CORNELL
AGRICULTURAL ECONOMICS
STAFF PAPER

Prior Information, General Information, and Specific Information in the Contingent Valuation of Environmental Risks: The Case of Nitrates in Groundwater

Gregory L. Poe
and
Richard C. Bishop

July 1992

SP 93-11

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853

Prior Information, General Information, and Specific Information In the Contingent Valuation of Environmental Risks: The Case of Nitrates in Groundwater

Gregory L. Poe
and
Richard C. Bishop*

Abstract

Information, or lack thereof, is an important input in value formation and the distribution of contingent values. Although most conceptualizations of the contingent valuation process stress that information provision should be 'adequate,' very little empirical research has been devoted to assessing the effects of different information flows on contingent values and to establishing a standard of information adequacy for contingent valuation studies. The need for such research is particularly cogent for valuing the benefits of reducing environmental risks, a non-market good which is increasingly being valued with the contingent valuation method.

Using nitrates in groundwater as a case study, this paper evaluates and compares health risk perceptions and the distribution of contingent values for groundwater protection associated with three different levels of information provision. In the first level, no information about nitrates or personal exposure was provided to the participants, an approach which reflects the philosophy that values should be based on *prior* information and preferences. The second information level provided participants with *general* information about the health effects of nitrates, sources of nitrate contamination, government standards for nitrates, indicators of the distribution of nitrate levels in local wells, and opportunities for averting behavior. The third level of information flow provided the general information packet along with *specific* information about actual nitrate levels found in participants' wells.

The primary results of this research are that individuals need a *full-information* set that includes both general and specific information to identify their own best interests with respect to groundwater protection programs, and that the provision of general information alone appears to lead to biased estimates of willingness to pay for groundwater protection. These results establish a full-information standard for future contingent valuation research of groundwater protection.

---

* The authors are, respectively, Assistant Professor, Department of Agricultural Economics, Cornell University, and Professor, Department of Agricultural Economics, University of Wisconsin-Madison. This research and paper were funded, in part, by the Center for Integrated Agricultural Systems, University of Wisconsin-Madison, and the College of Agriculture and Life Sciences, Cornell University. The authors are indebted to Jean-Paul Chavas and Bill Provencher for comments on the research, and to Patricia Champ and Dan Mullarkey for their help with the data collection.

This paper was presented at the Association of Environmental and Resource Economists sponsored session of the Annual Meetings of the American Agricultural Economics Association, Orlando, August 1993.

Prior Information, General Information, and Specific Information in the Contingent Valuation of Environmental Risks: The Case of Nitrates In Groundwater

Information is an important input in value formation and the distribution of contingent values [Hoehn and Randall; Bergstrom and Stoll; Samples, Dixon and Gowen; Boyle; Bergstrom, Stoll and Randall]. Although critical assessments of the contingent valuation process stress that information provision should be 'adequate' in order to obtain satisfactory transactions and reliable values [Fischhoff and Furby; NOAA], very little empirical research has been devoted to establishing a minimum standard of information adequacy for contingent valuation studies. The need for such research is particularly cogent for valuing the benefits of reducing environmental risks such as groundwater contamination, as this is an unfamiliar commodity for most households and previous research indicates that risk perceptions are affected by new information [Viscusi and O'Connor; Smith *et al.*; Smith and Johnson].

Using nitrates in groundwater as a case study, this paper evaluates health risk perceptions and the distribution of contingent values for groundwater protection associated with different levels of information provision. The evidence presented in this analysis suggests that *general information* about nitrates, *specific information* about exposure levels, and *prior information* affect contingent values, and that individuals update their perceptions of groundwater safety with new information. Evaluations of individuals' abilities to assess their reference and target risks associated with a nitrate protection program suggest a *full-information* standard that includes both general and specific information for future contingent valuation research of groundwater protection.

Conceptual Framework

The conceptual framework underlying this analysis is based on the *ex ante* statistical life model in which exogenous risks are modified by self-protection activities [see Berger *et al.*, Shogren and Crocker]. In this framework it is hypothesized that individuals optimally select exposure and averting activities in order to maximize state dependent expected utility.

The extension of this framework to willingness to pay for groundwater protection from nitrates requires that the consumption and averting activities be specified. Here we assume that households consume drinking and cooking water (X) from three sources (i), each with an associated price (p) and nitrate level (N). These include: water consumed from the household well ($X_1(N_1)$); water consumed from sources outside the home ($X_2(N_2)$) such as at school, restaurants, neighbors' homes etc.; and sources of water consumption intended to mitigate exposure ($X_3(N_3)$), including the installation of purification systems, importation of water from 'pure' wells, and the purchase of bottled water. Let $\bar{X}$ denote the vector of water consumption, $\bar{N}$ denote the associated nitrate levels, $\bar{p}$ denote the vector of prices, and define $\bar{p}\bar{X} = p_1X_1(\bar{N}) + p_2X_2(\bar{N}) + p_3X_3(\bar{N})$. For simplicity assume that $N_3=0 < N_1,N_2$.

Uncertainty is introduced into the model at two levels. Because of the stochastic nature of biological and physical transport, it is reasonable to define N_1 and N_2 as random variables with a joint probability of $\eta = \eta(N_1, N_2)$. Second, under the state dependency framework of the statistical life theory, health outcomes play an important role. Yet, given exposure to a hazard, future health outcomes (h) remain a random variable. Let this uncertainty be characterized by the conditional probability density function $f(h;\bar{X},\eta)$ and let $F(h;\bar{X},\eta)$ represent the associated cumulative distribution function defined over the set of possible health states A.

The distribution of anticipated exposure levels and health risks are subjective and information dependent, implying that information levels need to be explicitly identified in the model. In specifying information levels, our analysis distinguishes between information about nitrates that is general in nature and information that is specific to a household's exposure level from its own water source. *General information* (GI) about nitrates would thus include possible health effects and sources of nitrates, government standards, and opportunities for mitigation. With this bundle of information, the decision maker could conceivably define health effects and optimal averting and consumption strategies for each hypothetical level of exposure. *Specific information* (SI) about nitrate levels found in an individual's well would affect the subjective distribution of nitrate exposure levels.

On this basis, general and specific information can be incorporated into the subjective distributions as follows. Joint distributions of nitrate exposure levels are treated as a function of both general and specific information

$$\eta = \eta(\bar{N}_1, \bar{N}_2 | GI, SI) \tag{1}$$

as both types of information will likely have effects on the perceived distribution of N_1 and N_2. That is, individuals may extrapolate their own exposure to general groundwater effects and vice versa. It is postulated that the distribution of conditional health outcomes, however, is a direct function of general information alone

$$f(h | \bar{X}, \eta, GI) \tag{2}$$

The corresponding joint conditional probability distribution of exposure and conditional health outcomes links the two distributions

$$g(h,\eta\,|\bar{X},GI,SI) = f(h|\bar{X},\eta,GI)\,\eta\,(N_1,N_2|GI,SI) \tag{3}$$

The ability to assess the exposure risk and the conditional health effects underlying this conditional joint probability distribution for both target and reference risks is of fundamental import in the valuation of groundwater protection programs. For this reason, the analysis of survey responses presented later in this paper focus on the ability of individuals to assess the safety level of their current exposure. Throughout the remainder of this paper, safety perceptions serve as a proxy for exact risk distributions implied in the equations.

The impact of new information on the joint conditional probability distribution will depend upon the degree of bias from the 'true' health risk and the weight placed on prior perceptions. In turn, the strength of the weights placed on prior perceptions and new information will likely be a function of the amount of prior information gathering.

It is essential to note that general and specific information will not only affect perceived risks but may enter directly affect arguments in the constraint and utility functions. For instance, information about the price of substitute goods could affect the optimal consumption set through the budget constraint. Information about nitrate contamination may affect preferences based on non-use motivations such as altruism, bequest and existence values.[1] Incorporating these ideas, the utility maximization problem can be stated as

$$\max_{\bar{X}} \int_0^{\infty}\int_0^{\infty}\int_A U_h(W-\bar{p}\bar{X},\eta;GI,SI)\,dG(h,\eta\,|\bar{X},GI,SI)\,dN_1\,dN_2 \tag{4}$$

where W is wealth, the subscript h denotes state (health) dependent utility, and A depicts the range of possible health outcomes[2]. In this model information components are interpreted as a signal or an observation of a random variable that affects the joint probability distribution of nitrate exposure and health risks as well as elements of the utility and constraint functions. Complete isolation of effects is not possible because information affects both the subjective utility and risk aspects of the maximization problem.

Defining X^{o} to be the optimal vector of water consumption associated with the nitrate distribution (η^{o}) without the program and X' to be the optimal vector of water consumption associated with the post-program nitrate distributions (η'), state independent willingness to pay (WTP) is defined implicitly by

$$\int_0^\infty\int_0^\infty\int_A U_h(W-\bar{p}\bar{X}^{o},\eta^{o};GI,SI)\,dG(h,\eta^{o}|\bar{X}^{o},GI,SI)\,dN_1\,dN_2 = \int_0^\infty\int_0^\infty\int_A U_h(W-WTP-\bar{p}\bar{X}',\eta';GI,SI)\,dG(h,\eta'|\bar{X}',GI,SI)\,dN_1\,dN_2 \tag{5}$$

In this model, WTP is considered an *ex ante* total value that accounts for both use and non-use motivations.

Survey Design and Procedures

As a case study, this research focused on the very specific issue of groundwater protection from nitrate contamination in rural areas of Portage County, Wisconsin. Here, "rural" is defined as the 1980 census tracts which did not have municipally or centrally provided water. The population in this area was estimated to be 22,432 in 1990.

In order to assess how general information about contaminants and specific information about exposure levels affects WTP for a groundwater protection program that keeps nitrate levels in all county wells within government standards of 10 mg/l, the survey design consisted of two sequential stages. WTP for the groundwater protection program was elicited before (Stage 1) and after (Stage 2) individual nitrate test results were provided to survey participants. In addition, general information about nitrates was varied across groups in the Stage 1 survey.

Stage 1 survey participants were asked to complete a questionnaire and submit a water sample that would be analyzed for nitrates by the Wisconsin State Laboratory of Hygiene. All households selected for the Stage 1 survey received a package in the mail that included a questionnaire and water sampling kit. In addition, households selected for the Stage 1 survey were divided into two groups. One-half (With-GI) of the participants were provided written general information in the questionnaire about the possible health effects of nitrates, sources of nitrate contamination, government standards for nitrates, distribution of nitrate levels in Portage County wells, and opportunities for averting and mitigating actions. This information packet represented a composite of information taken from pamphlets available from local extension, university and other government sources -- i.e. sources that are readily accessible to Portage County residents through local extension offices. The other half (No-Info) of the Stage 1 sample did not receive this information packet. In the Stage 2 survey, all participants who returned samples and completed a Stage 1 survey were provided their nitrate test results for their household water supply along with general information about nitrates and a second questionnaire.

In all, this survey design resulted in three different treatments for the analysis of information effects: the 'No-Info' group received no information in the Stage 1 questionnaire;

the 'With-GI' group received general information about nitrates in the Stage 1 questionnaire; and the 'Stage 2' participants received both general and specific information about nitrates. This design allowed the evaluation of the impacts of general information on questionnaire responses by comparing the No-Info and With-GI group responses. The effect of specific information was evaluated by comparing the Stage 1 and Stage 2 responses.

The implementation of the survey followed established procedures detailed by Dillman. A total of 480 Stage 1 surveys were mailed out in three separate waves that allowed for updating of dichotomous choice bid values[3]. After correcting for bad addresses, approximately 77.9 percent of the households returned a completed Stage 1 questionnaire and water sample. Differences in responses between Stage 1 information groups were relatively minor and not statistically significant. The conditional response rate to the Stage 2 survey was approximately 83.0 percent. Combined, the overall response rate to both stages was about 64 percent. Item non-response reduced the effective response rate for the contingent valuation analysis to 69-71 percent for the various Stage 1 models, and to about 55 percent for both the Stage 1 and Stage 2 surveys combined.

General and Prior Information, Learning, and Risk Perceptions: Stage 1

This section evaluates the effects of information on responses to select questions in the Stage 1 questionnaire. Difference in means tests of demographic characteristics across Stage 1 information treatments indicated that there was no significant difference in sex, age and education level of respondents, household size and age distribution, membership in environmental organizations, association with farming, and household income between the No-Info and the With-GI treatments. In addition, the well characteristics and mitigating activities were statistically similar across information groups.[4] On this basis, we concluded that information treatments were drawn from the same socioeconomic population. As such, observed differences in risk perceptions and contingent values across information groups can be attributed to informational rather than sampling effects.

In contrast, prior information --as measured by the existence of a previous water test for nitrates-- is associated with different socioeconomic characteristics. Using difference of means tests, it was determined that people who had previously tested their water for nitrates (With-Test) had significantly higher levels of education and income, were younger and had more family members (especially children) in the household than the people who had not previously tested their water (No-Test). The wells of the With-Test group tend to be newer than those of the No-Test group, and a significantly higher proportion had undertaken averting actions (e.g. using water from another well, purchasing bottled water, installing nitrate purification systems). Based on these comparisons it was concluded that the With-Test and the No-Test groups constituted self-selected subpopulations in Portage County, and were separated in the analyses that follow. In conjunction with the differences in information provision, four different subgroups are identified in the Stage 1 analysis. These subgroups, and the acronyms used to identify them, are depicted in Table 1.

Learning: A fundamental question in survey research is whether or not individuals learn from information provided with questionnaires. The degree of learning attributed to general information was measured in the Stage 1 survey responses to a 9 point quiz about nitrate contamination. In spite of the demographic similarities noted above, the mean score on this quiz was significantly different across information groups, providing an indicator that individuals were able to assimilate the information provided. Prior water testing also appears to be correlated with knowledge about nitrates, as demonstrated by higher scores for the With-Test groups. A summary of these quiz scores is provided in Table 2.

Hypothetical Conditional Safety Perceptions: The ability to link perceptions of safety to different nitrate levels was addressed by the following question:

*Q17. Suppose that your well water was tested for nitrates, and that your well test indicated a nitrate level of _______ mg./l. In **your opinion** would you believe that this well is safe or unsafe for **your household** to use as the primary source of drinking water? (CIRCLE ONE NUMBER)*

for which nitrate levels 2, 4, 6, 8, 10, 12, 15, 20, 30, and 40 mg/l were randomly assigned to respondents within each information group. Categorical response options included "*Definitely Safe*", "*Probably Safe*", "*Not very safe*", "*Definitely Not Safe*" and "*Don't know*". For those who were able to respond, aggregated response patterns reflected government health standards of 10 mg/l: "*Definitely Safe*" responses are monotonically decreasing across increasing nitrate levels and "*Definitely Not Safe*" responses are monotonic in an increasing fashion. Both the "*Probably Safe*" and "*Not Very Safe*" responses peak at intermediate levels.

Of greater interest in this analysis is the magnitude of "*Don't know*" responses to safety questions, which provide an indicator of uncertainty in conditional health risk perceptions as defined in Equation (2). As depicted in the first column of Table 3, the proportion of "*Don't know*" responses to Q17 fell from 0.456 to 0.192 when general information was provided. Thus it appears that assimilation of general information does extend to the ability to assess the safety of different exposure levels. A similar reduction in uncertainty about conditional health risks was noted for the impact of prior nitrate tests. On average the proportion of "*Don't know*" responses fell from 0.450 to 0.103 between the No-

Test and the With-Test groups. This observation suggests that previous experience with nitrate testing is associated with the gathering and retention of general as well as specific information.

Current Exposure Levels: The respondents' ability to assess their current levels of nitrates in their household wells was evaluated with the following question:

Q23. Federal and state authorities have established safety standards for concentration of nitrates in the groundwater. Based on what you have heard and read, or any previous water tests that you may have taken, do you think that your well water has...(CIRCLE ONE NUMBER)

Categorical response options ranged from "*Much less nitrates than the safety standard (less than 1/2)*" to "*Much more nitrates than the safety standard (more than double)*". Again, a "*Don't know*" option was included. As demonstrated in the second column of Table 3, general information did not have a significant effect on the number of "*Don't know*" responses. A significant reduction was however associated with prior nitrate testing. Most notably, the high proportion of "*Don't know*" responses in the No-Test group (~53%) reflects the high degree of uncertainty about exposures for that group. In the context of Equation (1), this suggests a poorly defined (wide) distribution of exposure levels.

Personal Safety Levels: Further evidence of general information and prior testing effects on uncertainty in the joint conditional probability distribution expressed in Equation (3) is found in the responses to the following questions, each of which employed the response format presented in Q17 above,

*Q24. **In your opinion** are the nitrate levels found in your well safe for **adults** and **children older than 6 months** to use as their primary source of drinking and cooking water?*

*Q25. **In your opinion** are the nitrate levels found in your well safe for **infants less than 6 months** to use as their primary source of drinking and cooking water?*

As demonstrated in the fourth and fifth columns of Table 3, uncertainty concerning assessments of the safety of their personal well water, as measured by the proportion of "*Don't know*" responses, was not significantly reduced by general information. In fact, when evaluating general information effects within the With-Test group, a significantly larger proportion of "*Don't know*" responses to safety perceptions for adults and infants was observed for the treatment that received general information about nitrates. This provides an indication that general information may induce some uncertainty and anxiety about personal exposure levels. In contrast, uncertainty about exposure is apparently reduced by prior testing, as demonstrated by the significant reductions in the "*Don't know*" responses between the No-Test and With-Test groups and subgroups.

Future Exposure Levels: In addition to current exposure levels, individuals were asked to assess the likelihood of future exposure with the following question:

Q26a. **Without**... a groundwater protection program, do you expect the nitrate levels in your own well to exceed the government standards for nitrates during **the next five years**?

Responses to this question were categorical variables with probabilistic interpretations ranging from "*No, definitely not*" to "*Yes, definitely (100 percent chance)*". In order to force a response, a "*Don't know*" option was not included for this question.

In all cases, a bell shaped curve centered on "*Maybe (50 percent chance)*" was observed in the Stage 1 analysis (see Table 4), a response distribution characteristic of uncertainty about future exposures. Chi-squared tests of independence from contingency table analyses indicated that the With-GI and No-Info treatments were not independent ($\chi^2 = 1.24 < \chi^2_{4,.10} = 7.78$), and that the With-Test and No-Test response functions were also not independent ($\chi^2 = 3.25$). In this manner, neither general information nor prior testing strongly affect assessments of the likelihood of future exposure.

Specific Information and Risk Updating: Stage 2

As indicated, individuals received nitrate test results and general information along with the Stage 2 questionnaire. A graphical depiction of their nitrate level relative to natural levels and government standards was included on the inside front cover of the questionnaire, and thus participants were not asked to identify current levels of exposure. All participants in the Stage 2 survey received the same full information set, and separate Stage 1 information treatments were not isolated in the analysis of risk perceptions. Because of differences in socioeconomic characteristics, distinction between the With-Test and the No-Test group was maintained in the Stage 2 analysis.

Personal Safety Levels: The two safety questions for adults and children were repeated in order to assess the reductions in uncertainty associated with the conditional joint probability distributions of health outcomes presented in Equation (3). Again, the proportions of "*Don't know*" responses served as an indicator of uncertainty.

The Stage 1 and Stage 2 proportion of "*Don't know*" responses are presented in Table 5 for the subsample of respondents who completed both stages of the survey. As demonstrated by the comparison of columns, the proportion of "*Don't know*" responses was reduced for all groups and safety questions, indicating that some updating has occurred. Of these differences, only the proportion of "*Don't know*" responses to the adult safety question for the With-Test group was not significantly lower in the Stage 2 survey. The lack of significance for this group may indicate that adult safety was conveyed in prior testing.

Future Exposure Levels: As part of the contingent valuation question, individuals were again asked to assess their likelihood of exceeding government standards for nitrates during the next

5 years. A χ^2 contingency table analysis indicated that the Stage 1 and Stage 2 responses are statistically independent ($\chi^2 = 40.09 > \chi^2_{4,.10} = 7.78$), suggesting that updating has occurred. Notably, a comparison of the Stage 1 and Stage 2 distributions of future exposure expectations indicates that expectations shifted from a bell shaped distribution in Stage 1 to a bimodal distribution in Stage 2 with peaks at "*Yes, definitely (100 percent chance)*" and "*Probably not (25 percent chance)*". These patterns reflect nitrate test results for the sample: 16 percent of the wells tested currently exceed government standards of 10 mg/l for nitrates and about 60 percent had nitrate levels less than 5 mg/l.

Further analysis of updating within the No-Test and With-Test groups was conducted using a risk updating framework discussed in Smith and Johnson. Adapting the Smith and Johnson model and assuming a probabilistic interpretation of the likelihood of future exposures, Stage 2 probabilities (R_{S2}) of exposure were modeled as a two-limit linear probit function of the Stage 1 probabilities (R_{S1}) of exposure and the nitrate test levels (N):[5]

$$R_{S2} = \beta_o + \beta_1 R_{S1} + \beta_2 N \qquad (6)$$

where β_i are coefficients to be estimated. Positive and significant coefficients on prior risk and nitrate test values (see Table 6) suggest that respondents place weight on their prior perception as well as new information gained from nitrate testing. Treating the new information contained in the nitrate test as an information message equivalent to observing a sample risk [Viscusi and O'Connor; Smith and Johnson], it is possible to recover the relative weights (W_N/W_{S1}) placed on new information and prior probability assessments as follows:

$$\frac{W_N}{W_{S1}} = \frac{1}{\beta_1} - 1 \qquad (7)$$

where β_1 refers to the coefficient on the Stage 1 probability assessment in Equation (6). The estimates of relative weights provide strong evidence of risk updating in both groups but suggest that the relative weight placed on new information is higher for the No-Test group (2.560) than for the With-Test group (2.091). Such a result is intuitively appealing.

Information and Contingent Values

The previous sections demonstrated that information was assimilated and that new information did affect individual perceptions of safety levels. This section evaluates the impact of information on contingent values by estimating and comparing WTP distributions.

The dichotomous choice contingent valuation question consisted of two parts. As discussed previously, individuals were first asked in Q26a to provide their expectation of the likelihood that their own wells would exceed government standards for nitrates during the next five years. In the second part, individuals were asked the following question:

> *Would you vote for the groundwater program described above if the total **annual** cost to your household (in increased taxes, lower profits, higher costs, and higher prices) were $____________ each **year** beginning now and for as long as you live in Portage County?*

A dollar value (BID) was inscribed in each questionnaire.

A linear in the coefficients specification of the logit model was used to evaluate yes/no (1/0) responses to this question [Hanemann]. Because of small sample size[6] for individual cells depicted in Table 1, the data was grouped into With-Test and No-Test groups on the basis of the previous conclusion that these groups represent distinct subpopulations. Differences in information provision are accounted for by binary variables that shift the constant (DINFO) and the coefficient on dichotomous choice bid values (DINFO*BID).

Knowledge about nitrates was accounted for in the analysis using the score on the 9 point quiz about nitrates (QUIZSCORE) in the Stage 1 survey. In accordance with the theoretical model, averting activities were also included, with binary variables that took a value of 1 if the averting activity was undertaken and 0 otherwise. The variable DAVTPERM captured permanent averting activities including the installation of a nitrate purification system and getting bottled water from another well. This binary variable was expected to have a negative coefficient because these activities represent somewhat irreversible substitute consumption choices that have high adjustment costs. Anecdotal evidence supports this line of reasoning. In response to a $216 dichotomous choice bid value, one respondent wrote "No, but I would have (voted yes) if I hadn't recently put in a H20 softener and reverse osmosis system for that reason". Similarly, in an in-person pre-study of the questionnaire, a participant indicated that his WTP for protecting his well water was bounded because he was able to get all the good quality water he needed from his daughter's well in town. With investment in water transporting containers, this represented a permanent solution. In contrast, purchasing bottled water (DBOTWAT) is less likely to be perceived as a permanent solution because of low investment costs. As a result, no sign expectation was formed on this coefficient.

The linear logistic model of the WTP function in a dichotomous choice framework is specified as

$$P(\text{Yes}) = (1 + e^{-\theta_T})^{-1}$$

where,

$$\theta_T = \alpha_T + \beta_{1T}(\text{QUIZSCORE}) + \beta_{2T}(\text{DAVTPERM}) + \beta_{3T}(\text{DBOTWAT}) + \beta_{4T}(\text{FUTURE}) + \beta_{5T}(\text{DINFO}) + \beta_{6T}(\text{DINFO*BID}) + \beta_{7T}(\text{BID})$$

In the above equation, β_{iT} are the coefficients to be estimated, and the subscript T refers to the prior nitrate testing category. The estimated logit response functions for the Stage 1 survey by prior test group for this model are presented in the 'Full Model' heading in Table 7. As demonstrated by the high χ^2 values, each model is highly significant.

Log likelihood values for the difference between the two prior-test Stage 1 models exceed the critical values at the 10 percent level (LR= 17.57 > $\chi^2_{8,.10}$ = 13.36). Three differences are particularly noteworthy. First, the coefficients on the binary averting variables are not significant for the No-Test group. Similarly, the coefficient on the FUTURE value is not significant for the No-Test group, but is highly significant for the With-Test Group. This result corresponds with the earlier observation that the No-Test group had poorly defined reference conditions of exposure, and thus, future expectations should play a small role in responses across bid values. Finally, prior testing apparently dampens the effect of new information on the distribution of WTP, as the coefficients on information variables are significant for the No-Test group but not for the With-Test group. This may indicate that prior values are more established for the With-Test group or that much of the information provided with the survey had already been assimilated through prior testing.

Table 7 also presents the results from the Stage 2 estimates. In contrast to the above results, the Stage 1 level of information provision was not a significant explanatory variable in either of the Stage 2 response functions, averting actions did not play a significant role in the Stage 2 analysis, and the coefficient on FUTURE is found to be significant for both groups. This last observation contrasts with the Stage 1 result that expectations of future contamination were not a significant explanatory variable for the No-Test group. In conjunction with prior evaluation of risk updating, this result suggests that individuals receiving specific information are better able to incorporate their assessment of future exposure levels into their WTP for a groundwater protection program.

Further support that updating of WTP values does occur for the No-Test respondents is found in log-likelihood ratio (LR) tests across Stage 1 and Stage 2 models. Using the Short set of variables (DINFO, DINFO*BID, FUTURE, and BID) as the basis, the LR (17.32) exceeds the $\chi^2_{5,.10}$ value of 9.24. It thus appears that new information has affected the distribution of WTP for the No-Test group. Similar results are not found in the analysis across stages for the With-Test group: the LR test using the Short 1 variables provides an estimated value of 1.17. Thus, in spite of the evidence of risk updating, the estimated WTP distributions for the Stage 2 With-Test group is not significantly different from that of the Stage 1 distribution. Although individual updating did occur, it appears that, as a group, the WTP distribution of the With-Test group is relatively stable[7].

Existence of prior testing does appear to have a significant residual effect on WTP in the Stage 2 analysis, as the No-Test and With-Test estimates of the Short 2 model are significantly different (LR= 8.76 > 6.25 = $\chi^2_{3,.10}$).

General Information, Specific Information, Prior Information and Mean WTP

The information effects for the Stage 1 response functions suggest that general information flattens out the response function across bid values. These shifts in WTP are reflected in the corresponding distributions of mean WTP created using a simulation method detailed in Duffield and Patterson and the 'short' models presented in Table 7 (which retain only the significant coefficients for the information, future and bid variables). As presented in Table 8, general information appears to increase the mean WTP and reduces the precision of that estimate for the No-Test group. Because of the joint and individual lack of significance for the coefficients on the information variables, separate distributions for the No-Info and With-Info treatments were not estimated for the With-Test group.

Two causes for increased dispersion associated with general information provision alone are offered for the Stage 1 No-Test group. The first is that in assimilating general information households may selectively focus on, or react to, different facets of information that are pertinent to their life situation or preferences. For example, a household with small children will likely react quite differently to information about blue baby syndrome than a household of retirees. In contrast to homogeneous commodities for which information is expected to increase the uniformity of the service and reduce the variance of WTP [Boyle; Bergstrom, Stoll and Randall], such heterogeneity in the population and exposure levels would be expected to widen the distribution of WTP and decrease the precision of the mean value.

The relatively large spread of WTP and mean WTP for the With-GI group that had not previously tested their water may also be attributed to an informational imbalance. Previous research has suggested that too much information may create confusion about the value placed on a resource or commodity [Bergstrom and Stoll; Grether and Wilde]. In this study, possible confusion associated with general information could instead be attributed to the fact that there was not enough information presented in the general information packet. Individuals were presented with an abundance of information about nitrate related health risks and possible methods of avoiding exposure, but remained uncertain about their actual exposure levels. With such uncertainty about reference exposure and safety levels, individuals may become confused about the values that they place on groundwater protection and may need more information to make a satisfactory transaction. In this manner, information overload, which is an absolute concept, does not seem to be a problem. Rather, the wide dispersion of values may be attributed to an informational imbalance.

Using a significance level of α=0.10 and the convolutions technique presented in Poe, Lossin and Welsh, the difference between distributions of mean WTP for With-GI and No-Info groups is significant ($\hat{\alpha}$=3.0) for the No-Test group. Comparing the Stage 1 and Stage 2 estimates, the Stage 2 mean WTP value lies below the previous estimates for the No-Test group. Calculated at the parameter means, the Stage 2 No-Test mean WTP value was $169, which compares to the Stage 1 values of $225 and $685 for the NINT and WINT groups respectively. The difference between the mean WTP distribution for the WINT (Stage 1) and the No-Test (Stage 2) groups was significant at the 10% level ($\hat{\alpha}$= 0.6). In contrast, although the Stage 2 value was lower, the difference in the distributions of mean WTP values between the NINT (Stage 1) and the No-Test (Stage 2) is not significant at the 10% level ($\hat{\alpha}$= 38.1). Combined, these results further reinforce the Stage 1 conclusions that general information alone will inflate contingent values for groundwater protection programs when people have not previously tested their water.

Comparisons of the Stage 1 and Stage 2 mean WTP values for the With-Test group exhibited a different pattern. Calculated at the parameter means, the Stage 2 With-Test value was $348, which is almost identical to the Stage 1 value of $344. Comparison of the mean WTP distributions across stages was not significant at the 10 percent level ($\hat{\alpha}$= 90.5), supporting the previous inference that new information has less of an impact on groundwater protection values for those people who have already tested their water.

A comparison of the Stage 2 mean WTP values across prior nitrate test groups indicated that the With-Test group had a significantly higher mean WTP than the No-Test group (α=0.6). Because nitrate levels found in wells for each test group were not significantly different, this higher WTP value is attributed here to greater concerns about exposure for each nitrate level.

Concluding Remarks

Using data from a two stage survey design for a nitrate protection program as a case study, this paper has demonstrated that prior information gathering and information provided with a survey can have a significant effect on estimated WTP distributions. Differences in prior information gathering, as measured by prior testing of wells for nitrates, had two effects on WTP distributions. First, people who had previously tested their water for nitrates had a greater concern and a higher WTP for groundwater protection than people who had not previously tested their water, suggesting that distinction between prior testing groups should be made in future studies of groundwater protection. Second, although some updating of risk preferences was observed for the With-Test group, the estimated distributions of WTP and mean WTP were relatively stable. In contrast, strong information effects were found for the No-Test group. Most notably, the provision of general information alone, without providing specific information about exposure significantly shifted the WTP distribution and grossly inflated the mean WTP estimates.

The fact that information effects were observed for the No-Test group -- which we argue is most representative of the population outside of Portage County -- raises the question of the appropriate level of information provision in the valuation of groundwater protection and programs that affect environmental risks. While this issue certainly has a philosophical component [e.g. Bishop and Welsh], we focus here on a transactions based criterion which asks how much information is needed in order for respondents to make satisfactory transactions that reflect their own best interests [Fischhoff and Furby]. From this perspective, the conclusion is obvious: full information provision that includes both specific information about personal exposure levels and general information about the contaminants is essential for valuing programs that change present or future exposure levels. Lacking information about their own personal exposure level, households remain uncertain about their reference exposure. Without general information, individuals do not appear to be able to assess the relative safety of reference and target levels. In this manner, general and specific information are viewed as complementary and necessary in an adequate information bundle for valuing environmental risks. This brings into question the reliability and validity of past groundwater valuation studies which did not provide full-information set [e.g. Edwards; Schultz and Lindsay; Sun] and sets a full-information standard for future studies.

Unfortunately, this conclusion does not bode well for contingent valuation of groundwater protection programs. Water testing is relatively expensive and timely collection of water samples is difficult to organize. A full-information requirement will certainly escalate the cost and organizational requirements of future valuation studies. Perhaps some of these difficulties can be deflected by linking valuation studies with random sampling provided by public programs or hydrological studies based on private well readings. In regions or for chemicals in which testing is not prevalent, it may also be possible to substitute specific information with a hypothetical reference level.

References

Aldrich, J. H., and F. D. Nelson, 1984. *Linear Probability, Logit and Probit Models*, Sage Publications, Newbury Park, Ca.

Berger, M. C., G. C. Blomquist, D. Kenkel, and G. S. Tolley, 1987. "Valuing Changes in Health Risks: A Comparison of Alternative Measures", *Southern Economics Journal*, 53: 967-984.

Bergstrom, J. C., and J. R. Stoll, 1989. "Application of Experimental Economics Concepts and Precepts to CVM Field Survey Procedures", *Western Journal of Agricultural Economics*, 14:98-109.

Bergstrom, J. C., J. R. Stoll and A. Randall, 1990. "The Impact of Information on Environmental Valuation Decisions", *American Journal of Agricultural Economics*, 72:614-21.

Bishop, R. C., and M.P. Welsh, 1992. "Existence Values in Benefit Cost Analysis and Damage Assessment", *Land Economics*, 65:57-63.

Boyle, K. J., 1989. "Commodity Specification and the Framing of Contingent-Valuation Questions", *Land Economics*, 65:57-63.

Boyle, K. J., and R. C. Bishop, 1988. "Welfare Measurements Using Contingent Valuation: A Comparison of Techniques", *American Journal of Agricultural Economics*, 70:20-28.

Crocker, T. D., B. A. Forster, and J. F. Shogren, 1991. "Valuing Potential Groundwater Protection Benefits", *Water Resources Research*, 27:1-6.

Dillman, D. A., 1978. *Mail and Telephone Surveys- The Total Design Method*, Wiley, New York.

Duffield, J. W., and D. A. Patterson, 1991. "Inference and Optimal Design for a Welfare Measure in Dichotomous Choice Contingent Valuation", *Land Economics*, 67:225-239.

Edwards, S. F., 1988. "Option Prices for Groundwater Protection", *Journal of Environmental Economics and Management*, 15:475-487.

Fischhoff, B., and L. Furby, 1988. "Measuring Values: A Conceptual Framework for Interpreting Transactions with Special Reference to Contingent Valuation of Visibility", *Journal of Risk and Uncertainty*, 1:147-184.

Grether, D. M., and L. L. Wilde, 1983. "Consumer Choice and Information: New Experimental Evidence", *Information Economics and Policy*, 1:115-144.

Hanemann, W. M., 1984. "Welfare Evaluation in Contingent Valuation Experiments with Discrete Responses," *American Journal of Agricultural Economics*, 66:332-41.

Hoehn, J. P., and A. Randall, 1987. "A Satisfactory Benefit-Cost Indicator from Contingent Valuation", *Journal of Environmental Economics and Management*, 14:226-247.

McClelland, G.H., W. D. Schulze, J. K. Lazo, D. M. Waldman, J. K. Doyle, S. R. Elliott, and J. R. Irwin, 1992. *Methods for Measuring Non-Use Values: A Contingent Valuation Study of Groundwater Cleanup*, Draft, U.S. Environmental Protection Agency, Washington, DC.

National Oceanic and Atmospheric Administration, 1993. *Natural Resource Damage Assessments Under the Oil Pollution Act of 1990*, Federal Register, Vol. 58, No. 10 (January 15, 1993).

Poe, G. L., 1993. "Information, Risk Perceptions and Contingent Values: The Case of Nitrates in Groundwater," Ph.D. dissertation, University of Wisconsin-Madison.

Poe, G. L., E. K. Lossin, and M. P. Welsh, 1993. "A Convolutions Approach to Measuring the Differences in Simulated Distributions: Application to Dichotomous Choice Contingent Valuation," *Agricultural Economics Working Paper 93-03*, Cornell University, Ithaca, NY.

Quiggen, J., 1992. "Risk, Self Protection and Ex Ante Economic Value-Some Positive Results", *Journal of Environmental Economics and Management*, 23:40-53.

Samples, K. C., J. A. Dixon, and M. M. Gowen, 1986. "Information Disclosure and Endangered Species Valuation", *Land Economics*, 62:307-312.

Schultz, S. D., and B. E. Lindsay. "The Willingness to Pay for Groundwater Protection", *Water Resources Research*, 26:1869-1875.

Shogren, J. F., and T. C. Crocker, 1991, "Risk, Self-Protection and Ex Ante Economic Value", *Journal of Environmental Economics and Management*, 20:1-15.

Smith, V. K., W. H. Desvousges, F. R. Johnson, and A. Fisher, 1990. "Can Public Information Programs Affect Risk Perceptions?", *Journal of Policy Analysis and Management*, 9:41-59.

Smith, V. K., and F. R. Johnson, 1988. "How Do Risk Perceptions Respond to Information? The Case of Radon", *The Review of Economics and Statistics*, 70(1):1-9.

Sun, H., 1990. *An Economic Analysis of Groundwater Pollution By Agricultural Chemicals*, Unpublished Master of Science Thesis, Department of Agricultural Economics, University of Georgia at Athens.

Viscusi, W. K., and C. J. O'Connor, 1984. "Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers?", *American Economic Review*, 74:942-956.

Table 1: Knowledge and Information Groupings

	Water Not Previously Tested for Nitrates No-Test (n=149)	Water Previously Tested for Nitrates With-Test (n=190)
Not Provided General Information in Survey (No-Info, n=169)	NINT (n=76)	NIWT (n=93)
Provided General Information in Survey (With-GI, n=170)	WINT (n=73)	WIWT (n=97)

Table 2: Summary of Responses and Differences in Stage 1 Quiz Scores by Group

	Avg. Questions Correct (Standard Error)	n	Max. Corr.	Differences Between Groups		
				NIWT	WINT	WIWT
NINT	2.57 (2.09)	76	7	-3.352***	-6.810***	-10.944***
NIWT	3.70 (2.30)	92	8		-4.127***	-7.587***
WINT	5.43 (2.97)	73	9			-1.926*
WIWT	6.24 (2.33)	97	9			

T-test values significantly different at 10% (*), 5% (**) and 1% (***)

Table 3: Comparisons of "Don't know" Responses to Selected Stage 1 Questions Defined in Text[a]

Group		Safety of Hypothetical Nitrate Levels Q17	Level of Nitrates in Well Q23	Adult Safety of Nitrate Levels in Well Q24	Infant Safety of Nitrate Levels in Well Q25
No-Info		0.456	0.311	0.230	0.291
With-GI		0.192	0.299	0.256	0.311
No-Test		0.450	0.531	0.424	0.503
With-Test		0.103	0.130	0.103	0.141
NINT		0.627	0.548	0.471	0.514
NIWT		0.330	0.121	0.066	0.103
WINT		0.288	0.514	0.426	0.493
WIWT		0.113	0.138	0.138	0.172
Groups Compared		Difference of Proportions Test			
No-Info	With-GI	8.246***	0.324	-0.734	-0.537
No-Test	With-Test	10.84***	10.82**	9.128***	9.684***
NINT	WINT	6.428***	0.91	1.487	0.600
NIWT	WIWT	4.098***	-0.45	-2.438***	-2.013**
NINT	NIWT	5.632***	11.36***	13.63***	11.983***
WINT	WIWT	10.84***	10.01***	9.710***	9.370***

a. Response Option to Question 23 was actually "I have no idea" rather than "Don't know".
T-test values significantly different at 10% (*), 5%(**) and 1%(***)

Table 4: Stage 1 and Stage 2 Distribution of Expectations that Nitrate Levels in Household Well Will Exceed Government Standards for Nitrates in the Next Five Years?

Responses	Stage 1					Stage 2
	No-Info	With-GI	No-Test	With-Test	All	
Yes (100% Chance)	13.7	10.8	8.6	15.2	12.3	18.0
Probably (75% Chance)	13.0	16.6	15.7	14.0	14.8	10.5
Maybe (50% Chance)	37.9	36.9	36.8	36.5	37.4	17.3
Probably Not (25% Chance)	27.3	28.0	29.3	26.4	27.7	37.2
No	8.1	7.6	7.9	7.9	7.9	16.9
n	161	157	140	178	318	266

Table 5: Comparison of "Don't know" Responses For Safety Questions [a]

	Stage 1	Stage 2	T-Value
Infant Safety (No- Test)	0.422	0.098	10.179***
Infant Safety (With-Test)	0.119	0.052	4.070***
Adult Safety (No-Test)	0.333	0.088	7.697***
Adult Safety (With-Test)	0.044	0.022	1.628

a. Only those who responded to Stage 2 Questionnaire are included
T-test values significantly different at 10% (*), 5%(**) and 1%(***)

Table 6: Updating of Expectations of Future Contamination by Prior Test Group Using Double Bounded Probit Model

	No-Test	With-Test
Constant	-0.0553 (0.0906)	-0.0505 (0.0683)
R_{S1} (Stage 1)	0.281* (0.152)	0.324*** (0.111)
Nitrate Level	0.0592*** (0.00896)	0.0658*** (0.00776)
σ	0.368*** (0.0364)	0.330*** (0.0271)
n	102	134
Log(L)	58.29	62.84
ω_N/ω_{S1} (Weight Ratio)	2.560	2.091
Descriptive Statistics of Updating by Prior Test Group		
R_{S1} (Stage 1 Risk)	0.493 [0.269]	0.500 [0.295]
R_{S2} (Stage 2 Risk)	0.402 [0.341]	0.480 [0.344]
Mean Nitrate Level (mg/l)	5.71 [6.79]	6.65 [6.91]

T-test values significantly different at 10% (*), 5%(**) and 1%(***)
Asymptotic Standard Errors in (), Standard Deviations in [ ]

Table 7: Stage 1: Estimated Logit Equations to Dichotomous Choice Contingent Valuation Questions

	Stage 1				Stage 2			
	No-Test		With-Test		No-Test		With-Test	
	Full	Short	Full	Short	Full	Short	Full	Short
Constant	0.342 (0.606)	1.064*** (0.394)	-1.081 (0.698)	0.105 (0.361)	-0.576 (0.559)	-0.258*** (0.431)	-0.581 (0.448)	-0.248 (0.338)
Quiz Score	0.133 (0.096)		0.180* (0.092)					
Davtperm	0.586 (1.381)		-1.667** (0.784)		-8.352 (20.777)		-0.800 (0.754)	
Dbotwat	-6.862 (35.413)		2.245** (1.026)		-7.139 (38.16)		0.632 (1.087)	
Future	0.807 (0.841)		2.306*** (0.824)	1.247* (0.679)	2.205*** (0.832)	2.225*** (0.791)	2.278*** (0.637)	2.113*** (0.605)
DInfo	-2.340*** (0.705)	-1.701*** (0.542)	-0.337 (0.563)		0.860 (0.676)		-0. 694 (0.538)	
Dinfo*bid	0.00653*** (0.00207)	0.00546*** (0.00174)	0.00096 (0.00128)		-0.00203 (0.00334)		0.000112 (0.00163)	
bid	-0.00700*** (0.00200)	-0.00606*** (0.00167)	-0.00455*** (0.00110)	-0.00326*** (0.00063)	-0.00503** (0.00203)	-0.00615*** (0.00168)	-0.00339*** (0.00123)	-0.00321*** (0.000809)
n	135	143	168	168	102	103	140	140
χ^2	46.19***	41.26***	56.29***	42.17***	43.22***	36.97***	34.46***	29.77***

Notes: Asymptotic standard errors in (). Significance levels are denoted * (10 percent), ** (5 percent) and *** (1 percent).

Table 8: Mean WTP Distributions for Different Information Flows Using Duffield and Patterson Simulation Method (truncation point = $6,000)

Group			Calculated at Parameter Means	Based on 1000 Draws		
				Lower Bound 10%	Mean	Upper Bound 10%
No Prior Nitrate Test	Stage 1	No-Info,No-Prior-Test	224.72	143.30	222.98	312.35
		With-Info, No-Prior-Test	684.95	306.56	708.38	1409.32
	Stage 2		168.72	117.16	167.80	226.16
With Prior Nitrate Test	Stage 1		344.15	264.31	342.18	441.39
	Stage 2		348.15	255.90	355.38	477.22

Table 9: Significance Levels of Difference Between Mean WTP Distributions in Table 8

Groups Compared			Signif. Level of Diff.
No Prior Nitrate Test	NINT (Stage 1)	WINT (Stage 1)	3.0
	NINT (Stage 1)	No-Test (Stage 2)	38.1
	WINT (Stage 1)	No-Test (Stage 2)	0.6
With Prior Nitrate Test	With-Test (Stage 1)	With-Test (Stage 2)	90.5
	No-Test (Stage 2)	With-Prior-Test (Stage 2)	0.6

Notes

1. McClelland *et al.* provide an interesting two period model that accounts for these motivations. In the current analysis it is postulated that non-use motivation may enter into the valuation function, but the exact linkages are not specified.

2. A more complete model might include severity effects as measured by the costs of illness. This aspect may be important, but is ignored here. See Berger *et al.*, Shogren and Crocker, Crocker, Forster and Shogren, and Quiggen for a discussion of this issue.

3. Bid values for the first wave of the Stage 1 survey (225 surveys) were based on estimated logit functions from Sun's analysis, with bid values ranging from $1 to $2,500. Bid values for subsequent waves (255 surveys) and the Stage 2 survey were revised downward based on preliminary responses to the first wave of the survey. The range in Stage 2 was bound between $1 and $1,000.

4. One anomaly did occur in comparing information groups. A higher proportion of people within the With-GI group reported having attended public meetings. This attendance did not appear to have been translated into other public actions or concerns. A complete comparison of demographic characteristics is provided in Poe.

5. Because the probabilities of exceeding the standard have a lower bound of 0 and an upper bound of 1, it is necessary to define R^*_{S2} as an index variable of predicted outcomes as follows.

$$R_{S2} = 0 \text{ if } R^*_{S2} \leq 0$$
$$R_{S2} = R^*_{S2} \text{ if } 0 \leq R^*_{S2} \leq 0$$
$$R_{S2} = 1 \text{ if } R^*_{S2} \geq 1$$

The corresponding likelihood function for this two limit probit model is

$$L(B,\sigma|R_{s2},X_i)$$

$$= \prod_{R_{s2}=0} \Phi\left(\frac{-BX_i}{\sigma}\right) \prod_{R_{s2}=R^*_{s2}} \frac{1}{\sigma}\phi\left(\frac{R_{s2} - BX_i}{\sigma}\right) \prod_{R_{s2}=1}\left[1-\Phi\left(\frac{1 - BX_i}{\sigma}\right)\right]$$

where ϕ and Φ are the normal probability density function and cumulative distribution function respectively, and X_i is a vector that includes the variables R_{si} and N defined in equation (8)

6. Aldrich and Nelson note that large sample size properties of unbiasedness, efficiency and normality seem to hold reasonably well for logit models once sample size exceeds the order of N-K=100 (p. 53).

7. Because of the two stage process, there exists a possibility of selection bias in the second stage. A difference of means comparison of demographic characteristics, well characteristics and averting actions shows that there are no significant differences in these variables across stages within the test and information groups, as would be expected from the high stage 2 response rate. Selection effects on the WTP and mean WTP distributions were evaluated by re-estimating the Stage 1 dichotomous choice models for only those who responded to the Stage 2 questionnaire. While some slight shifts in distributions did occur, these shifts did not affect the conclusions in this analysis. General information still had a significant effect on the Stage 1 No-Test group and less of an effect on the With-Test group. Updating of the WTP and mean WTP distribution across stages was significant for the No-Test groups identified in the text, but not for the With-Test group.

<u>OTHER AGRICULTURAL ECONOMICS STAFF PAPERS</u>

No. 93-01	Managing Transboundary Water Conflict: The United States and its Boundary Commissions	David J. Allee Leonard B. Dworsky Albert E. Utton
No. 93-02	Segmenting the Milk Market into bST-Produced and Non-bST-Produced Milk	Loren W. Tauer
No. 93-03	"Economic Correctness" and Agricultural Economics	Ralph D. Christy
No. 93-04	The Effectiveness of Concept Mapping as a Teaching Tool: Evidence from Courses in Applied Economics	Lois Schertz Willett Harry M. Kaiser Deborah H. Streeter Katherine L. Beissner
No. 93-05	An Analysis of the Effects of the Immigration Reform and Control Act of 1986 (IRCA) On Seasonal Agricultural Service (SAS) Crops In New York State	Enrique E. Figueroa
No. 93-06	The Skills and Training Needed by Farm Management Researchers in the Future	Loren W. Tauer
No. 93-07	Consumer Preferences for Non-Conventionally Grown Produce	Sheila E. Underhill Enrique E. Figueroa
No. 93-08	Farmer Productivity at Various Ages	Loren W. Tauer
No. 93-09	Nonparametric Technical Efficiency with N Firms and M Inputs: A Simulation	Loren W. Tauer John J. Hanchar
No. 93-10	Pesticide Use and Produce Quality: Evaluating the Role of Private Sector Institutions	Enrique E. Figueroa