

Benefits and costs of groundwater protection in Denmark

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Outline of presentation

- **Background**
- **The valuation study**
- **The results**
- **Conclusions**



Background

- **Danish drinking water policy and supply**
 - **Politically decided that drinking water should be naturally clean, i.e. untreated**
 - **99% of danish drinking water comes from groundwater**
 - **Boreholes are increasingly being closed due to contamination with pesticides and nitrate**
 - ? **The policy is becoming costly and increasingly difficult to maintain**
 - ? **Relevant to investigate consumers' preferences**



Background

- **The Water Framework Directive (WFD)**
 - Prescribes that good chemical and ecological water status should prevail in water bodies
 - Cost benefit analyses are required to support the implementation of WFD
 - Use of the disproportionate costs exemption requires specific knowledge of costs and benefits
 - ? Necessary to know the value of benefits of implementation
 - ? Relevant to perform valuation studies as benefits are non-marketed



The valuation study

- **Aim:** To estimate the benefits associated with groundwater protection and the benefits of water treatment
- **Method:** Choice Experiments (CE)

Note: A CVM study was conducted parallel to the CE



The two overall scenarios

- **1) Groundwater protection**
 - **Protection primarily through agricultural measures**
 - **Secures future supply of naturally clean drinking water**
 - **Improves conditions for animals and plants in surface waters**
 - **In compliance with the WFD**



The two overall scenarios

- **2) Water treatment**
 - **Polluted water is treated in order to satisfy standards for drinking water**
 - **BUT: no improved conditions for animals and plants in surface waters, and**
 - **Non-compliance with the WFD**



Attributes and attributes levels

- **Drinking water quality:**

- ***Naturally clean:***

Measures aimed primarily at agricultural practices prevent groundwater pollution from pesticides and nitrogen. In this way, clean drinking water is secured both now and in the future.

- ***Uncertain:***

The current situation, i.e. groundwater is protected as it is at the moment, however, no further measures to prevent pollution are introduced. There is, therefore, a risk that in future water from our taps will exceed current limit values for pesticides and nitrogen.

- ***Treated:***

By cleaning polluted drinking water for pesticide and nitrogen residues, supplies of clean drinking water can be ensured both now and in the future.



Attributes and attributes levels

- **Animal and plant life in watercourses and lakes:**
 - ***Very good:***
Animal and plant-life is natural, varied and in balance. Slight to medium impact from human activity.
 - ***Less good:***
Animal and plant-life is markedly different than would be the case under natural conditions and is, to a degree, in a state of imbalance. Representative of the current situation.
 - ***Poor:***
Animal and plant-life is significantly different than would be the case under natural conditions and is in a state of serious imbalance. Often completely changed due to human activity.



Attributes and attributes levels

- **The price attribute – an annual increase in water bill per household:**
 - Fixed annual sum per household claimed once a year via the water bill
 - 6 levels from 0 to 320 EUR/year increase (average annual water bill 530 EUR/year)

Note: A “Cheap talk” and budget constraint reminder is added



Example of a choice set

- 3 alternatives (incl. a status quo)

Choice 1.

Drinking water:

Animal and plant-life
in watercourses and
lakes:

Annual increase in
water bill per house-
hold:

I would prefer (*please
mark with a cross*):

Alternative 1

Uncertain

Less good

0 kr.

1

Alternative 2

Naturally clean

Very good

2.400 kr.

2

Alternative 3

Treated

Less good

625 kr.

3



Responses and modelling

- **Responses**
 - Survey administered in 2004
 - Initial sample size: 900
 - Effective sample size: 528
 - Respondents were presented with 6 choice sets each
- **Modelling**
 - Simple conditional logit model



Estimation results - WTP

	Parameter	Std. error	WTP (EUR)
Price	-0.00059***	0.0000	
Alternative specific constant	-0.7285 ***	0.1018	-165
Natural clean groundwater	1.1205 ***	0.0882	253
Treated groundwater	0.5381 ***	0.0852	122
Very good conditions	0.7105 ***	0.0661	161
Poor conditions	-1.0379 ***	0.0737	-235
N (no. of observations)	3,074		
Log L	-2,723.97		
χ^2	1,306.33		
Adjusted pseudo R ²	0.193		

Significance levels at 1%, 5% and 10% are indicated by three, two and one asterisk(s), respectively



Conclusions – use of results

- In relation to Danish drinking water policy:
 - Consumers prefer naturally clean drinking water to water that has been treated (the adopted policy is supported)
 - WTP for naturally clean water is almost 50% higher than the WTP for treated water
 - Consumers prefer treated water to water of an uncertain quality.



Conclusions – use of results

- **Good quality of drinking water is valued significantly higher than good quality of surface waters**
- **Respondents are ready to accept an 75% increase in their water bill in order to secure ground water protection**
- **In total, WTP for the ground water protection scenario exceed WTP for the water treatment scenario by almost 300 EUR per hh per year**



Conclusions – use of results

- **In relation to the WFD:**
 - **People have preferences for the benefits provided by the WFD**
 - **Input to assessments of benefits of implementation at local or national level (aggregation over no. of affected households)**
 - **Input to assessments of disproportionate costs?**



Conclusions – use of results

- **Example of use: (very crude) CBA of WFD implementation in Denmark:**
 - **NPV of groundwater protection based on this study: 33 billion EUR**
 - **Costs in terms of lost land rents: 133 – 2,000 million EUR**
 - **Conclusion: Why wait?**

Note: 2.5 mio. hhs, 3% interest rate, infinite timehorizon



Want to read more?

Report can be downloaded from www.dmu.dk

