



An economic evaluation of nitrate in groundwater: A contingent valuation survey in Northwest Florida



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Abstract

A double-bounded dichotomous choice contingent valuation survey was administered to 2,000 residents of Franklin and Gulf Counties, Florida, with the objective of documenting any bias as a result of the institutional basis in the hypothetical payment vehicle. The mean willingness to pay (WTP) estimates for state and private payment vehicles are \$4.39 and \$5.08 per month respectively, significantly different at the 0.15 level. This is evidence of the importance in choosing the institutional foundation for the payment vehicle. The major determinants of WTP appear to be education, perception of existing water quality and the attitudes of respondents towards the environment. However, WTP responses may vary temporally and spatially with differences in demographics and goods and services valued. This may have implication for contingent valuation practitioners.

Introduction

Nitrate in groundwater is a health concern. Florida relies heavily on groundwater for drinking. Ninety percent of Florida's population drinking water comes from groundwater.

Public concerns regarding the potential nitrate pollution of groundwater, and the subsequent health and environmental risks have created a demand for public policies to more closely examine and monitor water quality. Best management practices are recommended as control measures but more rigorous controls may need to be implemented. In either case, policies to improve groundwater will benefit from a rational approach that includes an economic assessment. Assigning costs to environmental disamenities (e.g. nitrate-polluted water) or benefits to environmental amenities (nitrate-reduced water) becomes important in determining the health risks of nitrate in groundwater.

To measure the impact of this health issue contingent valuation (CV) is used to evaluate willingness to pay.

Numerous CV studies have employed the double-bounded dichotomous choice (yes=1, no=0) format to elicit WTP values (Bishop, Heberlein and Kealy, 1983; Hanemann, 1984; Randall and Hoehn, 1989; Poe and Bishop, 1992; deZoysa, 1995).

Care must be taken in both the design and administration of a CV instrument to avoid potentially biased responses (Mitchell and Carson, 1989; Arrow, et al., 1993).

The 1993 (National Oceanic and Atmospheric Administration) NOAA Panel Report on CV model identifies the sources and potential corrections for survey biases.

The objective is to determine the mean WTP for reduced levels of groundwater nitrates, test for significant differences in the mean WTP between public and private institution payment vehicles, and evaluating the importance of an institutional basis.

Data and Method

A double-bounded dichotomous choice (yes/no with two open-ended follow-up questions) CV survey questionnaire was developed to be administered to 2000 residents in Franklin and Gulf counties, Florida to determine WTP to avoid nitrate in well water (Lyttle-N'Guessan, 2003). The survey instrument is designed with three sections:

First, the introductory section which sets the tone for decision making regarding budget allocation. It reminds the reader of the options and substitutes available to him/her by drawing attention to some government funded programs (environmental and non-environmental).

Second, a description of the amenity and WTP options follow i.e. the problem is explained along with the suggested corrective program, how the program will be implemented and a method of payment. Individuals are presented with a choice to purchase the amenity (nitrate-reduced water) for the specified bid price. This followed with a question to identify upper or lower bounds on their initial WTP. Two versions of the survey instrument that differed only by the institutional basis of the payment vehicle were presented. One version used the state of Florida (SF) while the other listed a private utility (PU) as the institution collecting the payment. The valuation question was introduced with monthly offer prices of \$1, \$5, \$10, \$20.

Payment Vehicle	Offer Prices			
PU	\$1	\$5	\$10	\$20
SF	\$1	\$5	\$10	\$20

Third, the socio-economic backgrounds such as age, sex, education, income of the respondents other information about her/his household are included as covariates in determining WTP values.

The study determined the mean WTP for reduced levels of groundwater nitrates and test for significant differences (Figure 1) in the mean WTP between public and private institution payment vehicles.

Figure 1:

$$t = \frac{(\bar{X}_{PU} - \bar{X}_{SF}) - (\bar{X}_{PU} - \bar{X}_{SF})}{\sqrt{S^2 \left(\frac{1}{n_{PU}} + \frac{1}{n_{SF}} \right)}}$$

Where:

- S^2 = the pooled variance
- PU = Private utility (private) payment vehicle
- SF = State of Florida (public) payment vehicle
- \bar{X}_{PU} & \bar{X}_{SF} = sample means (estimation of) for PU and SF respectively
- \bar{X}_{PU} & \bar{X}_{SF} = Population means for PU and SF respectively
- n = Number of observations

Data and Method Cont.

To evaluate the participation choices by survey respondents, and to validate findings, a probit model is used (Figure 2). The probit model is useful in establishing a relationship between the variable of interest (e.g. WTP= y) and a set of covariates (e.g. X including income, education). In other words it explains why people make the decision they made.

Figure 2: $E(y) = 0[1 - F(\beta X)] + 1[F(\beta X)] = F(\beta' X)$

Results and Discussion

The response rate from the survey questionnaire is a relatively low 15 percent. The mean WTP estimates differ significantly between payment vehicles at the 0.15 level (Table 1). While this is less than the 0.05 or 0.10 levels often reported in literature, it may still be noteworthy for some CV practitioners.

Table 1: Mean WTP by payment vehicle

Payment vehicle	Mean WTP	Standard error
State of Florida	4.3857	0.772
Private utility	5.0820	1.0077

Note: the WTP values are significantly different at the 0.156 level: $t = 1.489$, $df = 129$

Table 2. Summary of probit model results

Variable	Parameter estimate	p-value	Variable mean
CONSTANT	-3.035	0.232	
MALE (# of males in household)	-0.583	0.104*	1.08
INCOME (household income)	-0.0001	0.866	61,300
COLLEGE (0=none, 1=some +)	0.327	0.626	0.793
Q1ENV (preference index, environ.)	-0.840	0.468	0.632
Q1EDU (preference index, edu.)	-0.016	0.985	0.721
Q6 (opinion index of water quality)	-0.150	0.529	2.72
SF (state of Florida payment vehicle)	1.041	0.037**	0.534
Q6 (opinion index of water quality)	-0.150	0.529	2.72
Q7 (type of beverage typically consume.)	0.575	0.066*	2.23
PROTEST (objection to valuation ques.)	-0.464	0.000***	2.28
UPPERA (accepted offer price)	0.682	0.000***	4.23
PRICE (highest WTP)	-0.251	0.028**	4.71

NB: *, **, ***, indicate levels of significance at .10, .05 and .01 respectively.

Six variables including PRICE are found to be significant at 0.10 level or better, Table 2.

A person's likelihood to accept the offered price and participant in the program is negatively affected by the offered price itself.

Respondents with more education and longer years of residency are more likely to accept the offered price and participant in the program.

Respondents who believe the quality of water used in the home is safe are less likely to participate in the program.

Conclusion

Based on 131 respondents, there is a significant difference at the 15 percent level between the state vs. private payment vehicles for mean WTP.

The mean WTP per household per month for SF and PU are \$4.39 and \$5.08 respectively, while the standard deviation for the complete sample (pooled standard deviation) is \$7.13.

The respondent's attitude and socio-economic characteristics affect his willingness to participate in the program?

The respondent's level of education, the price offered to participate in the program and the institutional basis of the hypothetical payment all affects choice behaviour.

The degree of distrust in a particular institution or organization might influence the WTP for a program.

Future studies may need to examine how varying demographics and historical perspective might alter the effectiveness of institutional basis.

Outcome is noteworthy for policy-makers and CV practitioners.

References

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