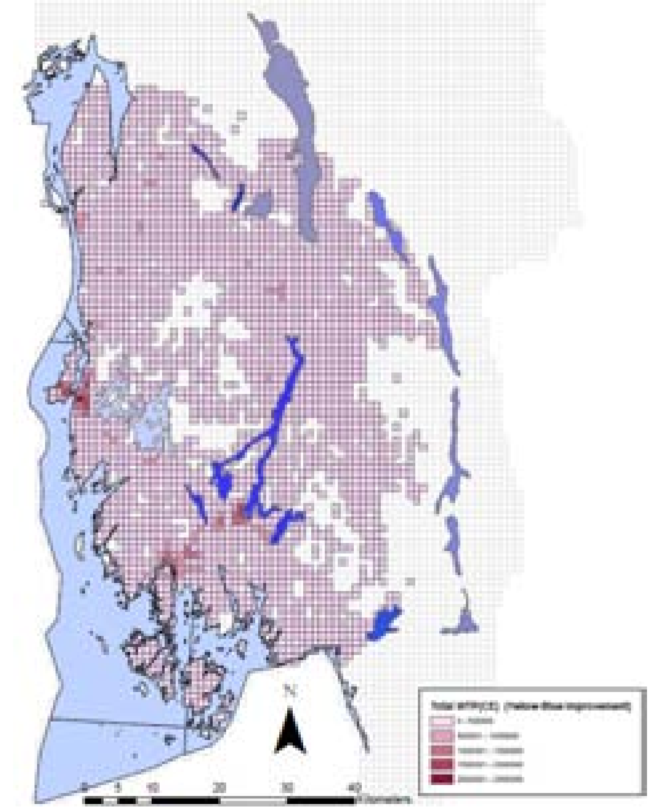
Map 4.Choice experiment(CE) (red-blue)

Figure 45. Comparison of WTP estimates per household Nedre Morsa Lakes

4.9 Some benefits transfer considerations

The importance of correct estimation of distance decay can be seen in **Figure 46**. Map 1 shows the population distribution in and around the study area, including the capital city Oslo (north-eastern corner of the map). The “area of economic concern” falls just short of the high population density areas of the capital city. Even low WTP estimates at this distance, when multiplied over high population densities, can lead to large differences in aggregate WTP.

Map 1.Population distribution in study area

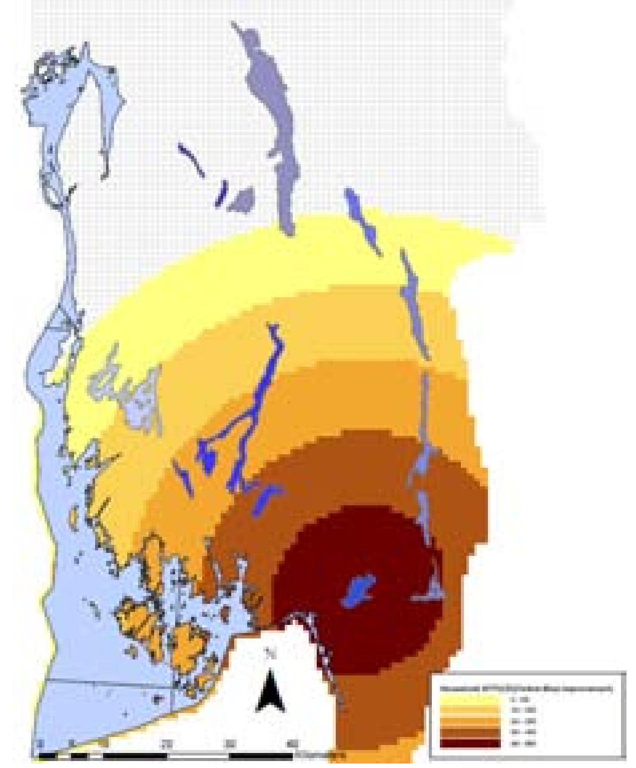


Map 2. Total WTP in study area (CE) (yellow-blue)

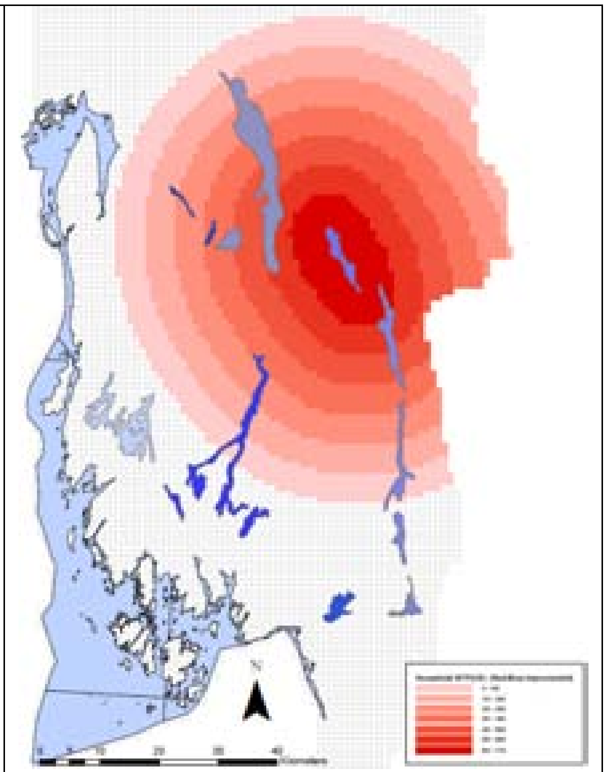
Figure 46. Total WTP Nedre Morsa lakes based on population distribution

Nor can we assume that preferences for lakes in Østfold of Oslo city inhabitations will be similar to those of residents of Østfold itself.

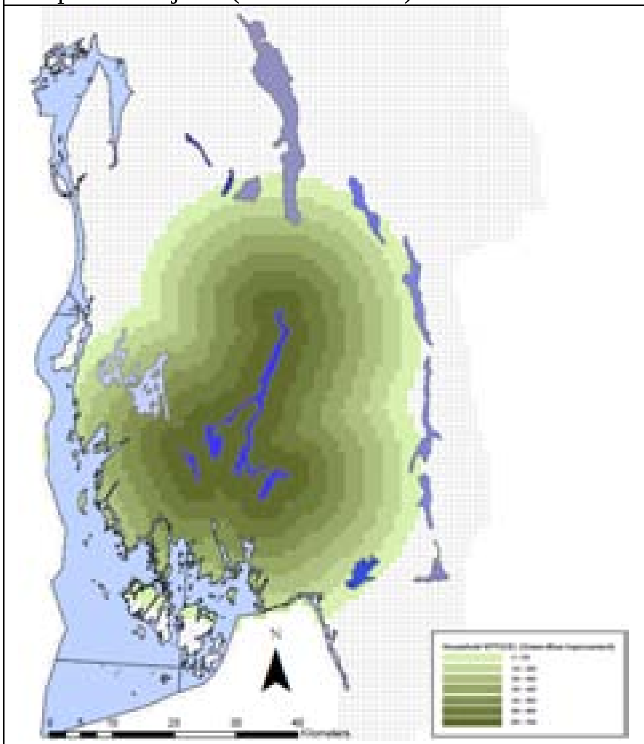
Choice experiment results with multiple lakes suggest that CE can be misleading for lakes that elicit low but significant concern, such as Femsjøen (Nedre Halden) and Rødnessjøen(Øvre Halden)(**Figure 47**) relative to Vansjø-Storefjorden (Nedre Morsa)(Figure 45). Lakes will show lower WTP for any given pixel. All 7 lake groups in the choice experiment seem to have approximately similar “area of economic concern”. The distance decay effect also seems to be low for lakes in sparsely inhabitated areas, because there are relatively few respondents living in a distance gradient close to these lakes. This can be seen in the case of Halden catchment lakes, which is more sparsely populated than the Nedre Morsa catchment. Broadly speaking WTP estimates are almost an order of magnitude higher for Nedre Morsa lakes compared to Nedre Halden; benefits transfers across these lakes, although in the same county would lead to large transfer errors of several hundred percent.



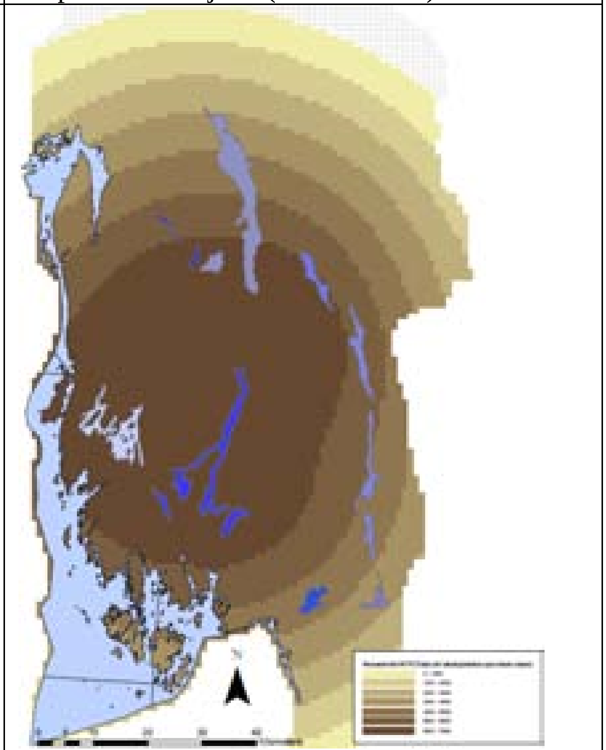
Map 1. Femsjøen (Nedre Halden)



Map 2. Rødnessjøen (Øvre Halden)



Map 3. Mingevatnet/Glomma(Nedre Glomma)



Map 4. Sum all lakes in Østfold (status quo-best quality level)

Figure 47. WTP per household selected lakes and sum WTP per household all Østfold lakes (CE)

The choice experiment is framing a joint valuation of water quality improvement in all major lakes in Østfold. **Figure 47**, Map 4, shows the distribution of total WTP/household for major lakes in Østfold for an improvement from status quo to blue class. WTP estimates are dominated by the Nedre Morsa results. The mapped results suggests that households around Nedre Morsa and Glomma water bodies would be willing to see their average annual water and sewage bill increase by about as much 150% (+6000 NOK/hh year) to see an increase to the best water quality level.

Finally, we have not considered applying the results of our study across the border in Sweden. We cannot assume that the border population derives no benefit from water quality improvements on the Norwegian side of the border, nor can we transfer estimates directly. Results from the CVM study in Nedre Morsa found a significant reduction in WTP for households living outside municipalities adjacent to the Vansjø-Storefjorden lakes (**Figure 43**). We would expect such an "administrative boundary effect" to be even stronger for national borders.

5. Conclusions

WTP per household per year. These figures have to be seen in light of the area in which households were interviewed for each set of lakes.

Contingent valuation: Mean WTP of the Morsa-Glomma sub-sample for improvement of the Vestre Vansjø and Storefjorden Lakes was 660 NOK/year per household. For the Glomma-Halden sub-sample mean WTP was 649 NOK/year per household for mprovements in the Femsjøen and Aspern lakes The mean WTP for the municipalities bordering the Nedre Morsa lakes was 1070 NOK/year per household.

Choice experiment: for the Morsa-Glomma subsample mean implicit willingness to pay for a yellow-blue improvement is approximately 584 NOK/year for the average household in that area. (For a red-green improvement we were not able to derive a meaningful WTP estimate due to insignificant distance decay parameters in the model). The mean implicit WTP for the municipalities bordering the Nedre Morsa lakes was approximately 2000 NOK/year (yellow-blue improvement).

Previous studies: Magnussen et al. (1995) reported mean WTP (in 2007 NOK) of municipalities bordering the Vestre Vansjø and Storefjorden Lakes (Moss, Våler, Råde, Rygge) of around 2400 NOK/year per household. This was for an improvement of two classes in the Norwegian water quality classification system (not directly comparable with the AQUAMONEY water quality ladder).

These values may be compared to what households in Østfold currently pay for water and sanitation**:** on average kr 4000/yr. (official statistics and respondents self-reported payments are almost identical).

Comparison of WTP distance decay across methods. Distance decay of WTP is stronger in the choice experiment data (from about 35 NOK/km to 72 NOK/km for 2 quality level changes) compared to contingent valuation (25 NOK/km for a simple model without a catchment specific effect).

Aggregate WTP for improving Lakes Vestre Vansjø and Storefjorden. The aggregate WTP based on contingent valuation is around 30 million NOK/year (Table 15). By comparison using the WTP distance decay function based on the choice experiment leads to an aggregate WTP of 113 million NOK/year (yellow-blue improvement) Table 18. This comparison is based on not excluding the percentage of households protesting to the contingent valuation question (because there is no protest option in the choice experiment).

A conservative estimate for benefit-cost analysis purposes might exclude households protesting to WTP questions, in which case aggregate WTP would be approximately 21 million NOK/year for the improvement shown in the contingent valuation scenario.

NB: Aggregation rules are a highly political question (who's WTP should count). The estimates made in this report are by way of illustration and have not (so far) been consulted with policy-makers.

Sensitivity of WTP to a one versus a two lake improvement (scope test). WTP is sensitive to the scope of improvements only under certain conditions. There is no significant difference between a one lake and two lake improvement when separate sub-samples are shown the different scenarios (an external scope test). When the same sub-sample is shown a two lake improvement, followed by a one lake improvement, we do observe significant reduction in WTP. But not when a one lake improvemen is followed by a two lake improvement. Contingent valuation partly fails the "scope test" which is commonly used as a validity check. The ordering of the improvements shown respondents is important.

What could this mean for policy and a programme of measures under the Water Framework Directive? If authorities announce a “large” programme of measures covering several lakes, but then scale it back to fewer lakes in the implementation phase, willingness to co-finance measures will be significantly lower than if authorities propose a “small” package which is then progressively scaled up.

User suitability thresholds. The pilot study suggested that valuation studies using the official guidelines for suitability will tend to over-emphasise the impact of water quality improvements on recreational uses such as bathing (which has the greatest contact with water).

Sample representativity of an internet survey. The web-based panel we used clearly shows that responses reflect population geographical distribution well, with most respondents found in urban areas. It also accurately represents the socio-demographics of the 90% of the population using internet (undersampling the old and young adults somewhat). The “lumpy” distribution of surveyed households gives an indication of why it is difficult to observe a “smooth” or continuous reduction of WTP as distance increases from the improved lakes.

WTP question response rates. Roughly 60% of the sample had positive WTP for the contingent valuation scenarios. About 10% had “true zero” WTP, based on reasons such as not being interested in lakes or not being able to afford fee increases. These respondents were included in calculations of average WTP. About 10% stated only protest reasons, disagreeing the WTP question itself, while roughly 15% expressed a combination of protest and zero WTP reasons for not wanting to participate.

Respondent perception of WTP survey validity. Following the valuation questions we asked respondents whether WTP questions and choice experiments were perceived as an acceptable basis for evaluating water quality measures (see section 3.5 for exact wording). Broadly speaking a larger portion of respondents “disagreed completely” that these types of studies were an acceptable approach to expressing values and decision-making, than what was recorded in protest responses in the contingent valuation question (for example 32% of the subsample “disagreeing completely” and 27% “partly disagreed” that WTP responses should be used as a basis for making decisions about water quality measures). A large majority expressed that the polluter pays, rather than user pays, principle should be used in financing measures.

Political economy of valuation estimates under the WFD
If authorities are to use these valuation estimates to justify pollution control measures they consequently need to explain the difference between a valuation study attempting to place a monetary estimate on benefits, and the institutional arrangement that is actually used to finance the measures. In Norway, a number of measures will be implemented by municipalities (e.g. sewage improvement), but measures focus on agricultural run-off will likely mostly be financed by state institutions such as Ministry of Agriculture (taxation). Valuation studies are therefore unlikely to be used directly for setting e.g. water and sewage pricing in Norway.

A more likely use under the Water Framework Directive is the comparison of benefits of water quality improvements with the costs of measures. Under the WFD this is relevant only when justifying that cost of measures exceed benefits, as a basis for derogations from the WFD objective of good ecological status. Under Norwegian guidelines valuation studies will only be employed where costs are expected to be similar to benefits.

It remains unlikely that the WFD will lead to many new valuation studies in Norway given that they are mainly called on to justify derogations from the WFD (in a political climate where authorities are keen to be seen “doing their best” for water quality).

The present study emphasises accurate evaluation of the distance decay of WTP and as such advocates a conservative approach to valuation of benefits. It should make it more likely that authorities will trust non-market valuation studies not to overestimate benefits *under the condition that they already accept benefit valuation as a decision-criteria under the WFD.*

6. Best practice recommendations summary

The following list of best practice recommendations had as a starting point experiences from the Norwegian case study, but benefited from a comparison and discussion with other case studies in AQUAMONEY.

STUDY DESIGN ISSUES	
PROBLEMS	**RECOMMENDATIONS**
Water quality ladder creates a standard hierarchy of water use suitability thresholds for users with heterogenous preferences	Ask respondents their use suitability thresholds explicitely. Used mixed logit models with suitability threshold interaction effects that account for heterogeneity in respondents.
Lacking distance decay of WTP	Estimate distance decay indirectly by identifying geographical distribution of users/residents & non-users/non-residents and their respective WTP
Access to water quality or quantity is respondent specific if sampled over a larger geographical area	Askm respondents individual status quo access to quality/quantity
”Ideal” orthogonal experimental design of attributes (different ecological status characteristics; different water bodies) vs. ”realistic” correlation between characteristics and locations	Simulate trade-offs between realistic constraints and design efficiency. Identify more representative ”generic” study sites
Distance decay reduces significance of an ”additional” water body improved (scope insensitivity)	Choose adjacent water bodies for scope test
Scenario pictograms and attribute wording simplify the dimensions of the value of water	Complement WTP information with qualitative evaluation of scenarios from focus groups and open-ended questions
”Information bias” of valuation surveys	Identify ”a priori” importance of water resource issue among other societal policy objectives; compare proportion of a priori concerned respondents with a posteriori proportion with WTP>0

SAMPLING METHOD AND STRATEGY	
PROBLEMS	**RECOMMENDATIONS**
Trade-off between study objectives: policy welfare analysis versus methodology testing	If policy analysis is the aim, focus attention on obtaining a representative random sample (residential surveys). If the focus is methodology testing use targeted/ quota based sampling (intercept surveys)
	Sampling in rural as well as urban areas. Population weighted sampling within administrative areas that approximately cover the watershed. Internet panels are pre-recruited and offer little flexibility in sample design.
Timing of survey implementation	Immediately following a use season to improve recall rates;
Ensuring representation of age, sex, income levels	Quota based sampling (internet-panel or intercept) can ensure socio-demographic representation
Increase respondent convenience	Combine internet with postal surveys
Minimising data recording and entry errors	Computer-based in-person or internet surveys are an advantage.
ANALYSIS	
PROBLEMS	**RECOMMENDATIONS**
Choice of experimental design software	Sawtooth is a commercial package offering experimental design and simulation of sample efficiency.
	STATA was mainy used for analysis. It now offers a mixed logit command, but as yet not latent class models. We found STATA more userfriendly and less "picky" than LIMDEP.
Multiple approaches to coding attributes levels in choice experiment (effects, dummy or continuous coding?)	Use effects coding if evaluating suitability thresholds. Use effects coding to (avoid confounding status quo mean with grand mean. Dummy coding (easier if no status quo) Be careful about the economic interpretation of implicit prices derived from an effects coded model: implicit prices are not welfare estimates.

Demonstrating validity to colleagues IS NOT THE SAME AS Demonstrating validity to policy-makers	Provide documentation on: Response rate Protest rate Scope sensitivity Distance decay Use versus non-use Sensitivity to scale / substitutes Lack of ordering effects Sensitivity to time lag between payment and improvement Interaction effects with status quo and with attributes Income effect Importance of a priori knowledge and concern Convergence of CE and CV estimates and with prior valuation studies
REPORTING	
PROBLEMS	**RECOMMENDATIONS**
Maps of results	Use maps to convey geographical coverage and sampling intensity of the study. Generate a WTP ”heat map” to show the spatial extent of the “market” for lake quality improvements Map mean WTP and simulated voting by municipality
Scenario analysis	Illustrate WTP sensitivity at a site to changes in characteristics of substitutes. Use choice experiments to generate WTP for different ”policy packages” other than achieving GES;
Relative reliability of WTP	Include confidence bounds of WTP estimates versus engineering costs
Policy analysis	Benefit-cost analysis of derrogation Simulated voting scenarios on particular policy packages
Survey as a basis for communication strategy	Qualitative information on protests and a priori knowledge of population Opinion polling: WTP can be interpreted as an indicator of attitudes of social concern. Valuation surveys may still be useful as opinion polls, despite WTP estimates themselves not being employed in policy-analysis.

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Appendix 1 – Descriptive data

Survey response rates by respondent characteristics

Table A1.1 Response rates by sex

			Response rate		
			No response	Response	Total
Sex	F	Count	1 184	540	1 724
		%	68.7%	31.3%	100.0%
	M	Count	1 041	593	1 634
		%	63.7%	36.3%	100.0%
Total		Count	2 225	1 133	3 358
		%	66.3%	33.7%	100.0%

Table A1.2 Response rates by education

			Response rate		
			No response	Response	Total
Education	Primary (10-year primary or 7-year popular)	Count	194	64	258
		%	75.2%	24.8%	100.0%
	Secondary School	Count	570	273	843
		%	67.6%	32.4%	100.0%
	Higher Technical and Professional	Count	428	225	653
		%	65.5%	34.5%	100.0%
	Higher Academic up to 4 years	Count	697	358	1 055
		%	66.1%	33.9%	100.0%
	Higher Academic more than 4 years	Count	336	213	549
		%	61.2%	38.8%	100.0%
Total		Count	2 225	1 133	3 358
		%	66.3%	33.7%	100.0%

Table A1.3 Response rates by age

			Response rate		
			No response	Response	Total
Age	18-29 years	Count	318	128	446
		%	71.3%	28.7%	100.0%
	30-44 years	Count	930	446	1 376
		%	67.6%	32.4%	100.0%
	45-59 years	Count	681	371	1 052
		%	64.7%	35.3%	100.0%
	60 years +	Count	296	188	484
		%	61.2%	38.8%	100.0%
Total		Count	2 225	1 133	3 358
		%	66.3%	33.7%	100.0%

Table A1.4 Response rates by CV scenario subsample

			Response rates		Total
			No response	Response	
Sub-sample	Morsa-Glomma AB	Count	992	489	1 481
		%	67.0%	33.0%	100.0%
	Morsa-Glomma BA	Count	973	510	1 483
		%	65.6%	34.4%	100.0%
	Glomma-Halden AB	Count	125	72	197
		%	63.5%	36.5%	100.0%
	Glomma-Halden BA	Count	135	62	197
		%	68.5%	31.5%	100.0%
Total		Count	2 225	1 133	3 358
		%	66.3%	33.7%	100.0%

Subsample shares by respondent characteristics

Table A1.5 Sample characteristics by sex

			Response rate		Total
			No response	Response	
Sex	F	Count	1 184	540	1 724
		%	53.2%	47.7%	51.3%
	M	Count	1 041	593	1 634
		%	46.8%	52.3%	48.7%
Total		Count	2 225	1 133	3 358
		%	100.0%	100.0%	100.0%

Table A1.6 Sample characteristics by education

			Response rate		Total
			No response	Response	
Education	Primary (10-year primary or 7-year popular)	Count	194	64	258
		%	8.7%	5.6%	7.7%
	Secondary School	Count	570	273	843
		%	25.6%	24.1%	25.1%
	Higher Technical and Professional	Count	428	225	653
		%	19.2%	19.9%	19.4%
	Higher Academic up to 4 years	Count	697	358	1 055
		%	31.3%	31.6%	31.4%
	Higher Academic more than 4 years	Count	336	213	549
		%	15.1%	18.8%	16.3%
Total		Count	2 225	1 133	3 358
		%	100.0%	100.0%	100.0%

Table A1.7 Sample characteristics by age

			Response rate		
			No response	Response	Total
Age	18-29 years	Count	318	128	446
		%	14.3%	11.3%	13.3%
	30-44 years	Count	930	446	1 376
		%	41.8%	39.4%	41.0%
	45-59 years	Count	681	371	1 052
		%	30.6%	32.7%	31.3%
	60 years +	Count	296	188	484
		%	13.3%	16.6%	14.4%
Total		Count	2 225	1 133	3 358
		%	100.0%	100.0%	100.0%

Table A1.8 Sample characteristics by CV scenario

			Response rates		
			No response	Response	Total
Sub-sample	Morsa-Glomma AB	Count	992	489	1 481
		%	44.6%	43.2%	44.1%
	Morsa-Glomma BA	Count	973	510	1 483
		%	43.7%	45.0%	44.2%
	Glomma-Halden AB	Count	125	72	197
		%	5.6%	6.4%	5.9%
	Glomma-Halden BA	Count	135	62	197
		%	6.1%	5.5%	5.9%
Total		Count	2 225	1 133	3 358
		%	100.0%	100.0%	100.0%

Appendix 2 – Aggregate willingness to pay

Table A2.1 Aggregation of WTP from contingent valuation question (municipal averages)

				Response rates					Willingness to pay per household			Total willingness to pay	
Municipality	Sub-sample	Population (# hh)	Obs. (#hh)	Protests (%)	WTP=0 (%)	Protests &WTP=0 (%)	Other(%)	WTP>0 (%)	WTP Mean (NOK/yr)	WTP Lower(2.5%) (NOK/yr)	WTP Upper(97.5%) (NOK/yr)	Total WTP (1) (NOK/yr.)	Total WTP(2) (excl."protests" & "other")
0101 Halden	Halden	12417	73	8	11	19	7	55	794	356	1232	9 863 104	6 484 991
0104 Moss	Morsa	12642	76	9	8	8	1	74	1031	679	1383	13 033 902	10 633 057
0105 Sarpsborg	Glomma	21593	130	10	12	16	5	56	541	310	771	11 673 215	7 992 650
0106 Fredrikstad	Glomma	30414	197	8	9	15	4	63	638	441	836	19 417 167	14 094 922
0111 Hvaler	Halden	1489	6	50	17	0	17	17	75	-197	346	111 179	37 056
0118 Aremark	Halden	583	3	0	0	0	0	100	515	-698	1727	300 051	300 051
0119 Marker	Halden	1435	10	10	10	0	40	40	406	-67	879	582 200	291 100
0121 Rømskog	Halden	276	n.d.									-	-
0122 Trøgstad	Glomma	2138	13	8	8	8	8	69	1400	387	2413	2 993 200	2 302 669
0123 Spydeberg	Morsa	1889	n.d									-	-
0124 Askim	Glomma	6002	45	22	4	16	2	56	372	220	523	2 231 332	1 338 799
0125 Eidsberg	Glomma	4332	28	14	14	21	7	43	663	37	1289	2 873 560	1 641 952
0127 Skiptvet	Glomma	1327	7	14	14	14	0	57	913	-532	2358	1 211 993	865 606
0128 Rakkestad	Glomma	3052	17	29	29	12	0	29	115	-47	278	351 997	207 080
0135 Råde	Morsa	2525	20	10	0	5	5	80	1737	595	2879	4 385 776	3 508 621
0136 Rygge	Morsa	5677	48	6	6	15	10	63	704	390	1018	3 998 771	2 749 155
0137 Våler	Morsa	1575	9	0	11	0	11	78	1798	-138	3735	2 832 200	2 517 542
0138 Hobøl	Morsa	1781	21	5	19	10	5	62	516	277	754	918 621	743 716
0211 Vestby	Morsa	4832	54	15	13	9	2	61	433	310	557	2 094 616	1 551 691
0213 Ski	Morsa	10277	126	10	7	18	8	57	559	384	733	5 740 890	3 690 818
0214 Ås	Morsa	5733	60	5	10	12	2	72	1077	559	1596	6 175 547	5 042 952
0221 Aurskog-Høland	Halden	5445	42	7	10	19	5	60	508	216	801	2 766 649	1 910 371
0226 Sørum	Glomma	4841	33	9	15	21	3	52	485	244	725	2 345 570	1 563 791
0227 Fet	Glomma	3606	36	0	25	14	0	61	432	224	640	1 556 944	1 340 684
0228 Rælingen	Glomma	6232	51	6	18	14	2	61	478	274	683	2 981 813	2 338 636
0229 Enebak	Glomma	3496	27	7	19	33	4	37	247	32	462	863 360	479 683
Not identified			1	Sample means									
Total		155609	1133	9	11	15	5	60	659	580	737		

Table A2.2 Aggregation of WTP from contingent valuation question (based on distance decay function)

Municipality	Approx. distance lake	Sub-sample (1= Morsa)	Population (# hh)	WTP Mean (3.1) (NOK/yr)	Total WTP (3.1) (NOK/yr.)	WTP Mean (3.3) (NOK/yr)	Total WTP (3.3) (NOK/yr.)
0101 Halden	45	0	12417	-	-		
0104 Moss	0	1	12642	875	11 066 651	782	9 886 076
0105 Sarpsborg	30	0	21593	-	-	32	683 062
0106 Fredrikstad	20	0	30414	140	4 252 218	282	8 569 342
0111 Hvaler	45	0	1489	-	-	-	-
0118 Aremark	60	0	583	-	-	-	-
0119 Marker	60	0	1435	-	-	-	-
0121 Rømskog	75	0	276	-	-	-	-
0122 Trøgstad	40	0	2138	-	-	-	-
0123 Spydeberg	25	1	1889	316	597 444	157	295 997
0124 Askim	25	0	6002	28	167 988	157	940 483
0125 Eidsberg	35	0	4332	-	-	-	-
0127 Skiptvet	20	1	1327	428	568 086	282	373 891
0128 Rakkestad	35	0	3052	-	-	-	-
0135 Råde	5	1	2525	764	1 928 002	657	1 658 776
0136 Rygge	5	1	5677	764	4 334 760	657	3 729 454
0137 Våler	5	1	1575	764	1 202 615	657	1 034 682
0138 Hobøl	20	1	1781	428	762 442	282	501 808
0211 Vestby	15	0	4832	252	1 215 894	407	1 965 745
0213 Ski	35	0	10277	-	-	-	-
0214 Ås	25	0	5733	28	160 459	157	898 332
0221 Aurskog-Høland	70	0	5445	-	-	-	-
0226 Sørum	80	0	4841	-	-	-	-
0227 Fet	65	0	3606	-	-	-	-
0228 Rælingen	65	0	6232	-	-	-	-
0229 Enebak	45	0	3496	-	-	-	-
Totals			155609		26 256 559		30 537 649

Note: Distances are approximate to the nearest point on lakes Vestre Vansjø or Storefjorden and rounded to the nearest 5 km. Municipalities are defined as ‘in catchment” if they have some of their surface area within the catchment. If average WTP is estimated as positive for the municipality it is multiplied over the whole household population for that municipality.

Table A2.3 Aggregation of WTP for Nedre Morsa Lakes (estimated based on choice experiment model with distance interactions)

Municipality	Approx. distance lake	Sub-sample (1= Morsa)	Population (# hh)	WTP (red-blue) (NOK/yr.)	WTP (red-green) (NOK/yr.)	Total WTP (red-blue) (NOK/yr.)
0101 Halden	45	0	12417	1284.48	2311.648	15 949 392
0104 Moss	0	1	12642	4524.649	3876.255	57 200 611
0105 Sarpsborg	30	0	21593	2364.537	2833.184	51 057 437
0106 Fredrikstad	20	0	30414	3084.574	3180.874	93 814 233
0111 Hvaler	45	0	1489	1284.48	2311.648	1 912 591
0118 Aremark	60	0	583	204.4242	1790.113	119 179
0119 Marker	60	0	1435	204.4242	1790.113	293 349
0121 Rømskog	75	0	276	-875.632	1268.577	-
0122 Trøgstad	40	0	2138	1644.499	2485.493	3 515 939
0123 Spydeberg	25	1	1889	2724.555	3007.029	5 146 685
0124 Askim	25	0	6002	2724.555	3007.029	16 352 781
0125 Eidsberg	35	0	4332	2004.518	2659.339	8 683 571
0127 Skiptvet	20	1	1327	3084.574	3180.874	4 093 230
0128 Rakkestad	35	0	3052	2004.518	2659.339	6 117 788
0135 Råde	5	1	2525	4164.63	3702.41	10 515 691
0136 Rygge	5	1	5677	4164.63	3702.41	23 642 605
0137 Våler	5	1	1575	4164.63	3702.41	6 559 292
0138 Hobøl	20	1	1781	3084.574	3180.874	5 493 626
0211 Vestby	15	0	4832	3444.593	3354.719	16 644 272
0213 Ski	35	0	10277	2004.518	2659.339	20 600 429
0214 Ås	25	0	5733	2724.555	3007.029	15 619 875
0221 Aurskog-Høland	70	0	5445	-515.613	1442.422	-
0226 Sørum	80	0	4841	-1235.65	1094.732	-
0227 Fet	65	0	3606	-155.595	1616.267	-
0228 Rælingen	65	0	6232	-155.595	1616.267	-
0229 Enebak	45	0	3496	1284.48	2311.648	4 490 543
Totals			155609			367 823 121

Note: WTP per household estimates based on conditional logit model in Table 13. The last column shows the aggregation of WTP for red-blue change in quality. We have not aggregated for red-green, as the distance decay of WTP looks implausible compared to previous results.

Appendix 3 - Additional econometric results

Table A3.1 Example of the choice model structure used to calculate implicit prices by distance interval (conditional logit model). This model shows average effects across all distances.

Attributes of choice alternatives:	Coef.	Robust Std. Err.	z	P>z
W&S fee increase	-0.00032	1.07E-05	-29.78	0.000
Blue Nedre Morsa	0.264913	0.026864	9.86	0.000
Green Nedre Morsa	0.34052	0.02558	13.31	0.000
Yellow Nedre Morsa	0.003504	0.024727	0.14	0.887
Blue Øvre Morsa	0.073878	0.023632	3.13	0.002
Green Øvre Morsa	-0.02146	0.021095	-1.02	0.309
Yellow Øvre Morsa	-0.1642	0.024794	-6.62	0.000
Blue Nedre Glomma	0.065636	0.01316	4.99	0.000
Blue Øvre Glomma	0.093617	0.01309	7.15	0.000
Blue Nedre Halden	0.043023	0.020275	2.12	0.034
Green Nedre Halden	-0.06263	0.016966	-3.69	0.000
Blue Midtre Halden	0.222053	0.026914	8.25	0.000
Green Midtre Halden	0.083761	0.020071	4.17	0.000
Blue Øvre Halden	0.123236	0.029625	4.16	0.000
Green Øvre Halden	-0.03931	0.024751	-1.59	0.112
Yellow Øvre Halden	-0.22817	0.029163	-7.82	0.000

Conditional (fixed-effects) logistic regression
Number of obs = 40707
Wald chi2(16) = 2008.37 Prob > chi2 = 0
Log pseudolikelihood = -13638.312 Pseudo R2 = 0.0851

Table A3.2 Choice model (mixed logit model) which accounts for heterogeneity in attributes. SD refers to the standard deviation of the attributes and reflects whether attributes are evaluated significantly differently across respondents.

Mixed logit model		Number of obs	=	40707
		LR chi2(15)	=	8011.78
Log likelihood = -9632.4215		Prob > chi2	=	0.0000

chd	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Mean						
att_price	-.0005373	.0000141	-38.13	0.000	-.0005649	-.0005097
att_Bnedr~sa	.3699451	.0703096	5.26	0.000	.2321408	.5077494
att_Gnedre~a	.7448942	.039618	18.80	0.000	.6672444	.822544
att_Ynedre~a	-.108137	.046364	-2.33	0.020	-.1990088	-.0172652
att_Bovrem~a	-.0029185	.0486829	-0.06	0.952	-.0983353	.0924984
att_Govrem~a	.0219392	.0415101	0.53	0.597	-.0594192	.1032975
att_Yovrem~a	-.2224198	.0442529	-5.03	0.000	-.3091539	-.1356856
att_Bnedr~ma	.2102823	.0216169	9.73	0.000	.1679139	.2526506
att_Bovreg~a	.1267511	.0214769	5.90	0.000	.0846571	.1688451
att_Bnedre~n	.0447744	.0373391	1.20	0.230	-.0284089	.1179576
att_Gnedre~n	-.0377305	.0287959	-1.31	0.190	-.0941694	.0187083
att_Bmidtr~n	.3210003	.0514085	6.24	0.000	.2202415	.4217591
att_Gmidtr~n	-.0283344	.0385041	-0.74	0.462	-.1038011	.0471323
att_Bovreh~n	.2971217	.0522846	5.68	0.000	.1946459	.3995976
att_Govreh~n	.0516391	.0545867	0.95	0.344	-.055349	.1586271
att_Yovreh~n	-.150441	.0495469	-3.04	0.002	-.2475512	-.0533308
SD						
att_Bnedr~sa	1.624353	.0686787	23.65	0.000	1.489745	1.758961
att_Gnedre~a	.1853002	.0790644	2.34	0.019	.0303368	.3402636
att_Ynedre~a	-.4801592	.0439722	-10.92	0.000	-.566343	-.3939753
att_Bovrem~a	.6957797	.0678502	10.25	0.000	.5627957	.8287637
att_Govrem~a	-.2332475	.0546043	-4.27	0.000	-.3402699	-.1262251
att_Yovrem~a	-.1282006	.0635311	-2.02	0.044	-.2527192	-.0036819
att_Bnedr~ma	.3930252	.0241541	16.27	0.000	.345684	.4403664
att_Bovreg~a	.3817527	.0258626	14.76	0.000	.3310628	.4324425
att_Bnedre~n	.2902531	.0453871	6.40	0.000	.201296	.3792102
att_Gnedre~n	.0294762	.0406274	0.73	0.468	-.0501522	.1091045
att_Bmidtr~n	.5761084	.0490323	11.75	0.000	.4800068	.67221
att_Gmidtr~n	.0732461	.0459249	1.59	0.111	-.0167651	.1632573
att_Bovreh~n	.6774014	.0565764	11.97	0.000	.5665138	.788289
att_Govreh~n	.8077618	.0518205	15.59	0.000	.7061954	.9093282
att_Yovreh~n	-.2190449	.0522284	-4.19	0.000	-.3214106	-.1166792

Table A3.3 Conditional logit model with linear water quality attributes

```
Conditional (fixed-effects) logistic regression   Number of obs   =     40707
                                                  Wald chi2(8)    =   1777.63
                                                  Prob > chi2     =    0.0000
Log pseudolikelihood = -13667.201                 Pseudo R2       =    0.0832

                              (Std. Err. adjusted for 1133 clusters in respid)
------------------------------------------------------------------------------
             |               Robust
         chd |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   att_price |  -.0003158   .0000104   -30.37   0.000    -.0003361   -.0002954
att_nedrem~a |   .3887028   .0170923    22.74   0.000     .3552024    .4222032
att_ovremo~a |  -.0645664   .0142203    -4.54   0.000    -.0924377    -.036695
att_nedreg~a |   .1484088   .0269233     5.51   0.000     .0956401    .2011775
att_ovregl~a |   .1237153   .0262788     4.71   0.000     .0722098    .1752208
att_nedreh~n |   .0535011   .0155736     3.44   0.001     .0229774    .0840248
att_midtre~n |   .1047338   .0222378     4.71   0.000     .0611485     .148319
att_ovreha~n |   .1829611   .0181916    10.06   0.000     .1473062     .218616
------------------------------------------------------------------------------
```

Table A3.4 Mixed logit model with linear water quality attributes

```
Mixed logit model                                 Number of obs   =     40707
                                                  LR chi2(7)      =   7331.53
Log likelihood = -10001.438                       Prob > chi2     =    0.0000

------------------------------------------------------------------------------
         chd |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Mean         |
   att_price |  -.0005478   .0000131   -41.91   0.000    -.0005734   -.0005222
att_nedrem~a |   .7725187   .0337452    22.89   0.000     .7063793     .838658
att_ovremo~a |  -.1822278   .0336584    -5.41   0.000     -.248197   -.1162585
att_nedreg~a |   .4476506   .0480809     9.31   0.000     .3534137    .5418875
att_ovregl~a |   .2746935   .0444064     6.19   0.000     .1876584    .3617285
att_nedreh~n |    .174848   .0268139     6.52   0.000     .1222938    .2274022
att_midtre~n |   .1098873   .0486105     2.26   0.024     .0146124    .2051622
att_ovreha~n |   .4141931   .0327452    12.65   0.000     .3500136    .4783726
-------------+----------------------------------------------------------------
SD           |
att_nedrem~a |    .761393    .038504    19.77   0.000     .6859264    .8368595
att_ovremo~a |   .8492232   .0359264    23.64   0.000     .7788088    .9196376
att_nedreg~a |   1.120662    .053303    21.02   0.000      1.01619    1.225134
att_ovregl~a |   .9418537   .0563303    16.72   0.000     .8314483    1.052259
att_nedreh~n |   .1088381   .0783426     1.39   0.165    -.0447106    .2623867
att_midtre~n |   1.040308   .0490559    21.21   0.000     .9441602    1.136456
att_ovreha~n |  -.4024227   .0548455    -7.34   0.000     -.509918   -.2949274
------------------------------------------------------------------------------
```

Table A3.5 Mixed logit model with correlated linear water quality attributes

Mixed logit model

Number of obs = 40707
LR chi2(28) = 8387.95
Log likelihood = -9473.2262
Prob > chi2 = 0.0000

chd	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Mean						
att_price	-.0004838	.0000133	-36.31	0.000	-.0005099	-.0004576
att_nedrem~a	.7459558	.0323491	23.06	0.000	.6825528	.8093588
att_ovremo~a	-.126584	.0321557	-3.94	0.000	-.189608	-.0635599
att_nedreg~a	.4656945	.0471594	9.87	0.000	.3732637	.5581253
att_ovregl~a	.1951396	.0452063	4.32	0.000	.106537	.2837423
att_nedreh~n	.1060045	.0291626	3.63	0.000	.0488469	.1631622
att_midtre~n	.1846386	.0432883	4.27	0.000	.0997952	.269482
att_ovreha~n	.3657721	.0319888	11.43	0.000	.3030752	.428469
SD						
att_nedrem~a	.6445801	.0407612	15.81	0.000	.5646896	.7244707
att_ovremo~a	.7770231	.0371347	20.92	0.000	.7042404	.8498058
att_nedreg~a	1.093379	.0583504	18.74	0.000	.9790139	1.207743
att_ovregl~a	.9178388	.0565025	16.24	0.000	.807096	1.028582
att_nedreh~n	.4492765	.043246	10.39	0.000	.3645159	.5340372
att_midtre~n	.6475142	.0572373	11.31	0.000	.5353312	.7596972
att_ovreha~n	.2707996	.044299	6.11	0.000	.1839751	.3576241
Covariances						
v11	.4154835	.0525478	7.91	0.000	.3124918	.5184753
v21	.0469624	.02418	1.94	0.052	-.0004295	.0943544
v31	.0437956	.0381077	1.15	0.250	-.0308941	.1184853
v41	.3025076	.0530736	5.70	0.000	.1984853	.40653
v51	.0440406	.0279141	1.58	0.115	-.01067	.0987512
v61	.0905331	.040722	2.22	0.026	.0107194	.1703467
v71	.0367601	.0324369	1.13	0.257	-.0268151	.1003353
v22	.6037649	.0577091	10.46	0.000	.4906572	.7168727
v32	.5668206	.0638227	8.88	0.000	.4417305	.6919107
v42	.3250611	.0561372	5.79	0.000	.2150342	.4350879
v52	.3154262	.0401565	7.85	0.000	.2367208	.3941316
v62	.3393959	.0531976	6.38	0.000	.2351306	.4436612
v72	.1116561	.0376826	2.96	0.003	.0377995	.1855127
v33	1.195477	.1275982	9.37	0.000	.9453889	1.445565
v43	.4911589	.0744022	6.60	0.000	.3453333	.6369844
v53	.3905855	.0544393	7.17	0.000	.2838864	.4972847
v63	.4193718	.069879	6.00	0.000	.2824116	.556332
v73	.1674421	.0537635	3.11	0.002	.0620675	.2728167
v44	.842428	.1037203	8.12	0.000	.6391399	1.045716
v54	.1765186	.0455834	3.87	0.000	.0871768	.2658603
v64	.3095231	.0613534	5.04	0.000	.1892727	.4297735
v74	.1022319	.0440867	2.32	0.020	.0158235	.1886403
v55	.2018494	.0388588	5.19	0.000	.1256875	.2780114
v65	.1876135	.0325237	5.77	0.000	.1238682	.2513588
v75	.078721	.0225319	3.49	0.000	.0345593	.1228827
v66	.4192747	.0741239	5.66	0.000	.2739945	.5645548
v76	.1583668	.0230492	6.87	0.000	.1131913	.2035424
v77	.0733324	.0239923	3.06	0.002	.0263083	.1203565

Appendix 4 - Implicit prices estimated from choice experiment for other lakes

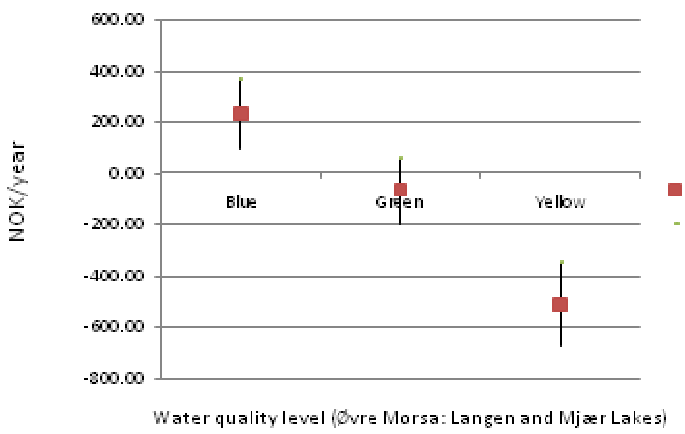


Figure A4.1 Confidence intervals for mean implicit prices (Øvre Morsa)

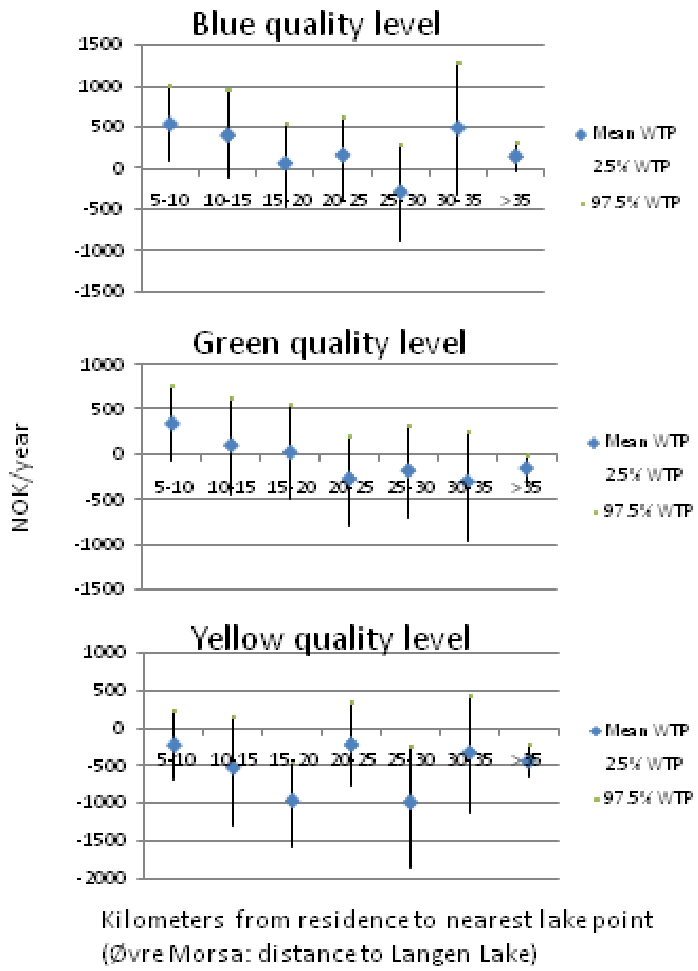


Figure A4.2 onfidence intervals for mean implicit prices (Øvre Morsa)

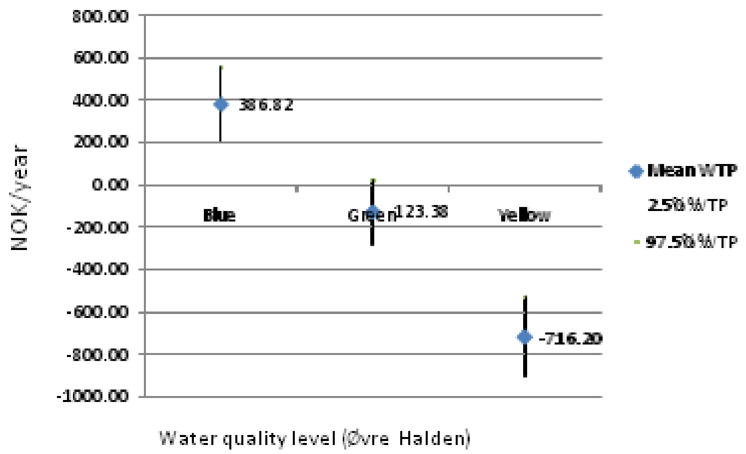


Figure A4.3 Confidence intervals for mean implicit prices from choice experiment for Øvre Halden

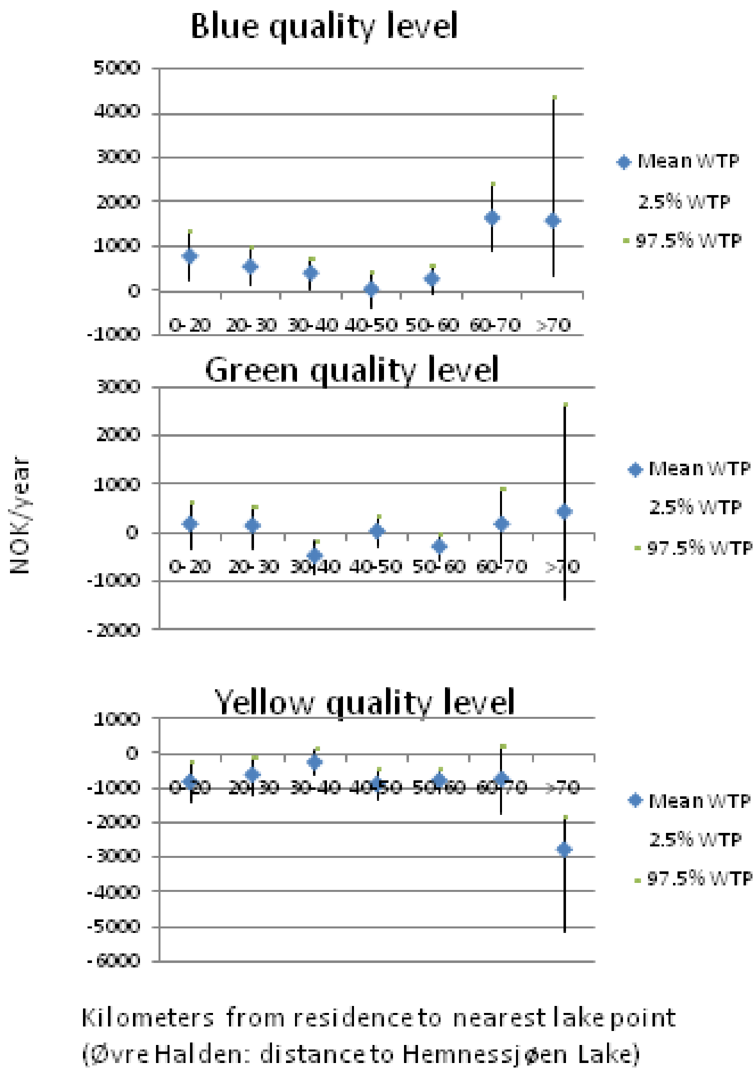


Figure A4.4 Confidence intervals for mean implicit prices from choice experiment for Øvre Halden by distance

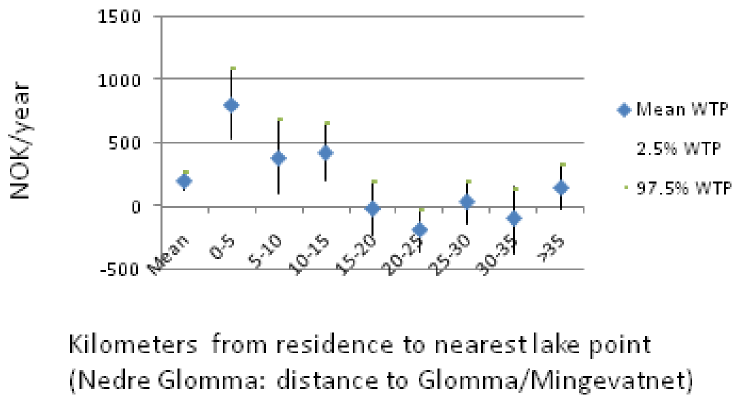


Figure A4.5 Confidence intervals for mean implicit prices from choice experiment for Nedre Glomma by distance (Blue quality level)

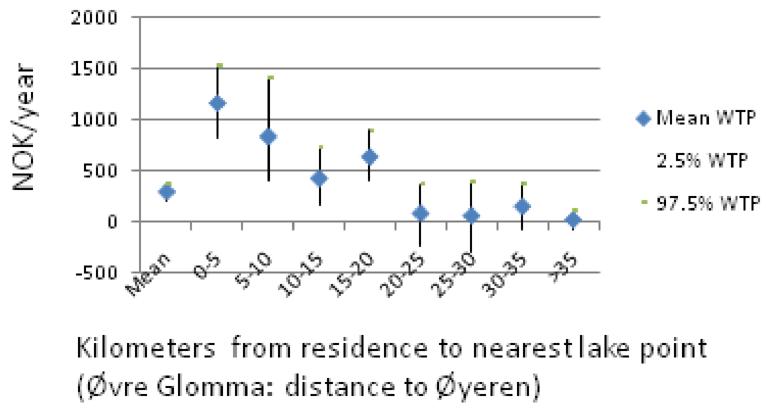


Figure A4.6 Confidence intervals for mean implicit prices from choice experiment for Nedre Glomma by distance (Blue quality level)

Appendix 5 – Web-survey (Norwegian)

Takk for at du vil delta i undersøkelsen!

Q01
Vennligst noter postnummeret der du bor i feltet under (fire siffer). Dersom du bor i utlandet registrerer du postnummer 9999.

i1
Vennligst markér det feltet i kartet der du bor:
Bolig ligger utenfor kartet
q2
X-position ______________________________
Y-position ______________________________
Q3
Hvor lenge har du bodd på denne adressen?
Vennligst notér antall år:

Q04
Vennligst noter postnummeret der du bodde før du flyttet til denne adressen
Postnummer:

Q05
Ligger den gamle adressen innenfor det samme feltet på kartet som du bor nå?
Ja (1)
Nei (2)
Vet ikke (3)
Q06
[*Field width=1*]
Eier eller leier eller disponerer du hytte eller fritidsbolig i Østfold eller Akershus?
Nei (1)
Ja, eier (2)
Ja, leier (3)
Ja, disponerer (4)
i07
Vennligst marker hvor hytta eller fritidsboligen ligger ved å klikke på det aktuelle området i kartet
q07a1
Hytta eller fritidsbolig ligger utenfor kartet
H07
X-position ______________________________
Y-position ______________________________
Q08
Hvor lenge har du leid, eid eller disponeret hytte eller fritidsbolig?
Vennligst notér antall år:

Info3
Fokuset i denne undersøkelsen er friluftsliv, men vi ønsker et balansert bilde av befolkningen. Vi er derfor like interessert i synspunktene til de som er interesserte i friluftsliv som de som ikke er det.
Q33
Hvor ofte brukte du følgende typer friluftsområder i fjor (2007) ?

Med "bruk" av elver, innsjøer eller sjøen, mener vi der en viktig del av turen er sikt til eller kontakt med vann.

	Hver dag (1)	mer enn to ganger i uken (2)	to ganger i uken (3)	én gang i uken (4)	én gang annenhver uke (5)	én gang i måneden (6)	én gang hver 3 måned (7)	én gang hvert halvår (8)	én gang i året (9)	aldri (10)	vet ikke (11)
Friluftsområder ved elver, innsjøer eller sjøen/fjorden i Østfold og Akershus (1)											
Friluftsområder ved elver, innsjøer, eller sjøen/fjorder i resten av Norge (2)											
Andre typer friluftsområder (for eksempel skog og mark) uavhengig av beliggenhet (3)											

info4

Du svarte at du hadde totalt omlag ^f("tabell")^ til friluftsområder ved elver, innsjøer eller sjøen/fjorden i Østfold og Akershus. På de neste spørsmålene vil vi vite hvordan disse turene fordelte seg over sommeren i forhold til andre årstider.

Q34a

Anslagsvis, hvordan ville du si at turene i Østfold/Akershus fordelte seg I SOMMER (juni - august 2008)? For eksempel "Én gang i måneden" blir tilsammen 3 turer i løpet av sommeren.

	Aldri = 0 turer (1)	Én gang hver 3 måned = 1 tur (2)	Én gang i måneden = 3 turer (3)	Én gang annenhver uke = 6 turer (4)	Én gang i uken = 12 turer (5)	To ganger i uken = ca. 24 turer (6)	Mer enn to ganger i uken = mer enn ca. 48 turer (7)	Hver dag = 92 turer. (8)
Til elver, elvevassdrag (1)								
Innsjøer (2)								
Sjøen/fjorden (3)								

Q34b

Anslagsvis, hvordan ville du si at turene i Østfold/Akershus fordelte seg i løpet av RESTEN AV ÅRET (september 2007 - mai 2008)?

	Aldri = 0 turer (1)	Én til to gang i året (2)	Én gang hver 3 måned = 3 turer (3)	Én gang i måneden = 9 turer (4)	Én gang annenhver uke = 18 turer (5)	Én gang i uken = 36 turer (6)	To ganger i uken = 72 turer (7)	Mer enn to ganger i uken = mer enn ca. 144 turer (8)	Hver dag = 275 turer (9)
Til elver, elvevassdrag									

	Aldri = 0 turer (1)	Én til to gang i året (2)	Én gang hver 3 måned = 3 turer (3)	Én gang i måneden = 9 turer (4)	Én gang annenhver uke = 18 turer (5)	Én gang i uken = 36 turer (6)	To ganger i uken = 72 turer (7)	Mer enn to ganger i uken = mer enn ca. 144 turer (8)	Hver dag = 275 turer (9)
(1)									
Innsjøer (2)									
Sjøen/fjorden (3)									

Q09

Hvor ofte gjør du følgende på turer til innsjøer, elver og fjord i Østfold/Akershus?

	På nesten hver tur (1)	Av og til (på omtrenthalvparten av turene) (2)	Sjelden (3)	Aldri (4)	Vet ikke. (5)
Aktiviteter på land som turgåing, sykling, løping, mate fugler, picnic, sole seg etc. (1)					
Gå tur med hunden (2)					
Jakt på vilt eller fugl (3)					
Annen aktivitet knyttet til vilt eller fugl, fugletitting ol. (4)					
Seiling, vindsurfing, kano, kajak, roing (5)					
Motorisert båtliv med motorbåt, vannski, jet-ski o.l. (6)					
Bading og svømming (7)					
Fiske etter laks eller ørret (8)					
Fiske etter annen fisk (9)					
Andre aktiviteter (10)					

QO9_10b

Hvis andre aktiviteter, vennligst spesifisér:

info5

Vi ønsker å vite mer om hvor ofte du bruker elver, innsjøer og sjøen i Østfold og Akershus. I de påfølgende spørsmålene ber vi deg om å tenke på perioden i sommer (2008). Ved "bruk" mener vi de aktivitetene du nevnte i det forrige spørsmålet.

iGeo2

Hvor ligger den INNSJØEN du brukte flest ganger i sommer (2008). Vennligst klikk på den aktuelle INNSJØEN på kartet (omtrent på det stedet du besøkte flest ganger

Q10a1

Jeg brukte ikke noen innsjø i det aktuelle området i sommer.

qGeo2

X-position ______________________________

Y-position ______________________________

i187

Hvor brukte du OSLOFJORDEN flest ganger i sommer? Vennligst klikk på det aktuelle stedet langs Oslofjorden (omtrent på det stedet du besøkte flest ganger

Q12a1

Jeg brukte ikke sjøen i det aktuelle området i sommer.

q188

X-position ______________________________

Y-position ______________________________

Q13

Var denne sommeren 2008 uvanlig med hensyn til antall besøk til elver, innsjøer eller sjøen?

Nei, jeg tok like mange turer som tidligere sommere (1)

Ja, jeg tok flere turer enn tidligere sommere (2)

Ja, jeg tok færre turer enn tidligere sommere (3)
Vet ikke (4)
Info06
For tiden vurderes flere tiltak for å forbedre kvaliteten av elver og innsjøer i Østfold og Akeshus. I de neste spørsmålene skal vi bruke ulike ikoner for å vise forskjellige kvalitetsnivåer på vannet innsjøer. Vannkvaliteten kan påvirke den gleden du har av å bruke vannforekomsten. Symbol brukt for vannkvalitet egnet for: : Fritidsfiske av den mestforurensningsfølsomme fisken(sjø-ørret,ørret, laks). : Fritidsfiske av fisk som er mermotstandsdyktig mot forurensning(f.eks. gjedde, abbor,gjørs). : Bading : Padling eller roing(f.eks. kano, kajak). : Fugleliv og fugletitting. : Dårlig vannkvalitet visesved at disse ikonene erdelvis eller helt krysset ut slik

Q14
Nedenfor vises fire ulike bilder av en innsjøbredde. Hvordan vil du rangere de fire bildene med hensyn til vannkvalitet? Det vil si, hvilken vannkvalitet mener du er best, nest best, nest dårligst eller dårligst? Bilde 1 Bilde 2 Bilde 3 Bilde 4

Best kvalitet (1)	Bilde 1. (1) Bilde 2. (2) Bilde 3. (3) Bilde 4. (4)
Nest best kvalitet (2)	Bilde 1. (1) Bilde 2. (2) Bilde 3. (3) Bilde 4. (4)
Nest dårligst kvalitet (3)	Bilde 1. (1) Bilde 2. (2) Bilde 3. (3) Bilde 4. (4)
Dårligst kvalitet (4)	Bilde 1. (1) Bilde 2. (2) Bilde 3. (3) Bilde 4. (4)

Info07
Tenk deg en stille sommerdag ved en innsjø.
Q15
Hvilke av de følgende aktivitetene ville du ikke gjort ved denne innsjøen? Vennligst klikk på de aktivitetene du IKKE ville praktisert hvis vannkvaliteten var som vist på bildet.
Fritidsfiske (ørret ol.) (1) Fritidsfiske (gjedde ol.) (2) Bading (3) Padling eller roing (4) Fugletitting (5)
q15a
Jeg ville gjort alle aktivitetene.
Q16
Hvilke av de følgende aktivitetene ville du ikke gjort ved denne innsjøen? Vennligst klikk på de aktivitetene du IKKE ville praktisert hvis vannkvaliteten var som vist på bildet.
Fritidsfiske (ørret ol.) (1) Fritidsfiske (gjedde ol.) (2) Bading (3) Padling eller roing (4) Fugletitting (5)
q16a
Jeg ville gjort alle aktivitetene.
Q17
Hvilke av de følgende aktivitetene ville du ikke gjort ved denne innsjøen? Vennligst klikk på de aktivitetene du IKKE ville praktisert hvis vannkvaliteten var som vist på bildet.
Fritidsfiske (ørret ol.) (1) Fritidsfiske (gjedde ol.) (2) Bading (3) Padling eller roing (4) Fugletitting (5)
q17a
Jeg ville gjort alle aktivitetene.
Q18
[*Not required*]
Hvilke av de følgende aktivitetene ville du ikke gjort ved denne innsjøen? Vennligst klikk på de aktivitetene du IKKE ville praktisert hvis vannkvaliteten var som vist på bildet.
Fritidsfiske (ørret ol.) (1) Fritidsfiske (gjedde ol.) (2) Bading (3) Padling eller roing (4) Fugletitting (5)
q18a
Jeg ville gjort alle aktivitetene.

info08

I bildene under ser du hvilke aktiviteter som er foreslått som egnet for hver vannkvalitet. Merk deg forskjellen mellom bildene med hensyn til sikt i vannet, fisk, planter, alger og så videre. I resten av spørsmålene vil vannkvalitet beskrives med ulike farger, der blått betyr "best kvalitet", og rødt betyr "dårligst kvalitet". Best kvalitet: Egnet for aktiviteter med vannkontakt som båtliv, bading og fisking. Egnet for alle typer fisk og mangfold av fugler og planter. Egnet for bading, båtliv og fisking. Den mest forurensningsfølsomme fisken er borte. Mangfoldet av fugler og planter er noe mindre. Egnet for båtliv med tilfeldig vannkontakt, men begrenset for bading og fiske. Fåtall fisk, fugler og planter. Noen alger på overflaten. Dårligst kvalitet: Uegnet for båtliv. Svært få fugler og planter og nesten ingen fisk. Større deler av overflaten med alger

Info10

I kartet under har vi markert dagens vannkvalitet i vassdragene i Østfold på sommeren med fargekodene som ble presentert på forrige side. Beskrivelsen er basert på miljøovervåkning. Klikk på "Hva betyr fargene" for en påminnelse om vannkvalitetsnivåene. Det er flere grunner til at vannkvalitet kan variere nedover og mellom vassdrag. Kvaliteten varierer på grunn av utslipp fra renseanlegg, septiktanker og avrenning fra jordbruksområder, på grunn av at utslipp og avrenning innholder næringssalter som fører til algeoppblomstring i innsjøer. Tiltak i jordbruket og bedre renseanlegg kan redusere utslipp.

info11

Se på kartet: Merk at både havet og mange innsjøer har blå fargekode, det vil si at de har beste kvalitet.

Q19

Hva er vannkvalitet i innsjøen nærmest der du bor?

Blå (best)
Grønn
Gul
Rød (dårligst)
Vet ikke

Q20

Vil du si at vannkvalitet i din nærmeste innsjø er:

Mye bedre enn forventet?
Litt bedre enn forventet?
Omtrent som forventet?
Litt verre enn forventet?
Mye verre enn forventet?
Vet ikke

Q21

Se på kartet: Merk at både havet og mange innsjøer har blå fargekode, det vil si at de har beste kvalitet. Hva er vannkvalitet i din HYPPIGST BRUKTE innsjøBlå (best)

Grønn
Gul
Rød (dårligst)
Bruker ikke innsjøer i området
Vet ikke

q20b

Vil du si at vannkvalitet i din hyppigst besøkte innsjø er:

Mye bedre enn forventet?
Litt bedre enn forventet?
Omtrent som forventet?
Litt verre enn forventet?
Mye verre enn forventet?
Vet ikke

UNDER-UTVALG MORSA-GLOMMA OG GLOMMA-HALDEN OMRÅDER HERFRA
info12
Miljømyndighetene vurderer for tiden tiltak for å forbedre vannkvalitet i regionen. Fordi slike tiltak vil koste penger, ønsker de å vite om husstandene i Østfold/Akershus føler at det er verdt noe for dem å forbedre vannkvalitet i innsjøene. Myndighetene vil stille følgende krav for å gjennomføre tiltakene: - Tiltakene skal finansieres med økning i vann- og kloakkavgifter (VA-avgift). - Alle som bidrar til forurensning må betale, så som jordbruk industri og husstander. - Hvis det totale beløpet husstander og andre forurensere er villig til å betale er lavere enn tiltakskostnadene vil tiltakene ikke bli gjennomført og   vannkvaliteten forblir som i dag.
info13
Før vi spør om din husstand ønsker slike tiltak, ber vi deg vurdere følgende: Vann- og kloakkavgiften (VA-avgiften) vil øke for å finansiere tiltakene. På grunn av kostnadene ved å vedlikeholde høy vannkvalitet må ekstrabeløpet betales hvert år. Investeringen og økningen i VA-avgiften ville starte i 2008, men vannkvalitetsforbedringen som vist på kartet kommer først fra 2010 og i alle år fremover. Økningen i vann- og kloakkavgiften vil bare bli brukt på dette tiltaket. Tiltaket vil ikke påvirke andre ting ved vannet som f.eks. drikkevannskvalitet i springen. Økningen i vann- og kloakkavgiften vil selvfølgelig bety en tilsvarende reduksjon i beløpet din husstand disponerer til andre formål.
info11b
Se først på dagens situasjon på kartet til venstre. Se så på kartet til høyre som viser en alternativ situasjon der det er gjennomført tiltak mot utslipp i utvalgte områder. Sammenlignes de to kartene kan man se at vannkvaliteten er forbedret for noen innsjøer. Oslofjorden holder samme høye kvalitet

DAGENS SITUASJON SITUASJON MED TILTAK

Q21_1AB
Hvor mange innsjøer er forbedret i forhold til dagens situasjon?

info14
For at du lettere skal kunne vurdere om eller hvor mye tiltakene er verdt for din husstand se på beløpene som er satt opp i listen under. For hvert beløp spør deg selv om din husstand ville være villig til å betale dette beløpet per år i tillegg til det du i dag betaler i VA-avgift for å få en forbedring som vist i kartene.
QVA1
Klikk på det beløpet som tilsvarer det maksimale din husstand ville være villig til å betale PER ÅR for denne forbedringen i vannkvalitet. Se kartene over forbedringer i vannkvalitet igjen.

kr. 0 (1)	kr. 280 (9)	kr. 600 (17)	kr. 920 (25)	kr. 1280 (33)	kr. 2400 (41)	kr. 5200 (49)
kr. 24 (2)	kr. 320 (10)	kr. 640 (18)	kr. 960 (26)	kr. 1360 (34)	kr. 2600 (42)	kr. 5600 (50)
kr. 40 (3)	kr. 360 (11)	kr. 680 (19)	kr. 1000 (27)	kr. 1440 (35)	kr. 2800 (43)	kr. 6000 (51)
kr. 80 (4)	kr. 400 (12)	kr. 720 (20)	kr. 1040 (28)	kr. 1520 (36)	kr. 3200 (44)	kr. 6400 (52)
kr. 120 (5)	kr. 440 (13)	kr. 760 (21)	kr. 1080 (29)	kr. 1600 (37)	kr. 3600 (45)	kr. 6800 (53)
kr. 160 (6)	kr. 480 (14)	kr. 800 (22)	kr. 1120 (30)	kr. 1800 (38)	kr. 3650 (46)	kr. 7200 (54)
kr. 200 (7)	kr. 520 (15)	kr. 840 (23)	kr. 1160 (31)	kr. 2000 (39)	kr. 4400 (47)	kr. 7600 (55)
kr. 240 (8)	kr. 560 (16)	kr. 880 (24)	kr. 1200 (32)	kr. 2200 (40)	kr. 4800 (48)	kr. 8000 (56)

QVA1_1
Du svarte annet beløp – vennligst notér beløpet i feltet under:
kroner per år

QVA2

Hva er de viktigste grunnene til at din husstand ikke ville betale økt vann- og avløpsavgift for forbedringene? Vennligst velg inntil to alternativer fra listen nedenfor.

	Viktigst	Nest viktigst
Økningene i vann- og avløpsavgift er for høye i forhold til forbedringen i vannkvalitet (1)		
Innsjøene som forbedres ligger for langt bort (2)		
Vi bruker ikke innsjøene (3)		
Dagens situasjon er god nok (4)		
Tror ikke vannkvalitet vil forbedres slik som beskrevet (5)		
Vil heller at andre innsjøer forbedres (6)		
Vil heller bruke penger på andre ting (7)		
Har ikke råd til å betale noe mer (8)		
Folk som bruker innsjøen bør betale (9)		
Kommunen bør betale (10)		
Staten bør betale (11)		
Vann- og avløpsavgifter er allerede for høye (12)		
Spørsmålet var for vanskelig (13)		
Andre grunner. Noter: (98)____________		

QVA3

Hva er de viktigste grunnene til at din husstand er villig til å betale økt vann-og avløpsavgift for forbedringene?

Velg inntil to alternativer.

	Viktigst	Nest viktigst
Tiltakspakken er verdiful for meg og/eller min husstand (1)		
Jeg var interessert i disse forbedringene uansett kostnad (2)		
Jeg var interessert i verdien av dette for andre enn min egen husstand (3)		
Andre bør få oppleve bedre innsjøer, uansett hva de måtte mene (4)		
Jeg ønsker å forbedre innsjøer for dyrelivets skyld (5)		
Jeg følte at det var moralsk riktig (6)		
Jeg forsto ikke spørsmålet (7)		
Andre grunner. Noter: (8)____________		

info15

Her følger en NY SITUASJON der det er gjennomført ANDRE TILTAK. Se først på dagens situasjon på kartet til venstre. Se så på kartet til høyre som viser en alternativ situasjon der det er gjennomført tiltak mot utslipp i utvalgte områder. Sammenlignes de to kartene kan man se at vannkvaliteten er forbedret for noen innsjøer DAGENS SITUASJON SITUASJON MED TILTAK

Q22_1AB

Hvor mange innsjøer er forbedret i forhold til dagens situasjon?

☐

QVB1

Klikk på det beløpet som tilsvarer det maksimale din husstand ville være villig til å betale PER ÅR for denne forbedringen i vannkvalitet. Se kartene over forbedringer i vannkvalitet igjen.

kr. 0 (1)	kr. 280 (9)	kr. 600 (17)	kr. 920 (25)	kr. 1280 (33)	kr. 2400 (41)	kr. 5200 (49)
kr. 24 (2)	kr. 320 (10)	kr. 640 (18)	kr. 960 (26)	kr. 1360 (34)	kr. 2600 (42)	kr. 5600 (50)
kr. 40 (3)	kr. 360 (11)	kr. 680 (19)	kr. 1000 (27)	kr. 1440 (35)	kr. 2800 (43)	kr. 6000 (51)
kr. 80 (4)	kr. 400 (12)	kr. 720 (20)	kr. 1040 (28)	kr. 1520 (36)	kr. 3200 (44)	kr. 6400 (52)
kr. 120 (5)	kr. 440 (13)	kr. 760 (21)	kr. 1080 (29)	kr. 1600 (37)	kr. 3600 (45)	kr. 6800 (53)
kr. 160 (6)	kr. 480 (14)	kr. 800 (22)	kr. 1120 (30)	kr. 1800 (38)	kr. 3650 (46)	kr. 7200 (54)
kr. 200 (7)	kr. 520 (15)	kr. 840 (23)	kr. 1160 (31)	kr. 2000 (39)	kr. 4400 (47)	kr. 7600 (55)
kr. 240 (8)	kr. 560 (16)	kr. 880 (24)	kr. 1200 (32)	kr. 2200 (40)	kr. 4800 (48)	kr. 8000 (56)

QVB1_1
Du svarte annet beløp – vennligst notér beløpet i feltet under:
kroner per år

QVB2
Hva er de viktigste grunnene til at din husstand ikke ville betale økt vann- og avløpsavgift for forbedringene? Vennligst velg inntil to alternativer fra listen nedenfor.

	Viktigst	Nest viktigst
Økningene i vann- og avløpsavgift er for høye i forhold til forbedringen i vannkvalitet (1)		
Innsjøene som forbedres ligger for langt bort (2)		
Vi bruker ikke innsjøene (3)		
Dagens situasjon er god nok (4)		
Tror ikke vannkvalitet vil forbedres slik som beskrevet (5)		
Vil heller at andre innsjøer forbedres (6)		
Vil heller bruke penger på andre ting (7)		
Har ikke råd til å betale noe mer (8)		
Folk som bruker innsjøen bør betale (9)		
Kommunen bør betale (10)		
Staten bør betale (11)		
Vann- og avløpsavgifter er allerede for høye (12)		
Spørsmålet var for vanskelig (13)		
Andre grunner. Noter: (14)____________		

QVB3
Hva er de viktigste grunnene til at din husstand er villig til å betale økt vann-og avløpsavgift for forbedringene?
Velg inntil to alternativer.

	Viktigst	Nest viktigst
Tiltakspakken er verdiful for meg og/eller min husstand (1)		
Jeg var interessert i disse forbedringene uansett kostnad (2)		
Jeg var interessert i verdien av dette for andre enn min egen husstand (3)		
Andre bør få oppleve bedre innsjøer, uansett hva de måtte mene (4)		
Jeg ønsker å forbedre innsjøer for dyrelivets skyld (5)		
Jeg følte at det var moralsk riktig (6)		
Jeg forsto ikke spørsmålet (7)		
Andre grunner. Noter: (8)____________		

UNDER-UTVALG MORSA-GLOMMA OG GLOMMA-HALDEN TIL HIT

Q26X1
Hvor mye tror du din husstand betalte i vann- og kloakkavgift i 2007?
Under 1000 kr. per år (1)
1000-1999 kr per år (2)
2000-2999 kr. per år (3)
3000-3999 kr. per år (4)
4000-4999 kr. per år (5)
5000-5999 kr. per år (6)
mer enn 6000 kr. per år (7)
Vet ikke (8)
info27

Resten av spørreskjemaet omhandler valg mellom ulike scenarier for vannkvalitet i innsjøer i Østfold og Akershus i 2010 (om 2 år). Tenk deg en økning i kloakkavgiften som begynner i 2008 og i all tid fremover for å betale årlige løpende forurensningstiltak. Vannkvaliteten i 2010 vil likevel kunne variere mellom innsjøer på grunn av endringer i klima, lokal befolkning og forurensende næringer. Nærliggende elver og indre fjordarmer vil også påvirkes, men her fokuserer vi på betydningen av vannkvalitet i innsjøene. Ellers er Oslofjorden i blått ("beste kvalitet"). Du vil i alt få presentert 12 ulike valg mellom vannkvalitetssituationer i Østfold/Akershus. Vi ber deg velge situationen du foretrekker. I hvert spørsmål har du tre valg. To av valgene innebærer økning i kloakkavgiften og er vist øverst på kartene. Ett av valgene er å beholde dagens vannkvalitet med ingen kloakk-avgiftsøkning. Noen av alternativene kan virke kunstige, men vi ber deg om å ta tid til å vurdere alle sammen. Velg det alternativet som du mener gir den beste kombinasjonen av vannkvalitet i 2010 og årlige ekstra-kostnader for din husstand.

info27a

Resten av spørreskjemaet omhandler valg mellom ulike scenarier for vannkvalitet i innsjøer i Østfold og Akershus i 2021 (om 13 år). Tenk deg en økning i kloakkavgiften som begynner i 2008 og i all tid fremover for å betale årlige løpende forurensningstiltak. Vannkvaliteten i 2021 vil likevel kunne variere mellom innsjøer på grunn av endringer i klima, lokal befolkning og forurensende næringer. Nærliggende elver og indre fjordarmer vil også påvirkes, men her fokuserer vi på betydningen av vannkvalitet i innsjøene. Ellers er Oslofjorden i blått ("beste kvalitet"). Du vil i alt få presentert 12 ulike valg mellom vannkvalitetssituationer i Østfold/Akershus. Vi ber deg velge situationen du foretrekker. I hvert spørsmål har du tre valg. To av valgene innebærer økning i kloakkavgiften og er vist øverst på kartene. Ett av valgene er å beholde dagens vannkvalitet med ingen kloakk-avgiftsøkning. Noen av alternativene kan virke kunstige, men vi ber deg om å ta tid til å vurdere alle sammen. Velg det alternativet som du mener gir den beste kombinasjonen av vannkvalitet i 2021 og årlige ekstra-kostnader for din husstand.

QF0_1

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

FIRE UNDERUTVALG MED TILFELDIG TRUKKET VALG-SPØRSMÅL HERFRA

QF1_1

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

QF1_2

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

QF1_3

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

QF1_4

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

QF1_5

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

QF1_6

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1)	Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3)	Situasjon 2. (2)

QF1_7

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1) Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3) Situasjon 2. (2)

QF1_8

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1) Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3) Situasjon 2. (2)

QF1_9

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1) Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3) Situasjon 2. (2)

QF1_10

Hvilke av disse situasjonene foretrekker du

Situasjon 1. (1) Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3) Situasjon 2. (2)

FIRE UNDERUTVALG MED TILFELDIG TRUKKET VALG-SPØRSMÅL TIL HIT

QF0_12

[*Field width=1*]

Hvilke av disse situasjonene foretrekker du? SITUASJON 1 SITUASJON 2

Situasjon 1. (1) Jeg foretrekker dagens situasjon og vannkvalitet,det vil si ingen avgiftsøkning.(Klikk her for å sammenligne med dagens vannkvalitet) (3) Situasjon 2. (2)

Q29

Du valgte ”dagens situasjon” i ett eller flere av valgspørsmålene vi har gått igjennom. Hva den viktigste og nest viktigste grunnen til at du valgte dette svaralternativet?
Velg inntil to alternativer.

	Viktigst	Nest viktigst
Forbedringen av innsjøene er for dyr i forhold til hva jeg får ut av det (1)		
Har ikke råd til å betale mer i kloakk-avgift (2)		
Innsjøene som forbedres ligger for langt vekk til at jeg vil betale noe (3)		
Interesserer meg ikke for vannkvaliteten i de innsjøene som forbedres (4)		
Bruker ikke disse innsjøene til friluftsliv eller annet (5)		
Synes at innsjøene er fine som de er nå (6)		
Ikke mitt ansvar å betale for forbedringer av vannmiljøet (7)		
Vil ikke betale mer i kloakkavgift - jeg betaler nok i skatt og avgifter fra før av (8)		
Spørsmålene var for vanskelige å svare på (9)		
Ingen av disse (10)		
Annet, notér: (11)_____________		

QF27

Hvor grundig vurderte du hvert av valgene?

Jeg vurderte alle valgene like grundig
Jeg vurderte de siste valgene grundigere enn de første
Jeg vurderte de første valgene grundigere enn de siste

Q27

Hvor vanskelig vil du si at det var å svare på valgspørsmålene vi nå har gått igjennom?

alle valgspørsmålene var vanskelige (1)
de fleste valgspørsmålene var vanskelige (2)
det var like mange vanskelige/lette valgspørsmål, (3)
de fleste valgspørsmålene var lette (4)
alle valgspørsmålene var lette (5)

Q28

Hvorfor var spørsmålene vanskelige? Vennligst sett kryss ved den viktigste og nest viktigste grunnen:
Velg inntil to alternativer.

	Viktigst	Nest viktigst
Det var for mange spørsmål (1)		
Valgene var svært like (23)		

	Viktigst	Nest viktigst
Jeg synes det var vanskelig å lese kartene (4)		
Jeg synes det var vanskelig å forstå symbolene for vannkvalitet (5)		
Jeg forsto ikke spørsmålene (6)		
Jeg synes at økningen i årlig VA-avgift var for høy (7)		
Det var vanskelig å velge, da flere forhold er viktige (8)		
Prinsipielt mener jeg at borgere ikke skal betale for miljøforbedringer (9)		
Jeg tror ikke at miljøforbedringene i alternativene er realistiske (10)		
Ingen av disse (11)		

Q26X2

Hvor mye tror du din husstand betalte i vann- og kloakkavgift i 2007?

Under 1000 kr. per år (1)
1000-1999 kr per år (2)
2000-2999 kr. per år (3)
3000-3999 kr. per år (4)
4000-4999 kr. per år (5)
5000-5999 kr. per år (6)
mer enn 6000 kr. per år (7)
Vet ikke (8)

Q30

Vennligst ta stilling til følgende påstander:

	Helt enig (1)	Delvis enig (2)	Delvis uenig (3)	Helt uenig (4)	Vet ikke (5)
Å si hvor stor økning i kloakkavgiften jeg er villig til å betale for en vannkvalitetsforbedring er en riktig måte å uttrykke verdiene jeg har vedrørende vannkvalitet					
Å velge mellom ulike scenarier med kloakkavgiftsøkning og vannkvalitet er en riktig måte å utrykke verdiene jeg har vedrørende vannkvalitet.					
Det er fornuftig at beslutninger om tiltak for å bedre vannkvalitet fattes på basis av hvor mye folk er villig til å betale.					
Folk er vant til å tenke på naturopplevelser i pengemessige termer.					
Det er lett å vurdere økninger i mine avgifter/skatter til miljøtiltak i forhold til forbedringer i vannmiljøet.					
Det er brukerne av vannmiljøtjenester som bør betale for at de er av god kvalitet.					
Det er de som forurenser vannmiljøet som bør sørge for at det er av god kvalitet.					

Q31

Kjøpte du fiskekort i fjor?

Ja
Nei

Q32

Eier du noen form for båt, kano, kajakk, eller surfebrett?

Ja
Nei

Q35

Er du eller andre i husstanden medlemmer av noen av følgende typer organisasjonene?

Ingen medlemskap
Sportsklubb/-forbund

Religiøs- eller veldedighetsorganisasjon
Utvalg eller dugnadsgrupper i barnehager eller skole
Speidere
Fagforening
Fiskeforening
Jaktforening
Miljøvernorganisasjon
Annen friluftslivsorganisasjon
Utviklings-/bistandsorganisasjon
Andre

Q35_1a

Hvis andre, vennligst spesifisér:

Q36

Dersom du har stemmerett og det var STORTINGSVALG i dag, hvilket parti ville du stemt på?

Det norske Arbeiderparti (1)
Fremskrittspartiet (2)
Høyre (3)
Kristelig Folkeparti (4)
Kystpartiet (5)
Rød Valgallianse (6)
Senterpartiet (7)
Sosialistisk Venstreparti (8)
Venstre (9)
Andre partier og lister (10)
Ville ikke stemme (11)
Vet ikke (12)
Vil ikke oppgi partipreferanse (13)
Har ikke stemmerett i Stortingsvalg (14)

Q37

Dersom du har stemmerett og det var KOMMUNEVALG i dag, hvilket parti ville du stemt på?

Det norske Arbeiderparti (1)
Fremskrittspartiet (2)
Høyre (3)
Kristelig Folkeparti (4)
Kystpartiet (5)
Rød Valgallianse (6)
Senterpartiet (7)
Sosialistisk Venstreparti (8)
Venstre (9)
Andre partier og lister (10)
Ville ikke stemme (11)
Vet ikke (12)
Vil ikke oppgi partipreferanse (13)
Har ikke stemmerett i kommunevalg (14)

qDeltag

Det kan bli aktuelt å gjennomføre dybdeintervjuer eller fokusgrupper med et mindre utvalg av de som har svart på denne undersøkelsen. Kan vi få lov til å kontakte deg med invitasjon til et dybdeintervju eller deltakelse på fokusgrupper dersom det blir aktuelt? Deltagere vil få en godtgjørelse.

Navn ______________________________

E-post adresse ______________________________
Telefon ______________________________

`qEjDeltage`
Jeg ønsker ikke å bli kontaktet (1)

Appendix 6 – Pilot study results

Introduction

This appendix gives an overview of some of the features of the pilot choice experiment carried out in the summer of 2007 to explore methodological issues. The overview is meant to give the reader a “visual” overview of the pilot study.

The summary is based on a slide presentation covering the following topics.

- Functional relationships between attributes
- Visual cues
- Number of choice sets
- Number of choices per choice set (incl. status quo)
- Water and sewage fee price range
- Model validity tests
- Continuous versus non-linear models
- Dealing with heterogenous preferences

Results will be submitted for journal publication. The data is also reported in N.C.Lande (2008). Valuation of thresholds in willingness to pay for water quality attributes using choice experiments: a case study on eutrophication and recreation in the Vansjø Lakes. Norway. M.Sc. Thesis. Department of Economic and Resource Management. Norwegian University of Life Sciences (UMB).

Pilot study characteristics in brief

- In-person interviews July 14- August 28 2007 carried out by Nina Lande.
  - Interview time 15-20 minutes
  - Sample response rate: 74%
    - N=302 of which
    - 14 respondents inconsistent on fixed ”hold out” tasks
    - 1 incomplete response
    - N=286 responses used in logit and hierarchical baysian analysis
- 3 attributes
  - Sight depth and water colour (4 levels)
  - Algal bloom advisory (4 levels)
  - Increase in muncipal water and wastewater fee (5 levels)
- 12 choice tasks
  - 10 random tasks
  - 2 fixed ”hold out” tasks to test internal validity (tasks 3 and 12)
  - choice tasks seem feasible in personal interviews with simple choice tasks (3 attributes)

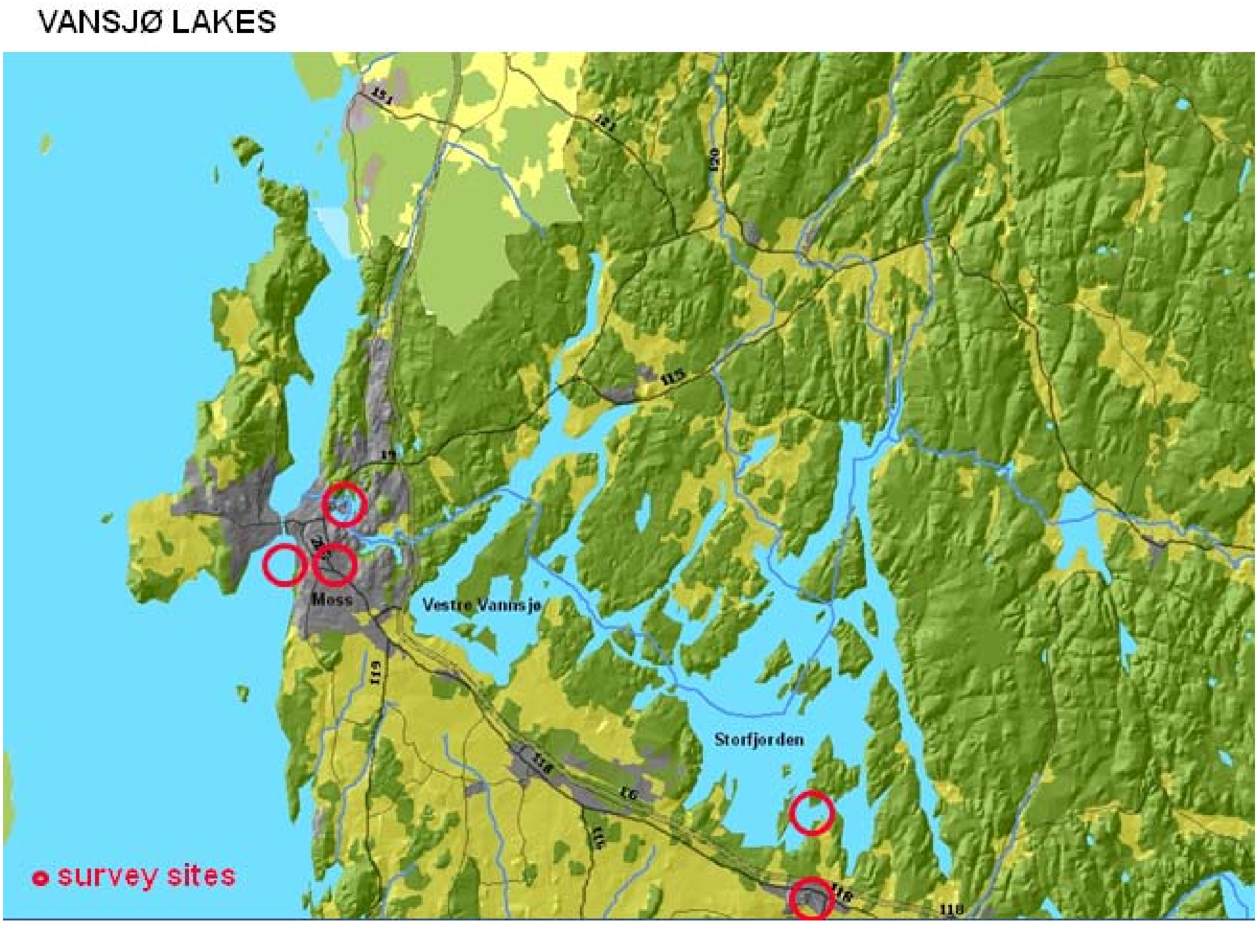


Figure A.6.1 Pilot study sites

Figure A.6.1 shows the locations of the in-person interviews conducted around Lakes Storefjorden and Vestre Vansjø during the summer of 2007. Respondents were interviewed through random intercepts along the shores of both lakes, at a seaside location, as well as in shopping centres (when rain prohibited outdoor interviews).

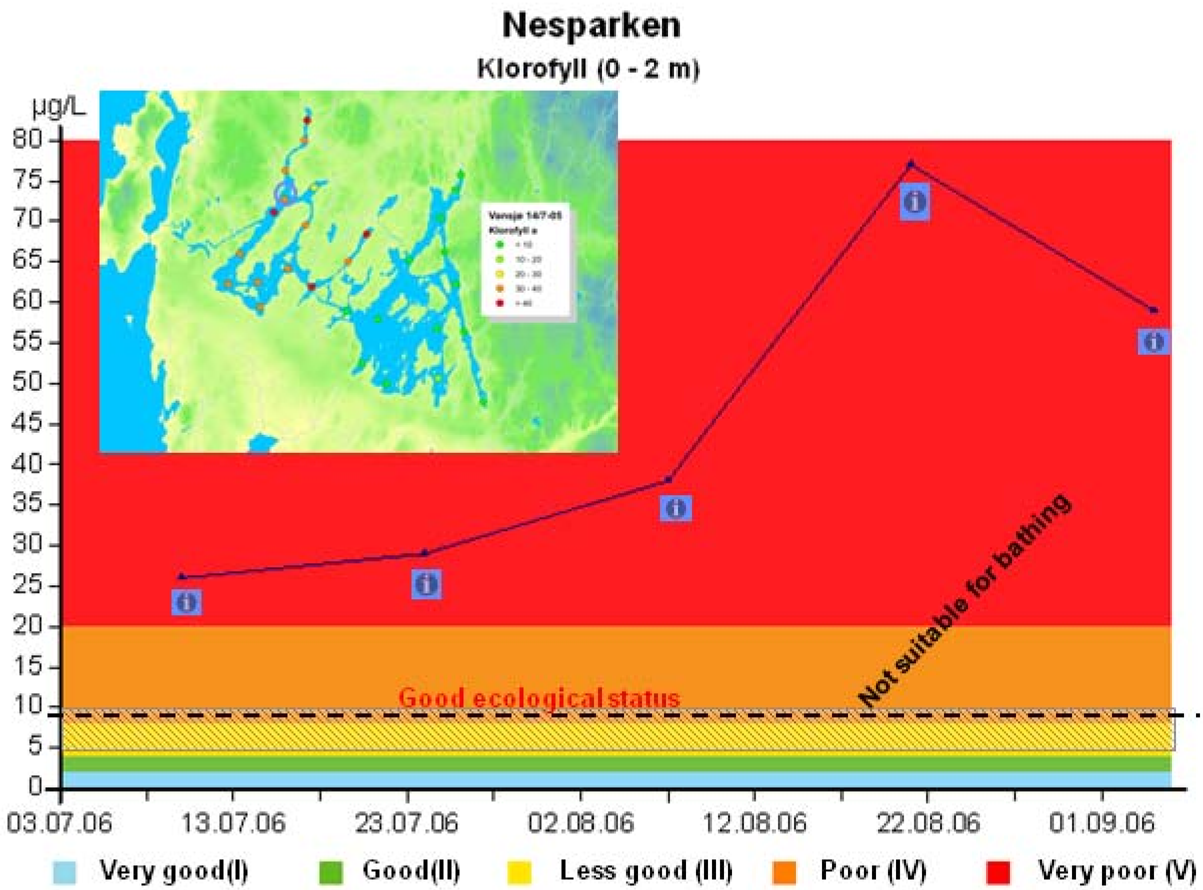


Figure A6.2 Water quality status pilot study site Note: Norwegian classification system for water quality status

Figure A6.2 illustrates the eutrophication status in Vestre Vansjø next to the town of Moss in the week leading up to pilot interviews. ChlA values at 0-2 meters depth were in in the poorest water quality category in the Norwegian classification system.

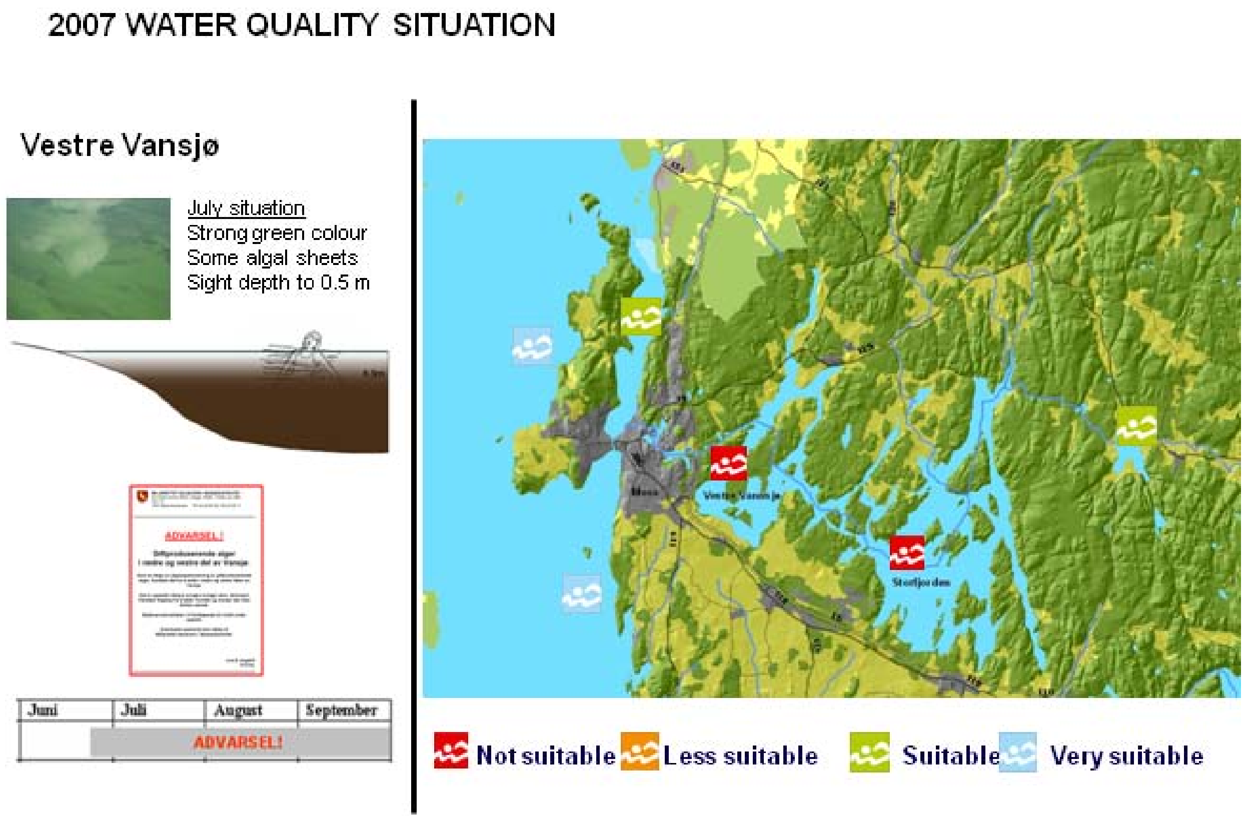


Figure A6.3 Description of status quo in the choice experiment design

Figure A6.3 illustrates the description shown respondents of the current situation in the lakes and coastal waters using the Norwegian water quality classification system for "bathing suitability".

Respondents were also informed that households in Østfold currently pay on average kr 4000/yr. or 2,61 øre/litre for water and sanitation**.**

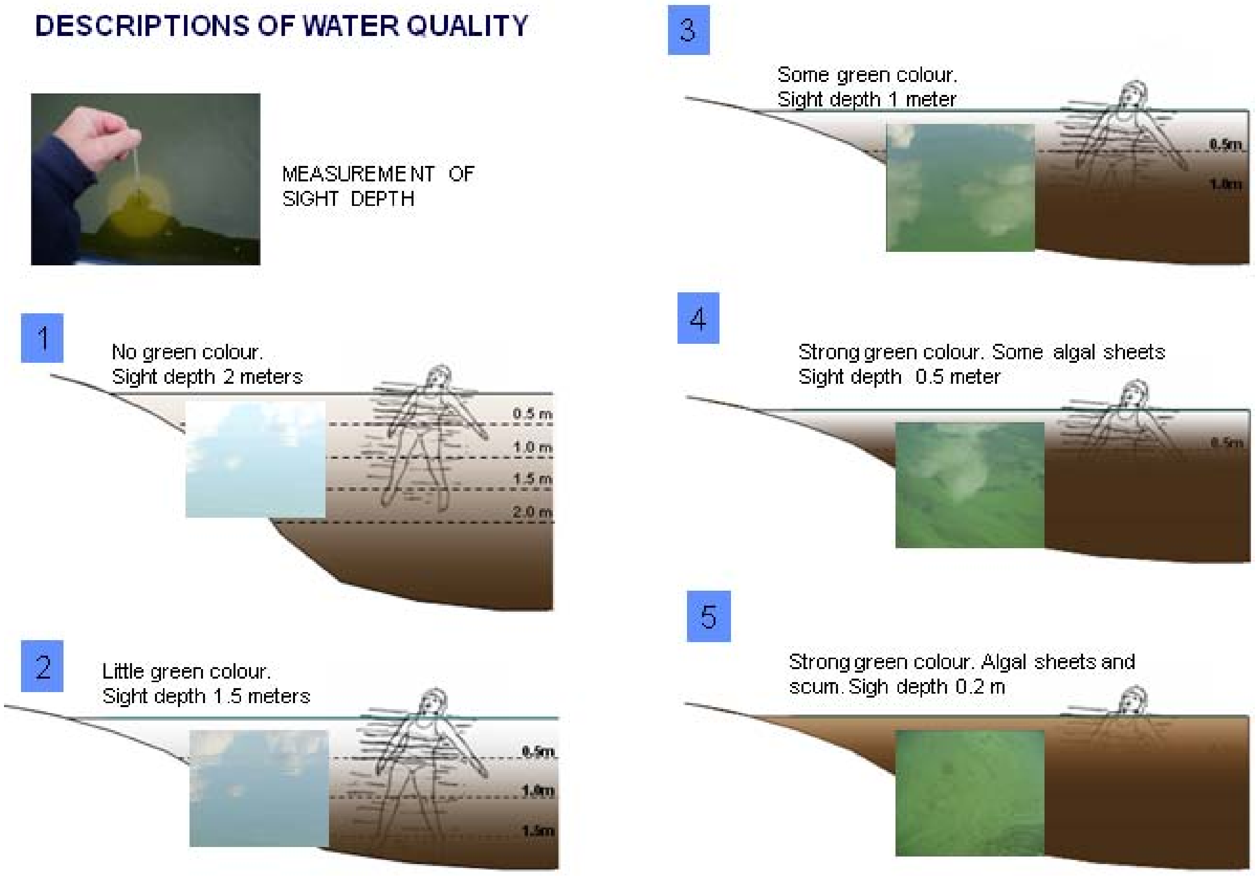


Figure A6.4 Descriptions of water quality attribute

After focus group discussions the water qualityattribute was defined as a combination of water colour and sight depth (Secchi depth) for a swimmer, conceptualised in diagrams. 5 water quality levels were depicted.

At the time of pilot testing the description of ecological status in rivers/lakes used in the main survey had not been developed. The definition of water quality in the pilot is narrower, focusing on esthetics and human health risk.

The water quality “ladder” above was also used to test respondents’ self-reported thresholds for when they would stop bathing, which could be compared with thresholds implied by choices made in the choice experiment.

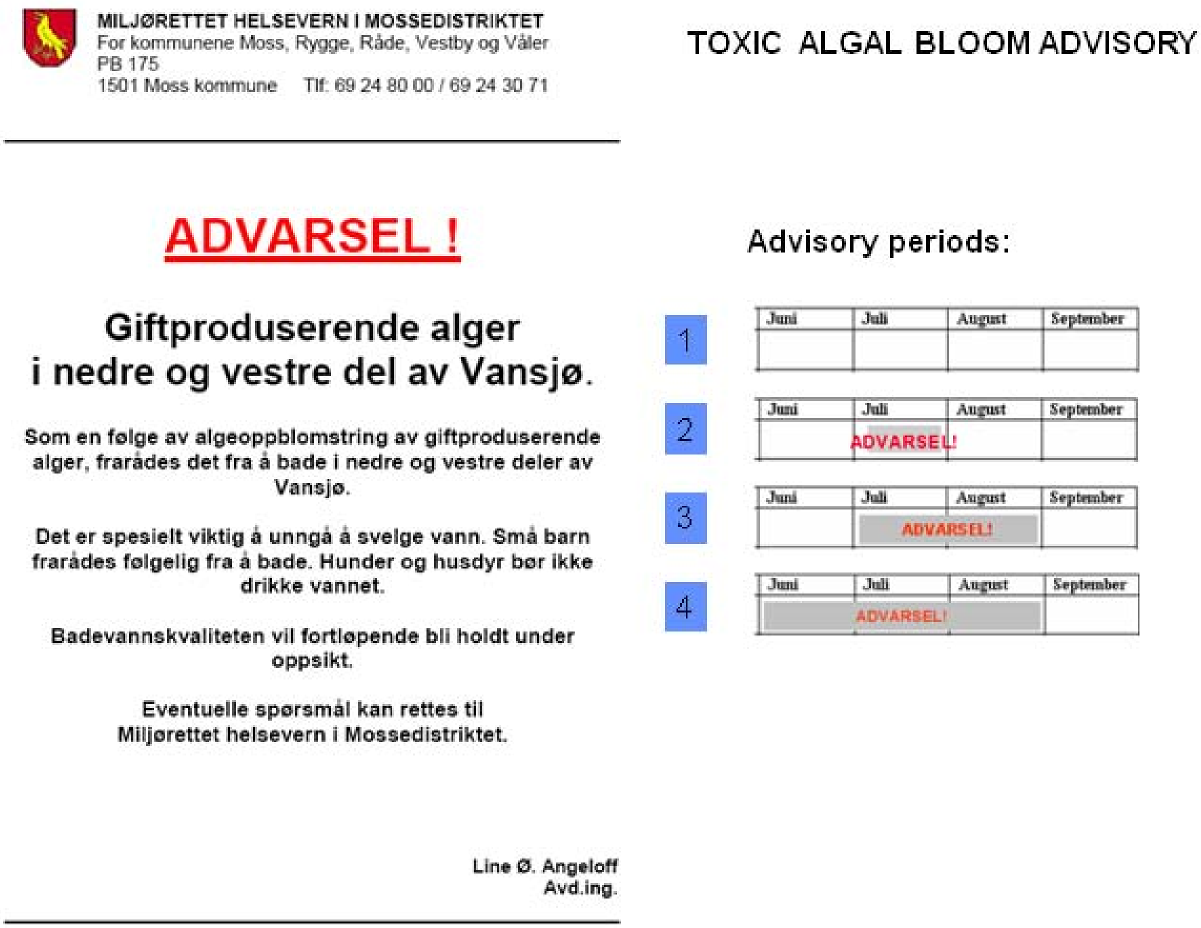


Figure A6.5 Descriptions of health risk as a bathing warning

A second attribute was a description of health risk associated with cyanobacteria blooms. This is a potentially toxic algae which can occur under certain eutrophic conditions. It is treated as a separate attribute because algal blooms can occur without toxic cyanobacteria. We were also interested in evaluating the relative importance of aesthetic versus health risk issues. The attribute has four levels according to different health advisory periods when the WARNING sign facsimilied above is posted at recreational sites around the lakes experiencing cyanobacteria blooms.

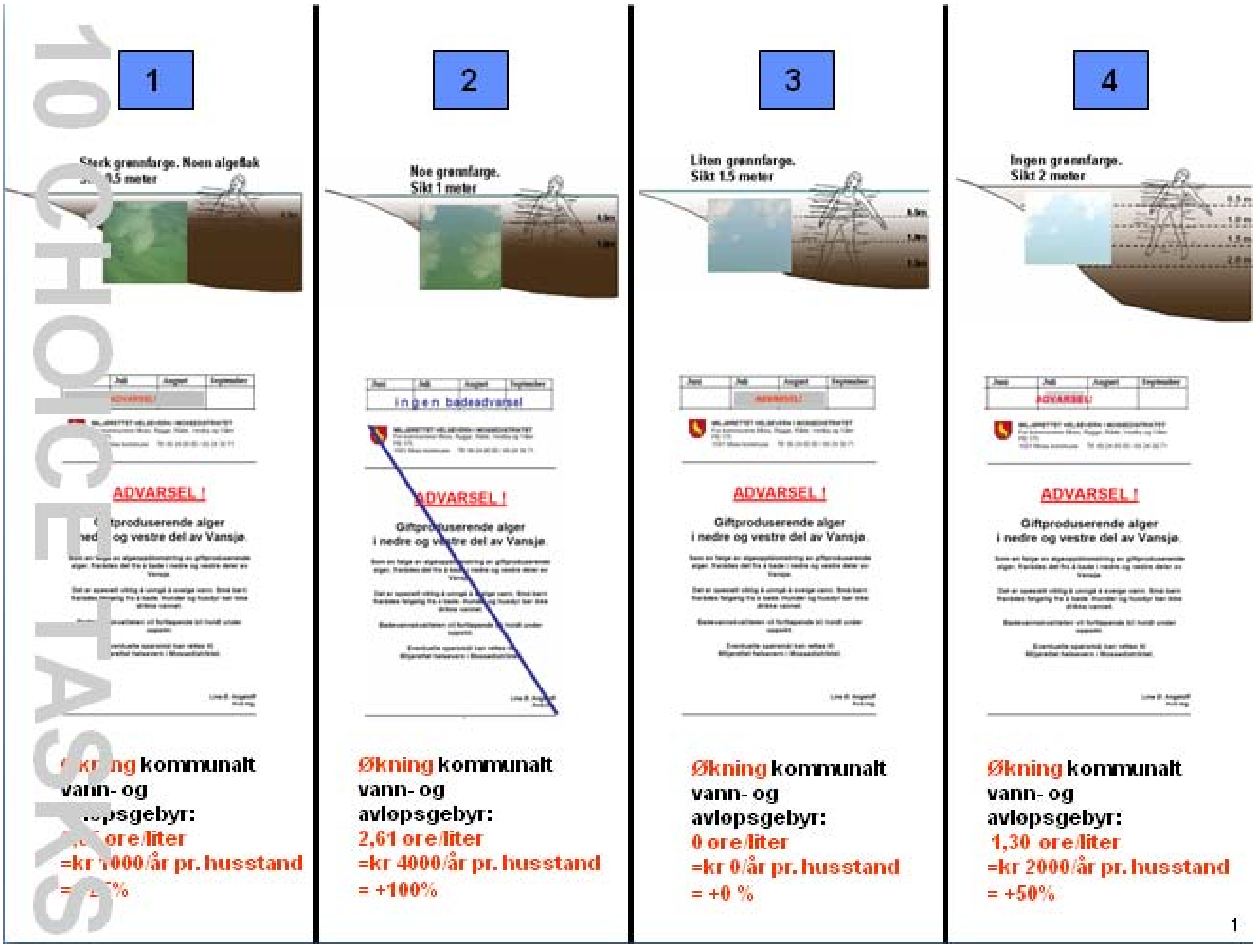


Figure A6.6 Illustration of a choice task

There were 12 choice tasks in total (10 experimentally designed and 2 fixed effects tasks). Each choice set had four alternatives. A status quo option was not used, but each attribute included the status quo level, making it possible to simulate choice probabilities for the status quo situation, based on respondent's choices (see below).

The experimental design was generated using Sawtooth software.

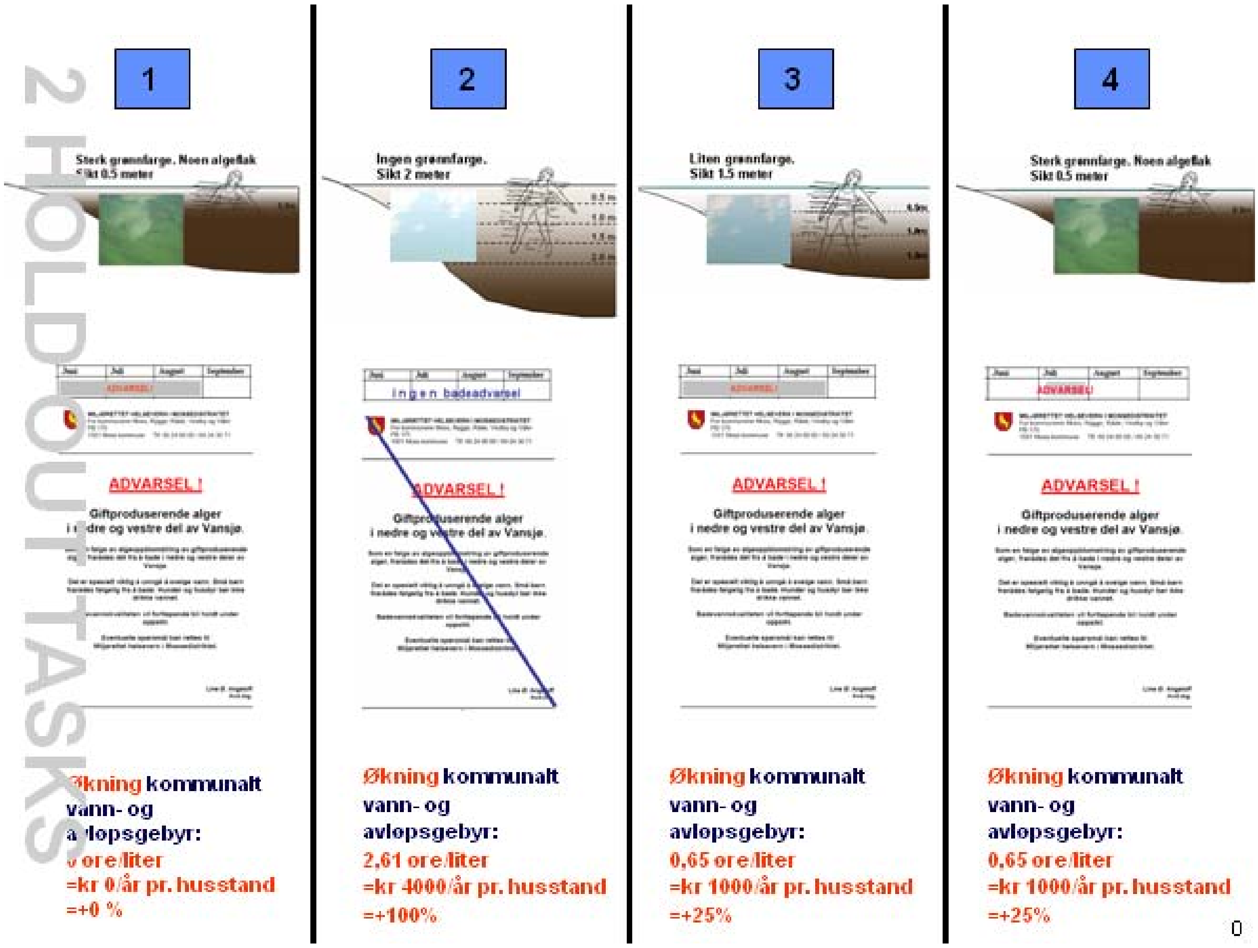


Figure A6.7 Illustration of fixed choice tasks

Two fixed choice tasks were included, as choice #3 and #12, in order to test respondent consistency. Both the use of fixed tasks, more than 3 alternatives, and a large number of choice tasks were features tested deliberately to evaluate response to challenging valuation tasks.

Pilot study results in brief

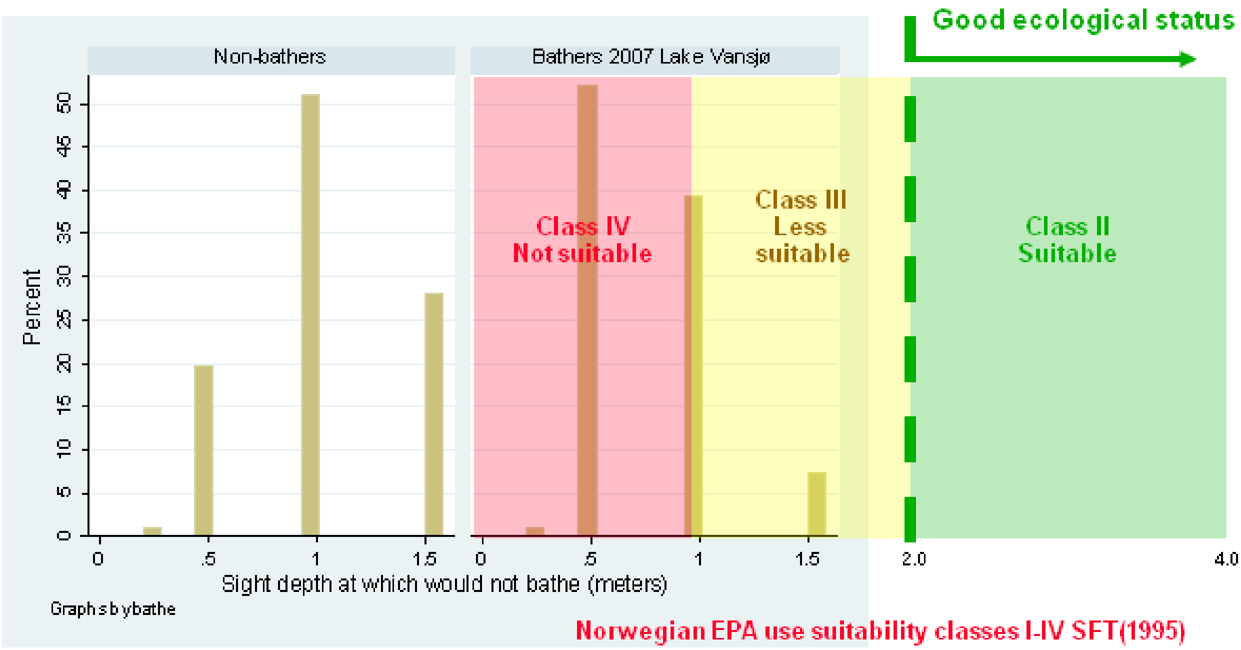
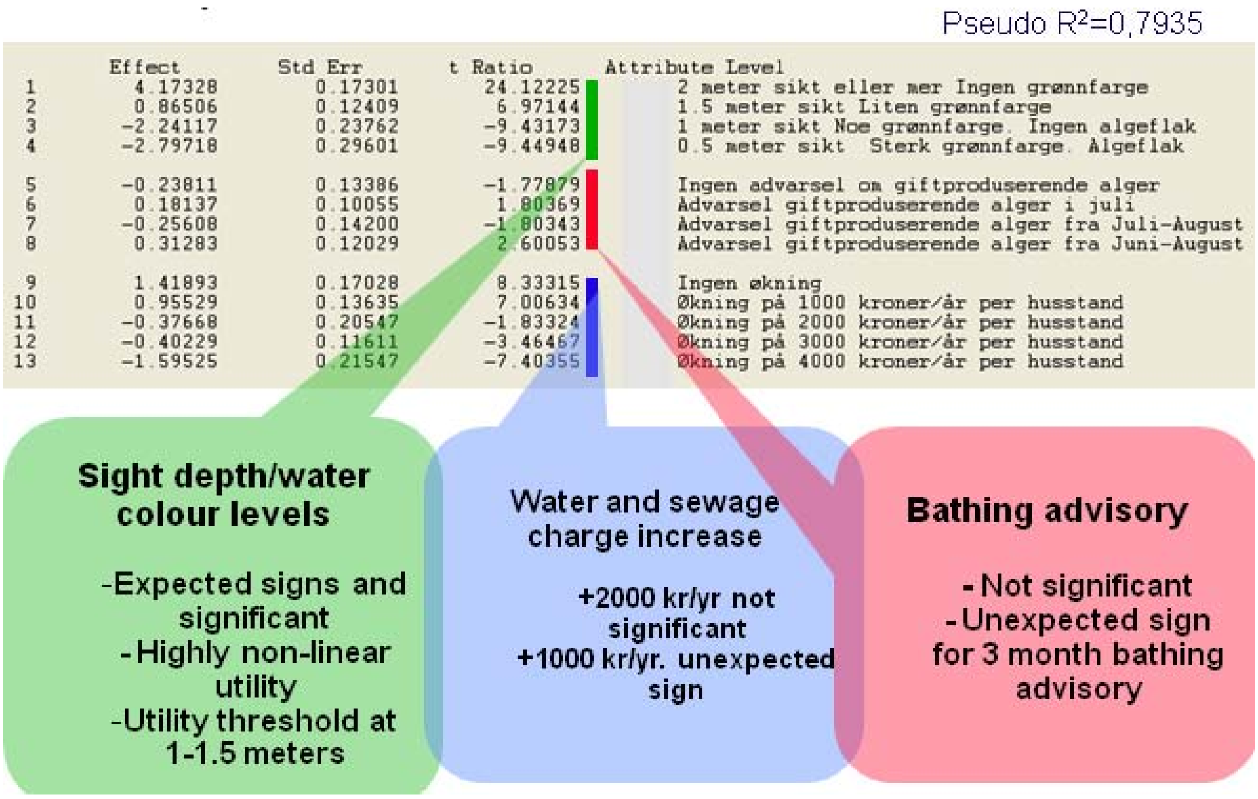


Figure A6.7 Regulator versus user perceived recreational suitability

Results from the questions regarding respondents' bathing suitability thresholds are shown in Figure A6.7. Class II is "suitable" for bathing in the Norwegian classification system (SFT 1995). Based on ChlA and Secchi depth values this corresponds roughly to the chemical definition of "good ecological status" for the lake type. The graph shows the percentage of "bathers" and "non-bathers" (in 2007 season) who would not bathe at different sight depths illustrated (0.2,0.5,1.0, 1.5 and 2 meters). For people who went bathing in summer 2007 the majority experienced a suitability threshold at 0.5 meters, whereas for non-bathers the majority experienced a threshold at 1 m. Bathers had higher tolerance of eutrophication levels, and in both groups their definition of suitability was less strict than the authorities' classification. This suggests that valuation studies using the official guidelines for suitability will tend to over-emphasise the impact of water quality improvements on recreational uses such as bathing (which has the greatest contact with water).



	Effect	Std Err	t Ratio	Attribute Level
1	4.17328	0.17301	24.12225	2 meter sikt eller mer Ingen grønnfarge
2	0.86506	0.12409	6.97144	1.5 meter sikt Liten grønnfarge
3	-2.24117	0.23762	-9.43173	1 meter sikt Noe grønnfarge. Ingen algeflak
4	-2.79718	0.29601	-9.44948	0.5 meter sikt Sterk grønnfarge. Algeflak
5	-0.23811	0.13386	-1.77879	Ingen advarsel om giftproduserende alger
6	0.18137	0.10055	1.80369	Advarsel giftproduserende alger i juli
7	-0.25608	0.14200	-1.80343	Advarsel giftproduserende alger fra Juli-August
8	0.31283	0.12029	2.60053	Advarsel giftproduserende alger fra Juni-August
9	1.41893	0.17028	8.33315	Ingen økning
10	0.95529	0.13635	7.00634	Økning på 1000 kroner/år per husstand
11	-0.37668	0.20547	-1.83324	Økning på 2000 kroner/år per husstand
12	-0.40229	0.11611	-3.46467	Økning på 3000 kroner/år per husstand
13	-1.59525	0.21547	-7.40355	Økning på 4000 kroner/år per husstand

Figure A6.8 Results of the effects coded model

The choice data was analysed using Sawtooth software. Figure A6.8 shows some of the model output and highlights the interpretation of the parameters. Notably, respondents' choices suggested an implicit threshold for when sight depth gives positive utility of between 1- 1.5 meters, most similar to thresholds expressed by non-bathers. WTP calculations based on choice experiments assume that the marginal utility of money (measured by the price attribute) is constant: this is not the case here.

The price attribute (water and sewage charge increase) is negative for high charge levels, but positive and significant for the lowest level of 1000 kr./yr. This may be interpreted as a certain fixed minimum fee increase being "acceptable" and even desired, in the context of the water and sewage.

The bathing advisory attribute has unexpected signs and is only significant for the highest level. Against expectations it is positive, indicating that respondents interpreted the bathing advisory all summer as something positive. The design of the attribute did not work as expected and it was decided to abandon this attribute in the main survey. A possible problem is that the visual queues of more months (of warning) were interpreted as better, while the warning sign "crossed out" when no warning was given was interpreted as something negative. Another interpretation is that respondents gave the information in the warning sign value rather than evaluating the disadvantage of not being able to bathe due to the health risk it portrayed (respondents valued the avoided health risk).

Choice	Actual holdout task shares	Predicted shares (HB)	Absolute error (HB)	Predicted shares (logit)	Absolute error (logit)
1	0,70%	0,99%	0,29%	1,78%	1,08%
2	78,32%	77,66%	0,66%	53,63%	24,69%
3	20,98%	21,35%	0,37%	43,61%	22,63%
4	0	0	0	0	0
Mean absolute error(MEA)			**0,33**		**12,1**

Table A6.1 Logit versus Hierarchical Bayesian(HB) predictions of hold out task market shares

Sawtooth software was also run with a Hierarchical Bayesian model (HB). The HB model has much better predictive power than logit model as measured by mean absolute error of predicting the"hold-out task" shares for each choice (1-4). The hold-out tasks are the two fixed tasks which we held out of the analysis. A weakness of the “hold-out” alternatives we specified is that they didn’t include the kr. 2000 and kr. 3000 price levels (i.e presented starker choices to respondents, that were more easily made and predicted by the model).

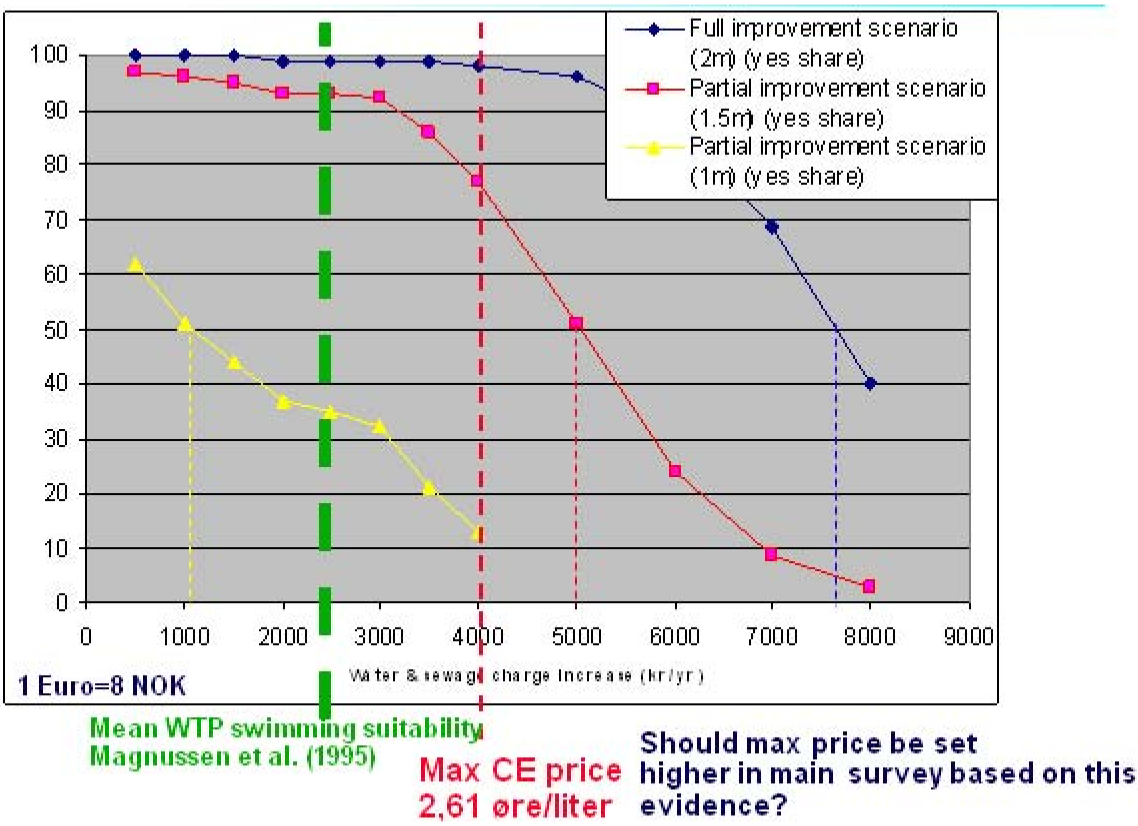


Figure A6.9 Evaluating pricing strategy using effects coded model

In figure A6.9 we use the multinomial logit model estimated in Sawtooth to predict the share of respondents that would say yes to a scenario at particular water and sewage fee increases and water quality levels. The choice experiment results in the pilot indicate that improvements in sight depth to 1.5 meters or better a majority of households would accept a fee increase as high as kr. 4000 per year. For a increase in sight depth to 1 meter a fee increase would have to be no more than about 1000 kr/year to be accepted by a majority of respondents.

This is compared to the contingent valuation based WTP results obtained by Magnussen et al. (1995). They conducted a study of households in municipalities around lakes Vestre Vansjø and Storefjorden, finding mean WTP of approximately 2400 kr/yr. per household for an improvement in two water quality classes.

Summary of pilot findings in brief

- Functional relationships between attributes
  - use a water quality ladder combining characteristics
  - impose realistic restrictions on experimental design
- Visual cues (increase price visibility)
- Large number of choice sets (keep 10 + 2 choice sets)
- Number of choices per choice set (reduce to 2+stat.quo)
- Water and sewage fee price range (increase by 50%)
- Model validity tests (consistency test, predictive capacity)
- Non-linear models (effects coding)
- Models without heterogenous preferences? (Mixlogit, Latent Class, Hierarchical Bayesian)

Appendix 7 - A note on sampling for distance decay and scope effects

The AQUAMONEY project is testing scope effects in the non-market valuation of water quality improvements. The scope test is conducted in order to document the internal validity of the case studies on water quality. The scope test is being conducted using a split sample experiment where one water body and then two water bodies (rivers or lakes), and vice versa, are increased two quality levels on a water quality ladder.

The AQUAMONEY project is also testing the presence of distance decay effects in the valuation of water quality improvements. The documentation of distance decay effects in the case studies is expected to provide further internal validity to the valuation results, in comparison with studies that do not sample populations far from the policy relevant water body. The definition of “far” in distance terms has generally be interpreted in the case studies to mean far enough for other substitute water bodies to be as close, or closer, than the water body that is the focus of policy assessment. We can call this the “scale“ of the study.

The AQUAMONEY case studies are hoping to identify distance decay, substitution and scope effects in the same studies. This note argues that these three research objectives may be hard to disentangle. There is even a trade-off to be made between identifying scope effects and distance decay in the same study while also accounting for substitutes. Distance decay is easier to observe with larger geographical scale / sampling area just because distance to the water body is greater from the furthest household sampled. Larger scale studies will also include more substitute sites reinforcing the distance decay effect. Substitute effects strengthen or are confounded with distance decay effects. The note argues that both make it harder to observe scope effects in the “one versus two water bodies” scope tests of AQUAMONEY. The note also illustrates the argument that explicit modeling of

- Scale/distance decay
- Substitute sites
- Scope effect

will reduce double counting and inflated benefit estimates in the aggregation of willingness to pay across multi-activity, multi-site-user households. At the same time greater demands are placed on conduct benefits transfer, because scale, substitutes and scope are expected to be significant elements of the context of the valuation case studies. This section makes the argument using mostly graphical analysis.

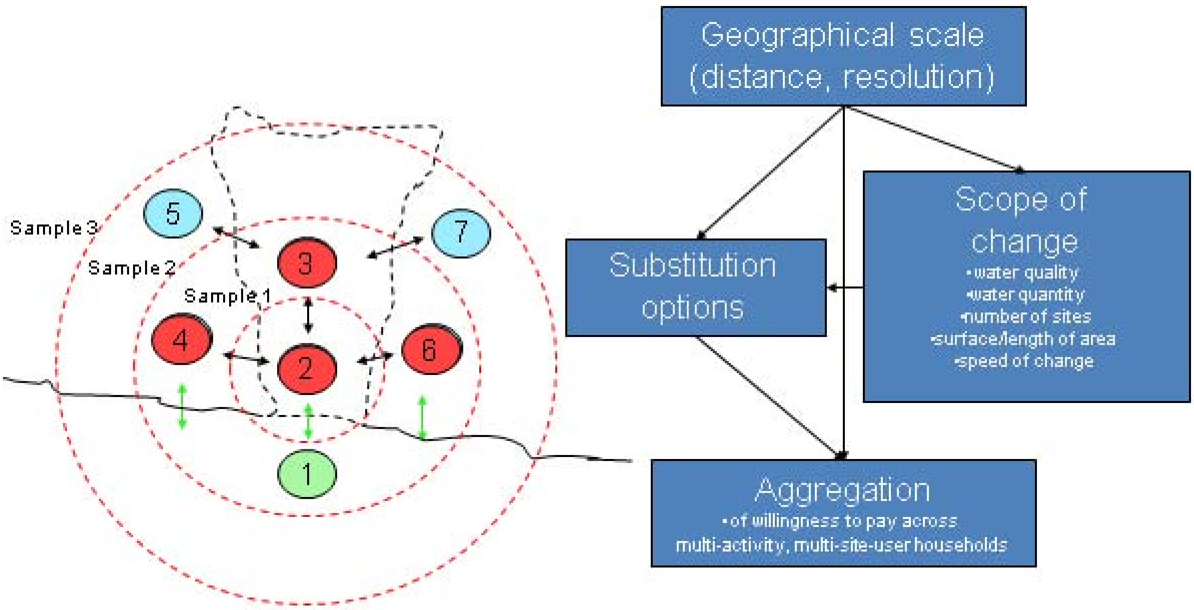


Figure A7.1 Context dependence of valuation study . Numbers symbolize different water bodies inside and outside a catchment draining to the sea (#1). A valuation practitioner must make a decision on the geographical scale of the sample (sample 1, 2 or 3).

Figure A7.1 summarises the context dependence of the valuation results and sets the stage for the discussion about the trade-off between observing distance decay and scope effects. Increasing the gepgraphical scale of the sampling increases the distance to site #2 of households at the edge of the sampling are, and increases the number of substitute sites, both increasing the expectation of distance decay effects in the willingness to pay (WTP) for improvements in site #2. Increasing geographical scale of the study increases the range of possible scope effects, as different water bodies are expected to have varying water quality levels and other site characteristics. The more variation in site characteristics the more sites are possible substitutes for site #2.

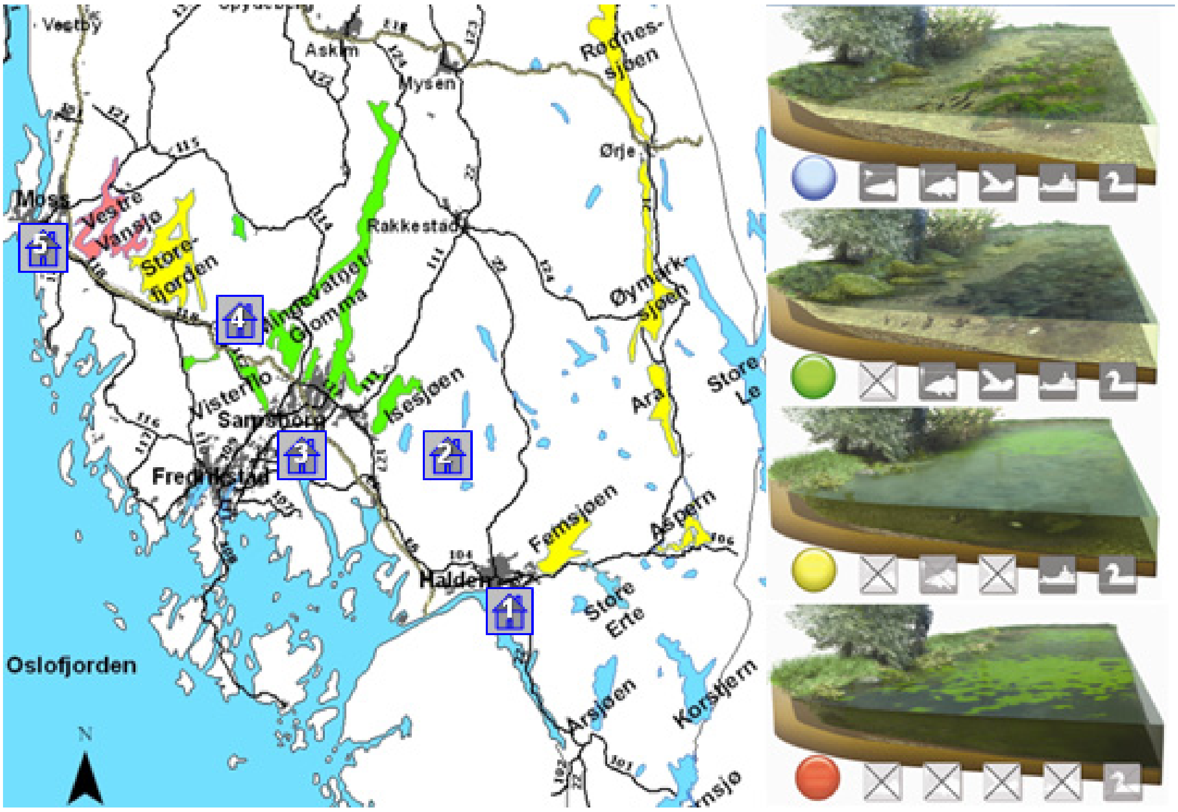


Figure A7.2. Lake water qualities and example household sampling locations. Water quality and recommended uses are illustrated using a "water quality ladder" with four levels. In this example from South Eastern Norway a number of lakes are of particular interest for valuation, including (a) "Vestre Vansjø ", (b) "Mingevatnet/Glomma", and (c) "Femsjøen". Household #1 - #5 live at different distances from these lakes and we are interested in finding whether their WTP drops with distance and also the presence of substitutes such as the sea and other lakes (in blue quality).

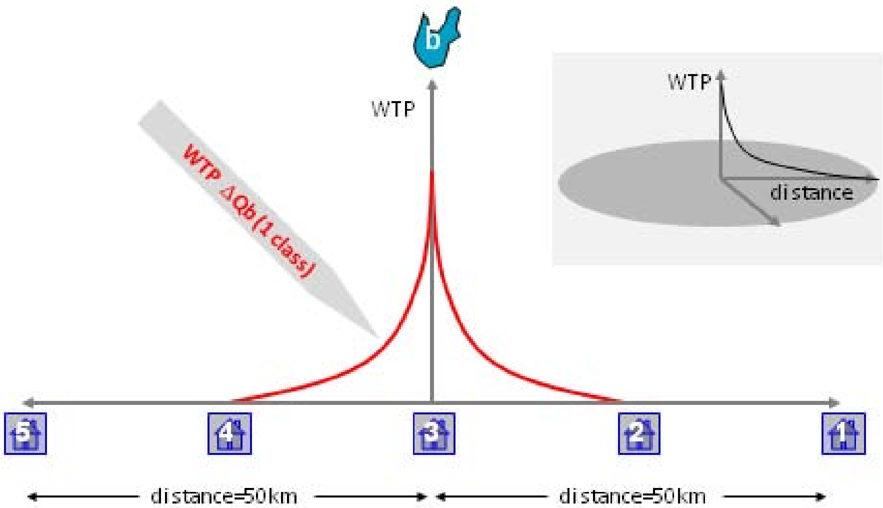


Figure A7.3. Distance decay in willingness to pay. Households #1 and #5 are about 50 km from lake (b). If distance decay in WTP is present we would expect WTP to be highest for household #3 and lowest for households #1 and #5. In this example households #2 and #4 have willingness to pay at or near zero, for an improvement Qb = 1 class on the water quality ladder. If there were no substitutes and the lake was equally accessible from all directions we would expect WTP to drop in a radius around the water body as illustrated in the upper right panel.

Figure A7.2 shows that the choice of geographical scale determines the variation in current water quality in the study and the variation in scope that is relevant to test for relative to the status quo. It also determines the number of substitutes that will be shown to respondents within the area.

Figure A7.3 shows that as long as there are no substitute sites WTP is expected to drop with increasing distance , or more accurately with increasing access time (because travel and time are assumed to entail costs for households). We would expect the "radius of WTP" to increase if the water quality improvement was 2 classes instead of 1 class.

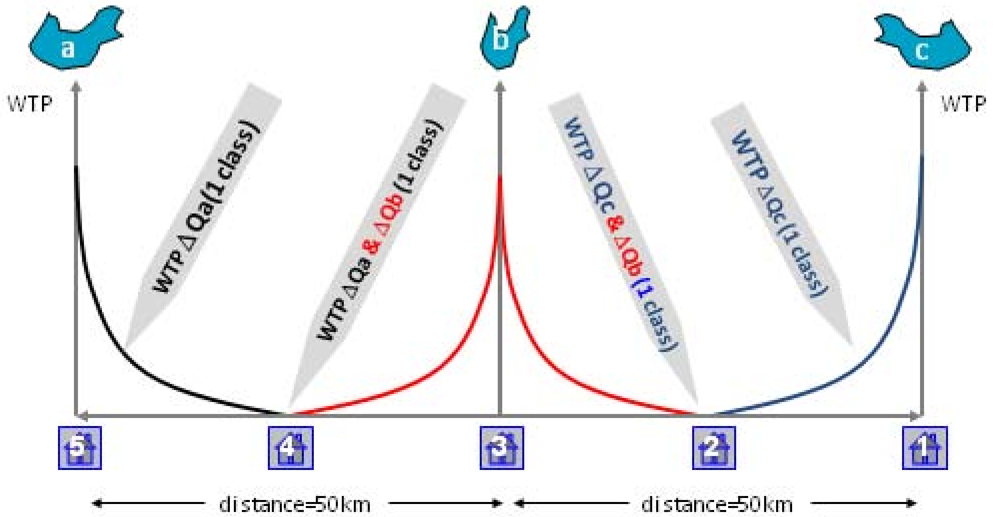


Figure A7.4. Distance decay in WTP and substitute sites. If quality improvements in additional lakes are being considered in the study, for example in a scope test, households #1 and #5 can be expected to have positive WTP for their local lakes. Households #2 and #4 live at equal distance from all lakes considered and still have near zero WTP for a 1 class quality improvement in this example.

Suppose that household # 1 is asked to give their WTP for an improvement in lake b first and then lake b+c, as an example of a scope test. Suppose we asked the same question to households #1-#3. Figure 4 shows that WTP for a 1 class quality improvement is not sufficient to uncover a scope effect because nowhere do any of the households live close enough to have WTP for both lakes (the valuation functions/lines don't cross in Figure 4). If these households are representative of the population there would be no significant scope effect observed in the study for lake b+a, or b+c.

This is not necessary because households are not sensitive to the scope of water quality improvements. The combination of the scale of the study, the resulting substitutes considered and the water quality improvement proposed to households together constitute a **study context** where there are no observable scope effects.

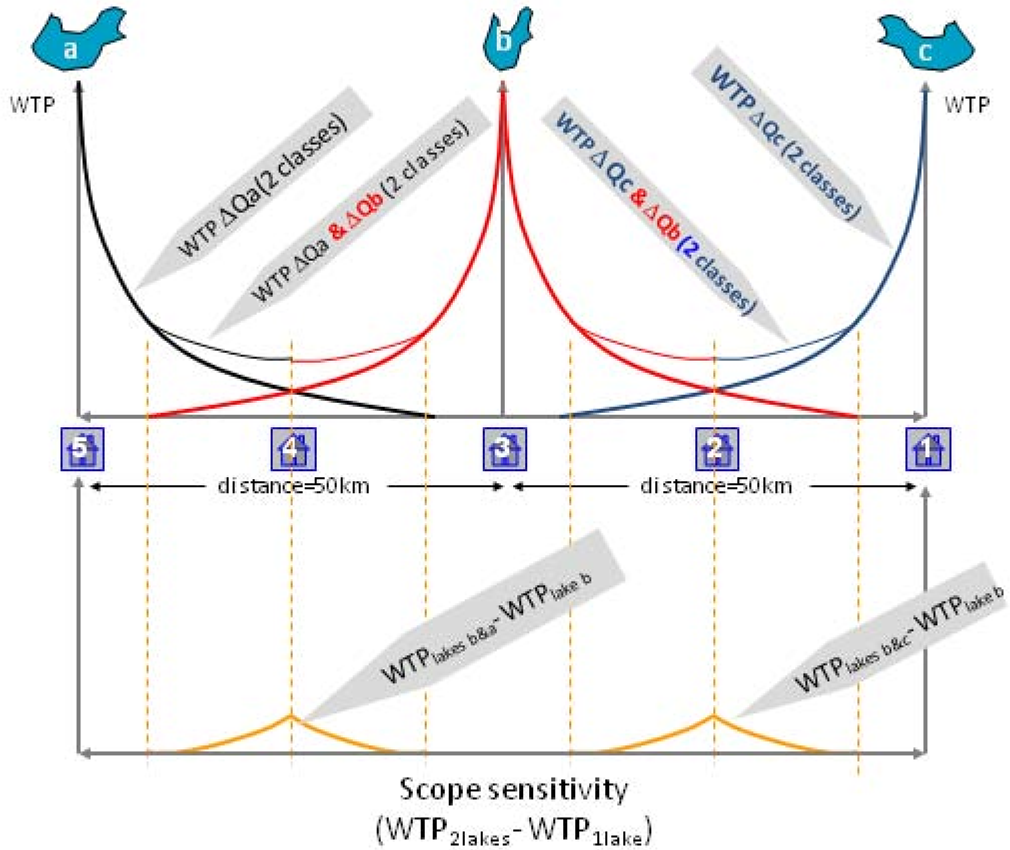


Figure A7.5. Sensitivity to scope when the water quality improvement is large enough. With a 2 class water quality improvement the WTP is positive at larger distances from the lakes. For households #2 and #4 they now overlap, implying that households in these areas consider the lakes to be substitutes and would be willing to pay for improvements in either. They have additional WTP for improvement in 2 lakes vesus in 1 lake (thin lines in the upper panel). Scope effects would only be observed for households that had the lakes as substitutes, while not being observed in other parts of the study area (households #1,#3 and #5).

Figure A7.5 illustrates that households may be sensitive to scope where the lakes included in the scope test are considered to be substitutes. In other words, presentation of water quality improvement scenarios in water bodies that are as close to each other as possible is advisable to increase the probability of finding scope effects (if indeed they are there). In the example of South-Eastern Norway shown in the map the scope tests have therefore been designed for the pair of lakes Vestre-Vansjø-Storefjorden and Femsjøen-Aspern in a split geographical sample.
Figure A7.6 shows that the geographical configuration of the lakes, their status quo quality, the size of the improvement proposed and the sampling strategy of the study, all combine to make it more or less likely that a scope effect will be identified.

Taken together these contextual characteristics of the valuation study pose greater challenges for benefit transfer testing than have been considered in previous research.

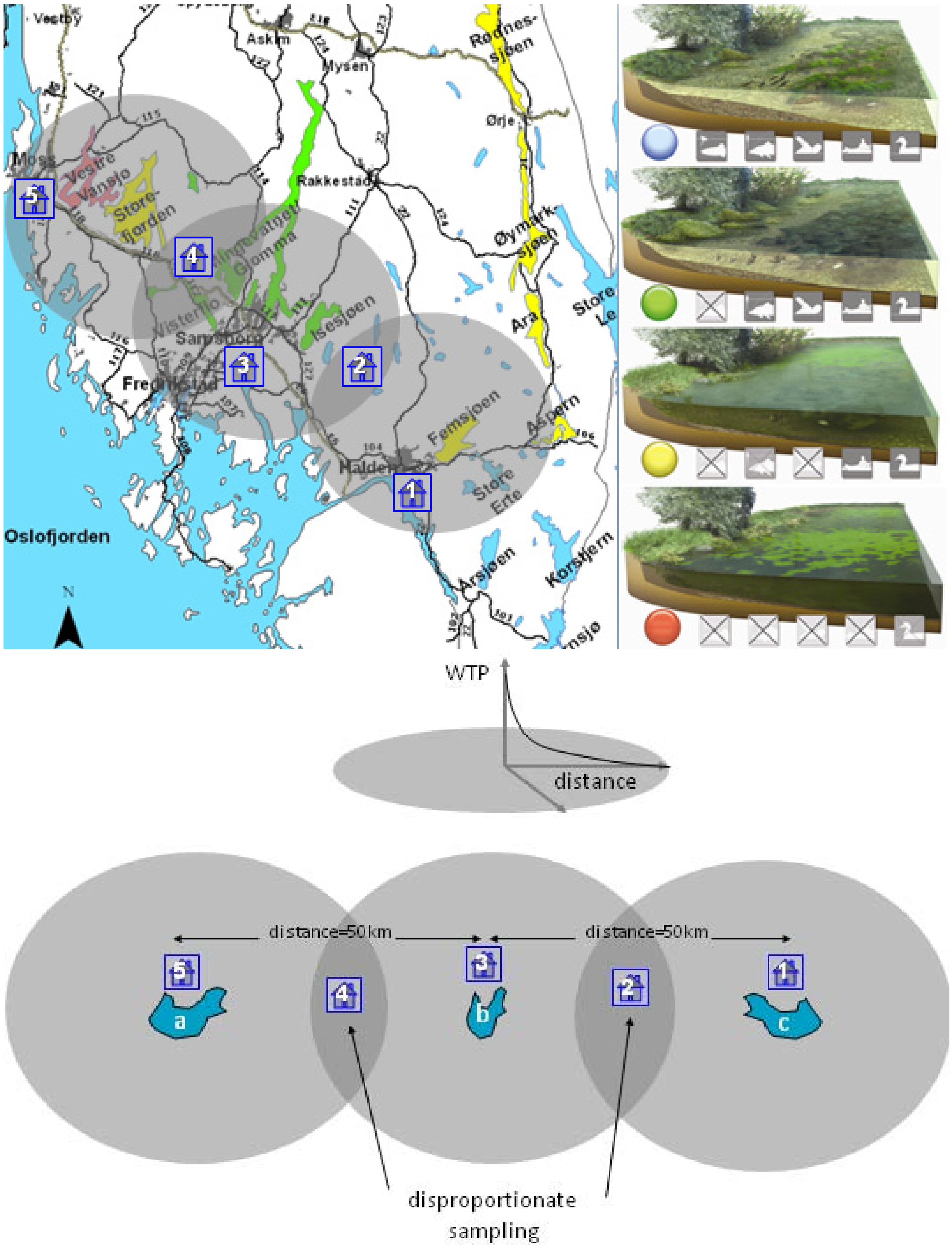


Figure A7.6 Adjusting household sampling strategies to detect scope. If WTP for lakes (a) "Vestre Vansjø ", (b) "Mingevatnet/Glomma", and (c) "Femsjøen" is positive in the radius suggested (upper panel) , then over proportional sampling of households in locations #2 and #4 might be necessary to detect a significant scope effect in the sample(lower panel). With (b) "Mingevatnet/Glomma" already in class "green" the scope test might also be limited by the status quo water quality situation (it isn't possible to propose a 2 class increase in this lake).

A limitation of internet surveys is that the panel of households may not permit sampling in households of the type #2 and #4, especially when they are in sparsely populated rural areas (Figure A7.7)

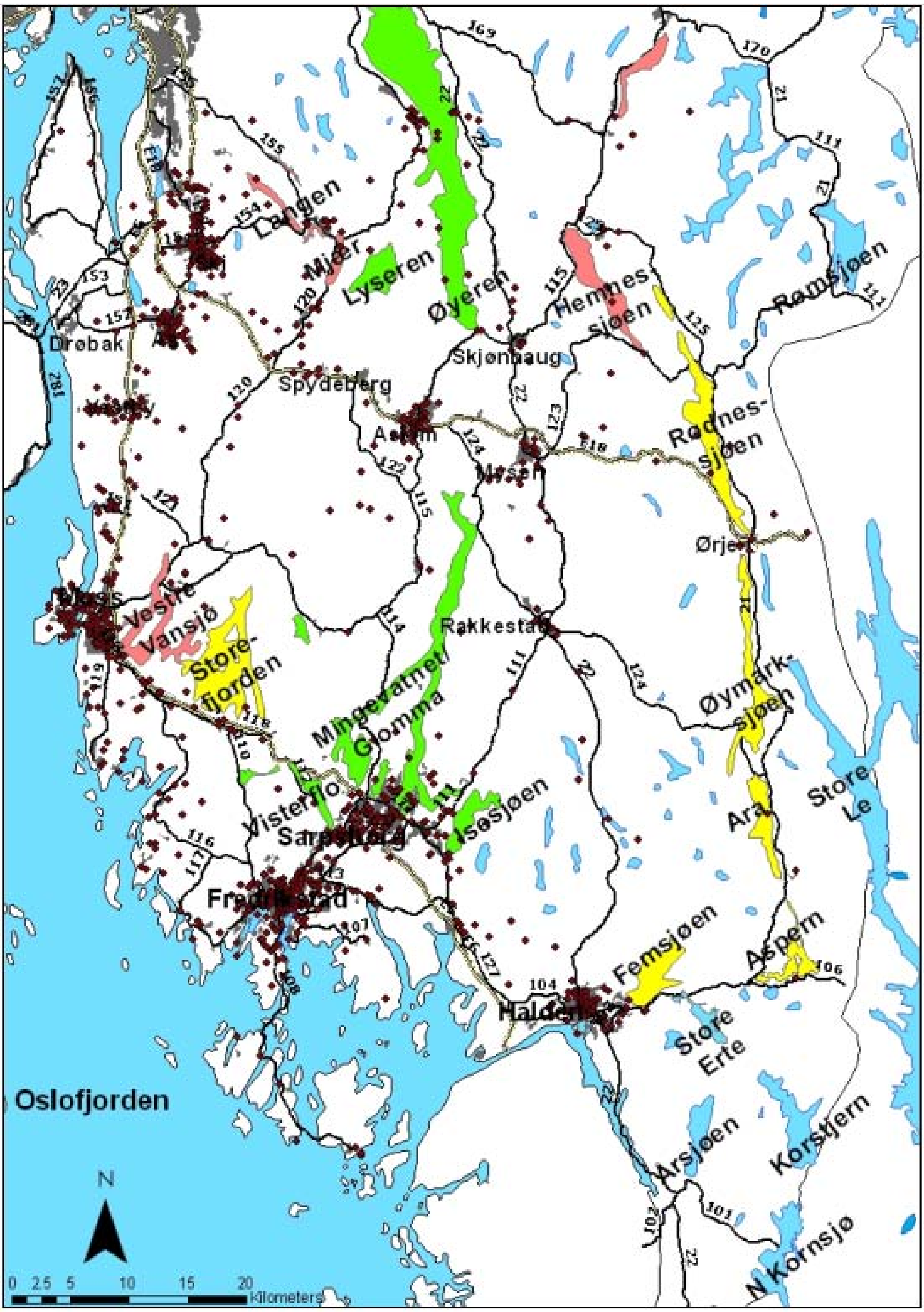


Figure A7.7 Distribution of the sample households in Østfold and Akershus.

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