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WILLINGNESS TO PAY FOR WATER IN RURAL AREAS: METHODOLOGICAL APPROACHES AND AN APPLICATION IN HAITI

WASH FIELD REPORT NO. 213

SEPTEMBER 1987

Prepared for
the Office of Health,
Bureau for Science and Technology,
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WASH Activity No. 166

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LIST OF ACRONYMS

CVM	Contingent Valuation Method
IBRD	International Bank for Reconstruction and Development
IDB	Inter-American Development Bank
PPC	Program, Policy and Coordination Bureau, AID
SNEP	Service National d'Eau Potable (National Water Authority in Haiti)
USAID	United States Agency for International Development
WTP	Willingness to Pay

EXECUTIVE SUMMARY

Progress in improving the quality and quantity of water used by people in developing countries has been unsatisfactory in two respects: systems that have been built are frequently neither used correctly nor maintained properly, and extension of improved service has been slow. A major impediment to improved performance is inadequate information concerning the response of consumers to new service options. The behavioral assumptions that typically underlie most rural water supply planning efforts are simple. It is commonly assumed that as long as the financial requirements do not exceed 3 percent to 5 percent of income, rural consumers will choose to abandon their existing water supply in favor of the improved system. Experience has shown that this simple model of behavioral response has usually proved incorrect.

If rural water projects are to be both sustainable and replicable, an improved planning methodology is required that includes a procedure for eliciting information regarding the value that households place on different levels of service. A key concept in such an improved planning methodology is that of "willingness to pay." If people are willing to pay for a particular service, that is a clear indication that the service is valued (and therefore will most likely be used and maintained) and that it is possible to generate the funds required to sustain and replicate the project. The first objective of this study was thus to assess and develop the methodological approaches available for estimating individuals' willingness to pay for rural water services.

This report reviews the planning experiences of the United States Agency for International Development (USAID), the World Bank, and the Inter-American Development Bank (IDB) in the rural water sector in order to

(1) identify cases where willingness-to-pay procedures have been incorporated into the design of rural water projects, and

(2) examine rural water supply project evaluations for insights into the factors that determine willingness to pay.

On the basis of this review, it was found that the IDB is the only major donor in the sector systematically incorporating willingness-to-pay considerations in its planning and project design procedures.

The report then describes a theoretical model for understanding village water use behavior which attempts to explain both the household's decision regarding which water source to use and how much water to use from that source. The application of this "discrete-continuous model" of household water demand will probably be successful in accurately predicting source choice decisions, and it will represent a major advance in understanding water use behavior in developing countries.

Two complementary types of data can be used to estimate such a model describing household water use behavior: The first (or "direct") approach is simply to interview an individual and ask directly how much he or she would be willing to pay for a public tap or private connection. This direct approach to estimating willingness to pay is termed the "contingent valuation method." Most of the applications of the contingent valuation method have involved efforts to measure the willingness of individuals to pay for changes in environmental quality and have been conducted in either the United States or Western Europe. Until this study, no systematic attempts were made to determine its suitability for assessing willingness to pay for publicly provided goods in developing countries. Among the advantages, a contingent valuation survey is inexpensive, can be used to value services not currently available in the village, and provides a procedure for incorporating community preferences into the planning process. The major disadvantage is that for a variety of reasons individuals may not reveal their actual willingness to pay in the interview process. (Ways of overcoming this problem are discussed in Chapters 3 and 4 of this report.)

The second (or "indirect") approach is to collect data on actual observed behavior. In this case, the planner collects information on the source of water chosen, the quantities of water collected by different households, the time spent collecting water, and other source and household characteristics, and on the basis of consumer demand theory infers how much the household would be willing to pay for an improved water supply. The major advantage of this approach is that the estimates of willingness to pay are based on what people actually do, not on what they say they will do. Among the disadvantages, (1) it may not be feasible in many locations because there is insufficient variation in the water source and household characteristics, (2) results may have to be extrapolated beyond the range of the data, and (3) a discrepancy may exist between the revealed value of a commodity and the payments which a household will actually make when the commodity or service is made available. The report considers other "indirect" procedures for estimating willingness to pay but concludes that they do not have great promise as practical planning tools in the rural water sector.

The second objective of this project was to field test the contingent valuation methodology to determine whether it could provide a practical tool for inexpensive, rapid assessments of a community's willingness to pay for improved water services. The report describes a case study conducted in two villages in southern Haiti during August 1986, in which individuals were asked how much they would be willing to pay for (a) a public water tap near their home and (b) a private connection or yard tap. The findings from this field study have many implications for future efforts to use the contingent valuation methodology in developing countries. Among the most important findings are the following:

- Respondents took the contingent valuation questions, and indeed the entire interview, seriously. Respondents did not give either unrealistic or "protest" bids.

- The mean of the willingness-to-pay (WTP) bids in the village of Laurent for public taps was $1.15 US per month, approximately 1.5 percent of per capita income and significantly lower than the 3 percent to 5 percent of income rule of thumb. On the basis of these WTP estimates, the village as a whole could afford to pay approximately $3,000 annually toward the cost of a community water system with public taps. The mean of the WTP bids for private connections, which was $1.40 US, was not significantly higher.

- The research design tested for several threats to the validity of the survey results (strategic bias, starting-point bias, and hypothetical bias). No evidence of any of these biases was found.

- The bidding game question format was more effective than open-ended questions.

- The WTP bids for Laurent were systematically related to the household and source characteristics suggested by consumer demand theory. For example, households farther away from their existing source were willing to pay more for a new public tap than a household close to the traditional source. Similarly, high-income households were willing to pay more than low-income households. These results suggest that the WTP bids offered by individuals are meaningful and not simply numbers "pulled out of the air."

In summary, results of the field test in Haiti suggest that contingent valuation surveys are feasible in developing countries and that an inexpensive, quick survey may provide valuable information on households' willingness to pay for improved water services. Such information could be particularly helpful in (1) identifying communities which could meet specified cost-recovery targets, (2) determining prices and connection fees to charge for the improved water services, and (3) determining the appropriate level of service and the water system capacity required. The implications of this study are not limited to the rural water sector. Contingent valuation surveys may be a viable method of collecting willingness-to-pay information for a wide range of public infrastructure projects and public services in developing countries.

Chapter 1

INTRODUCTION AND OBJECTIVES OF THE STUDY

Progress in improving the quality and quantity of water used by people in rural areas of the developing world has been unsatisfactory in two respects: systems that have been built are frequently neither used correctly nor maintained properly, and extension of improved service to unserved populations has been slow. Though this poor record is not the result of a single factor, a major impediment to improved performance is inadequate information concerning the response of consumers to new service options.

The behavioral assumptions that typically underlie most rural water supply planning efforts are simple. It is commonly assumed that so long as financial requirements do not exceed 3 percent to 5 percent of income, rural consumers will choose to abandon their existing water supply in favor of the "improved" system. Several reviews by the World Bank, bilateral donors, and water supply agencies in developing countries have shown, however, that this simple model of behavioral response to improved water supplies has usually proved incorrect (Saunders and Warford 1977; IBRD 1986a and 1986b; Australian Development Assistance Bureau 1983; Federal Republic of Germany 1983; Canadian International Development Agency 1983; European Economic Community 1983). When the "3 percent to 5 percent of income" rule is used to set levels of service, in many communities the level of service is too low (i.e., the community does not value the improved service and, therefore, will not pay for it), whereas in other communities the level of service is too high (that is, the community wants the service but not at the price that has to be charged).

Incorrect information on water use can adversely affect project design in terms of technology choice, level of service, the timing and scale of capacity expansions, and the price structure established. Not only will resources be allocated inefficiently, but the financial viability of the water system may be seriously misconstrued. Large shortfalls in revenues and inability to reach cost-recovery targets are commonplace, with the result that operations and maintenance are not carried out and systems fall into disrepair.

If rural water projects are to be both sustainable and replicable, an improved planning methodology is required that includes a procedure for eliciting information on the value placed on different levels of service, and tariffs must be designed so that at least operations and maintenance costs (and preferably capital costs) can be recovered. A key concept in such an improved planning methodology is that of "willingness to pay." If people are willing to pay for a particular service, that is a clear indication that the service is valued (and therefore will most likely be used and maintained) and that it will be possible to generate the funds required to sustain and even replicate the project. Because the words "willingness to pay" have both a technical meaning (in economics) and a lay meaning, it is important to specify precisely how the term is used in this study.

In economics, "willingness to pay" (WTP) is a measure of the maximum amount that a person would be willing to pay for a service rather than do without it. As shown in Figure 1, WTP is the area under the demand curve. That is, it is not simply the amount paid for a service but that amount plus the "consumers' surplus." This WTP is the economist's measure of the benefits to the individual of a water supply project. The water demand function illustrated in Figure 1 can also provide water supply planners and engineers with information concerning the amount of revenue that can be recovered if different prices are charged for water. For example, if P_1 is charged, the total revenue from water sales will be P_1Q_1.

The importance of the concept of willingness to pay for water in rural areas has been understood for some time. Twelve years ago the World Bank concluded that adequate information on the willingness to pay for water in rural areas was "absolutely essential for any noticeable improvement in the rural water supply situation in the developing world" (Saunders and Warford 1977). Despite this long-standing recognition, little progress has been made in the field. Most attempts to incorporate willingness-to-pay considerations into project design have been ad hoc, in large part because of the absence of validated, field-tested methodologies.

The objectives of this study were, first, to assess and develop methodological approaches for estimating individuals' willingness to pay for rural water services, and, second, to field test one of these methodologies to determine its applicability as a practical planning tool. Chapter 2 presents the results of a survey of rural water supply projects funded by USAID, the World Bank, and IDB. The purposes of this survey were (1) to determine the existing practices of the major donors in estimating WTP for water services, (2) to identify the most promising approaches for incorporating WTP considerations in project analysis, and (3) to glean insights on factors affecting WTP from ex-post project evaluations. Chapter 3 of the report discusses two major approaches for assessing WTP for water in rural areas of developing countries. The first procedure (the "indirect" approach) uses data on observed water use behavior (that is, quantities used, travel and queue times, and perceptions of water quality) to infer the extent to which improved and alternative water sources are valued and thus to assess the response of consumers to different characteristics of an improved water system. The second procedure (the "direct" approach) involves asking people directly how much they would pay for different levels of improved water services; this procedure is termed the "contingent valuation method" (CVM).

Chapter 4 presents the results of a field test of the CVM that was conducted in Haiti during August 1986 in collaboration with CARE's Southern Haiti Rural Water Supply Project funded by USAID. The fifth and final chapter presents conclusions and policy recommendations.

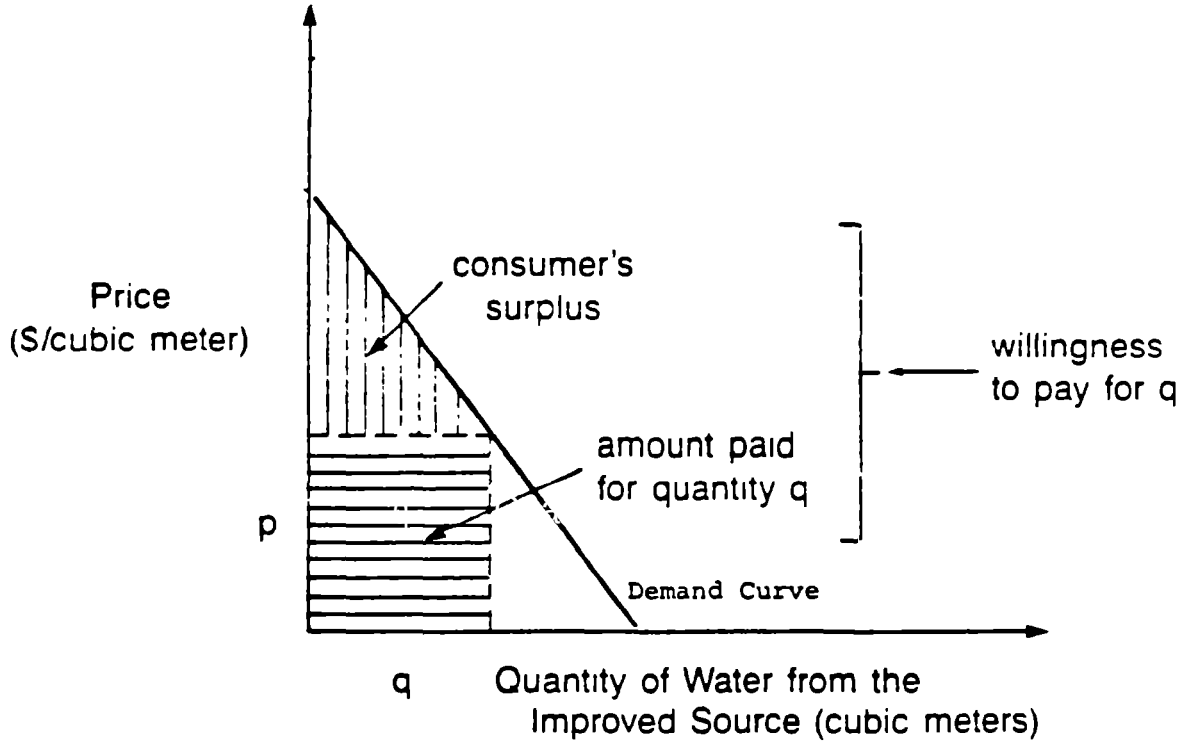

Figure 1.

An Individual's Demand Curve and the Economists' Definition of Willingness to Pay

Chapter 2

WILLINGNESS TO PAY IN RURAL WATER PROJECTS: A REVIEW OF USAID, WORLD BANK, AND IDB PROCEDURES AND EXPERIENCE

During the initial stage of this project, the planning experiences of three major donors that have been involved in the rural water sector were reviewed in order to: (1) identify cases where willingness-to-pay procedures have been incorporated into the design of rural water projects; and (2) examine rural water supply project evaluations for insights into revealed willingness to pay (whether or not WTP considerations were formally incorporated into the project design). Material for case studies was sought at the three major development institutions that were reasonably accessible: the U.S. Agency for Internation Development (USAID), the Inter-American Development Bank (IDB), and the World Bank. Rural water supply projects that either incorporated WTP considerations into project design or that might have evaluations which would be informative on actual WTP were identified, both through discussions with officials at these institutions and through systematic searches of project files. To put the material obtained into context, it is necessary to understand something of the history of involvement of these institutions in the rural water supply sector, which has been quite different in each case.

USAID has been involved in the sector for many years but until recently has attached little importance to issues of cost recovery (and thus of willingness to pay). Because USAID has to report to Congress on projects that have been executed with USAID funds, however, some ex-post project evaluations provided insights into revealed willingness to pay. The series of evaluations carried out by the Program, Policy and Coordination (PPC) Bureau in the early 1980s proved to be a particularly valuable source of information.

The World Bank has put great emphasis in published material on issues of willingness to pay and cost recovery. For example, in their book Village Water Supply, Saunders and Warford (1977) pinpoint incorporation of WTP considerations into the design of rural water projects as the single most important issue in the sector. The World Bank, however, is a relative newcomer to the rural water supply sector, having started after the articulation of the poverty groups' development strategy in the 1970s, and still has funded only a handful of "pure" rural water supply projects (as opposed to components of overall rural development projects). Incorporation of WTP factors into the design of its rural water supply projects has been uneven and ad hoc. Ex-post evaluations (called Project Performance Audit Reports) are produced only some time after project completion and often are primarily actuarial rather than substantive in nature. These provided no useful material to this study. Nevertheless, some interesting information has emerged from the Bank's rural water supply planning documents.

Although the Inter-American Development Bank shares some characteristics with the World Bank, it has written much less on the importance of willingness to pay and is generally considered to take a "softer line" on cost recovery. In discussions with IDB officials it was learned, however, that since the late

1970s all IDB rural water projects have been prepared on the basis of a common methodology that includes collecting household-level data from a large number of families in the areas to be served and the estimation, from these data, of demand curves for water. These data are used by IDB primarily to estimate overall benefits and not to set tariffs or to decide on levels of service, but they are a unique and rich source of information on the demand for water in rural areas.

The information collected from each of the institutions is thus quite different. The USAID evaluations are a useful source of information on factors that have affected participation in, and willingness to pay for, improved rural water supplies. The World Bank data provide some information on willingness-to-pay surveys, which were designed primarily to assess how tariffs should be set and whether costs could be recovered from the projects. The IDB files offer an extensive set of household-level data, with analyses used almost exclusively to derive demand curves for estimating benefits.

It is also pertinent to point out that the methods used in these cases vary. In the USAID evaluations all conclusions are drawn strictly on the basis of observed behavior, and inferences about determinants are made from these observations. The IDB case studies also examine only actual behavior and estimate demand functions directly from that. In a few of the investigations carried out in World Bank project preparation exercises, an understanding of the magnitude and determinants of WTP was sought through surveys which included direction questions about an individual's willingness to pay for water services.

2.1 USAID Evaluations

The principal conclusion drawn from the evaluations of the seven USAID rural water supply projects is that "the field evidence [shows] overwhelmingly that ... no system will be successful unless it is an improvement over existing conditions and is perceived to be so by the community" (Dworkin 1982). The USAID evaluations also have numerous implications for specifying the determinants of willingness to pay for improved water supply services in rural areas.

Factors influencing willingness to pay are as follows:

1. Perceived health benefits. Perceived quality of water is important. Perceived quality is determined by taste, odor, color, and tradition and usually not by bacteriological quality. Thus, in Korea shallow well water was preferred to chlorinated piped water, and in Thailand many people, even those with private connections, would not drink the chlorinated water from the new supply system. Health education components added to the water supply programs in Peru, Tunisia, and Korea did not appear to affect demand.

2. Other benefits. Convenience, amenity, and economic benefits (time savings) are usually most important for recipients.

3. Level of service. In some settings (Thailand and Tunisia), pumped schemes providing water to house connections functioned reliably whereas "simpler" technologies providing public facilities did not work well (because of the perceived benefits of higher level of service and the recipients' greater willingness to pay for and maintain the pump schemes).

4. Existence of alternatives. Where alternatives exist (household shallow wells in Korea, access to a reliable spring in Peru, wet areas of Tunisia), willingness to pay for "improved service" is low. In Korea, water supply connections are considered essential in urban areas, and connection rates are determined by supply factors; in rural areas, connection is primarily a function of demand factors.

5. Income. The "elasticity of connection probability regarding income" is substantial (Korea). In Thailand, poorer households did not pay for house connections; in Kenya, house connections could be afforded only by the rich.

6. Price. Where different prices were charged for the same level of service (for example, $0.25 for yard taps in gravity systems and $0.75 per month for yard taps from pumped systems, in Panama), there were few collection problems for the cheaper service, but substantial problems existed where the higher rate was charged. This suggests that price elasticity of demand for the improved service was substantial.

7. Different uses, different determinants. Even where people pay a substantial connection charge, they may still perform some tasks at a traditional source (for example, laundry in Korea).

8. Value of women's time. Where women are educated and employed (and where, therefore, the value of their time is higher) connection rates are higher (Korea).

9. Family size. Water use practices depend on family size. In Peru smaller families do laundry at home; larger families, however, continue to wash at the nearest stream.

Table 1, on the following page, summarizes the magnitude of WTP for water in rural areas.

2.2 World Bank Projects

In most World Bank rural water supply projects no consideration is given to willingness to pay. Ability to pay is assumed to be a proportion of total income (usually 3 percent to 5 percent). This figure is then compared with the payments that would be required to cover the costs of service. In some instances, however, some effort has been made to determine willingness to pay. In the Bank's Philippine water supply project, a sociologist was hired by the

Table 1

Apparent Willingness to Pay for Water in Rural Areas

Water Source	Economic Level	Wet Areas	Dry Areas
Yard Taps	Rich	+++	+++++
	Poor	++	++++
Standpipe (or Handpump)	Rich	+	++++
	Poor	0	+++

borrower to assess willingness to pay, but the survey questions were not framed in a way that could provide useful answers for project design purposes. The results, therefore, were apparently ignored in the design of the project.

In the Bank's Paraguay project, in which cost recovery was a prominent feature, no WTP analysis was conducted during the design stage. Levels of service and tariffs were set "in accordance with the populations' habits, expectations, and ability to pay."

During the implementation stage, the executing agency is to conduct a "socioeconomic survey of the community which would indicate its ability to pay." In the Bank's Burundi project, a socioeconomic survey was conducted, primarily to convince the government that people were willing to pay something, and not for choosing the levels of service or setting of tariffs. The results did show that willingness to pay was higher in drier areas and that most people were willing to pay something. Again, however, the survey had little impact on project design. The only inclusion of these considerations in project design was the usual "affordability" analysis.

In the Bank's project in Egypt, a large-sample survey was carried out prior to the project. The primary objective was to identify poverty groups and thus target areas for the water project, but questions of willingness to pay were also addressed. Although there were problems with the survey design and its implementation, some interesting results emerged:

1. Rural dwellers were willing to pay slightly more than urban dwellers for a private connection.

2. Willingness to pay both for private connections and standpipe supplies was highest where water supplies (determined by trip times and availability) were poor.

3. Willingness to pay for house connections averaged approximately 3 percent of household income; willingness to pay for public standpipes was about 1 percent of household income.

From the Appraisal Report, it appears that these WTP results were not incorporated into project design, although they were used to support the claim that the services to be provided were "affordable" and thus were used to justify charging for water from public standpipes.

In the Bank's project in China, no formal WTP analysis was undertaken. It was assumed that the standard Chinese procedure of full cost recovery would pertain, and that where the amount required exceeded the usual "3 percent to 5 percent of income" criterion, lower levels of service would be provided.

In the Bank's Mali project, a serious effort to assess willingness to pay was undertaken. The results of a contingent valuation survey were compared with the results of actual expenditures. Only a limited set of questions were addressed: the effect of income and distance to present source on WTP for a closer source. The effort was primarily a methodological exercise. The

results suggested that, for this limited set of hypotheses, the results of the WTP survey provided "reasonable" estimates. The Staff Appraisal Report of the Rural Water Supply Project shows that much emphasis was placed on projected financial contributions by the villagers, but only an oblique reference is made to the WTP survey.

In summary, all of the World Bank rural water supply projects reviewed have assumed that some degree of cost recovery will take place. Most project reports explicitly refer to the importance of willingness to pay if cost recovery objectives are to be achieved. In several projects, surveys were undertaken to assess willingness to pay. In two cases (the Philippines and Burundi), these surveys were conducted by local consultants with minimal guidance and poor terms of reference. The results were of little use and ignored in the design of the projects. In two other cases (Egypt and Mali), serious surveys were undertaken to assess willingness to pay. Despite some defects in design, the Egyptian survey showed some interesting results (for example, WTP for house connections was three times WTP for standpipes). These results appear to have been ignored when choosing levels of service (which were simply based on the usual "percentage of income" ability-to-pay criterion). The Mali case also yielded some interesting results (for example, the WTP depended on the availability of private wells), but these too were apparently ignored in the project design.

From the World Bank case studies, it can be concluded:

1. Considerable awareness exists on the part of Bank planners that willingness to pay must be taken into account if cost recovery is to be realized in rural water projects.

2. Where surveys have been conducted that address WTP issues, the results have been used primarily for other purposes (for example, to convince the Government of Burundi that villagers could be asked to pay for water; to identify poverty areas in the Egypt Provincial Water Project; to determine whether the required charges would exceed a preset proportion of income). In no case has the primary purpose of the survey been to provide information on which to base project planning decisions. In the few cases where such information has emerged from the surveys, it has apparently been ignored when deciding where projects should be located, what levels of service should be provided, and how tariffs should be set.

2.3 IDB Projects

IDB is the only one of the three institutions that has systematically collected and analyzed household-level data on water use practices before and after the improvement of water supplies (statistics are also included for "control" villages with unaltered supplies). To date, IDB has made only limited use of these data. Although the data collected used a common protocol, the data have been analyzed only on a project-by-project basis. No attempt has been made to analyze the ten rural water supply data sets (or the larger number of urban data sets) as a whole to draw general conclusions.

The project analyses show several useful things. The benefits from improved supplies are substantial, due to reduction in hauling distances for the existing level of water use, and increased use due to reduced cost of water (in a typical case comprising one-third and two-thirds of benefits, respectively), and are generally sufficient to justify most rural water supply projects. The price elasticity of demand is higher (for instance, approximately -0.3 in rural Chile and about -0.6 in urban slums in Brazil) than that which has been reported in developed countries. Income elasticities are also high (approximately 0.4 in rural Chile and 0.8 in urban slums in Brazil).

The IDB analyses are based on the implicit assumption that people will pay for the highest level of service for which expenditure on water does not exceed 3 percent of income. No account is taken of the possibility that people may be willing to spend more than this for a high-quality service and may be unwilling to spend even a substantially lesser amount for lower-quality service.

Chapter 3

THEORETICAL FRAMEWORK AND METHODOLOGICAL APPROACHES ASSESSING THE WILLINGNESS TO PAY FOR RURAL WATER SERVICE

This chapter of the report outlines a theoretical framework for understanding how water use patterns would change if a new rural water supply system is installed in a village. Before examining some of the theoretical issues involved in explaining water use behavior at the village level, consider the problem from the point of view of the rural water supply engineer or planner. Suppose there is a proposal to provide an improved water supply to a village in which people are now carrying water from several traditional, polluted sources to their homes. Assume that the project planner accepts as given that the village must pay for a new system to be constructed. Budget constraints and the need for projects to be replicable preclude any central government or donor subsidies. What exactly does the rural water supply planner need to know?

First, if yard taps were made available to individual households, the project planner would need information on how many households would connect to the new system at various combinations of connection fees and monthly charges. Second, for those households that did connect to the system, he would need to know how much water they would consume (monthly charges are generally not based on the volume used; therefore, the household would probably face a zero short run marginal cost of water). On the basis of this information, the project planner could determine whether the revenues collected would cover the cost of the system. Similarly for standposts and handpumps, the project planner needs to estimate the number of households that would use the new source (for at least some of their water needs), if different prices were charged, and the total amount of water which would be used.

Finally, the rural water supply planner needs a basis upon which to select the technology for the project and the price to be charged. For example, a system might be selected that provides the highest level of service for which the revenues could be collected to cover the costs. Alternatively, the decision could be to choose that technology that would serve the most households or result in greatest use of high quality water from new sources in the village, subject to the constraint that cost recovery objectives can be met. If the benefits of the new water system could be approximately estimated, a more appropriate objective would be to choose the technology and price which maximized the net benefits. Whatever objective is selected, however, the planner needs the information to measure the likely consequences of the project and compare them to the project costs.

The theoretical framework should thus assist the rural water supply planner or engineer in thinking about two questions: (a) **What will happen if various types of interventions are made in the provision of water supply?** and (b) **How should the changes in behavior that result from different interventions be valued?** Both questions require that the planner look carefully at how individuals use water and why they choose one water source rather than another for particular purposes.

A new rural water supply system will never be the only source of water in a village; a community cannot exist without some water supply. The question thus becomes one of determining how individuals will view the proposed new water supply relative to their existing sources. The new source may differ from traditional sources in a variety of dimensions, such as quality, convenience, reliability, and real resource costs (money and time).

An obvious place to look for insight into this decision is consumer demand theory. Because one of the major benefits of a piped water system, handpump, or standpost closer to the home than a traditional source will be the time saved from not having to carry water (IBRD 1986a), the application of consumer demand theory to village water use must explicitly incorporate time as a factor in the individual's decision. The theory must also address the empirical evidence from many developing countries which shows that when water is delivered inside the home through yard taps, water use increases dramatically, from approximately 20 liters per capita per day to approximately 100 liters per capita per day. If the water supply is outside the home, over a wide range of distances the quantity of water used is not very sensitive to the distance of the home from the source.

Whether the home is 15 meters or 500 meters from the source, water use per capita will generally be 15 to 25 liters per capita per day. The quantity of water use per capita typically decreases slowly as the distance of the home from the source increases beyond about 500 meters. The type of water service (yard taps versus standposts or handpumps) thus seems to be a more important determinant of the quantity of water used than any simple relationship between water use and distance would suggest.

3.1 Household Production Function Model

One way to determine the effect of a new rural water supply system, such as handpumps or yard taps, on water-use behavior in a village is to observe a situation where such a system has been installed and determine the number of people using the new source and the quantity of water used. If functional relationships can be estimated which are consistent with a theoretical understanding of how individuals use water sources, and which "explain" the water-use behavior in the village which has a new source installed, then the estimated "model" of water-use behavior can be used to predict what would happen if a new system was introduced into a village lacking an improved supply.

Consider the estimation of a model of water-use behavior in a village which has an improved water supply, say a handpump. Water is obtained from different sources and used for different purposes. For example, animal washing may be done at a particular source. On the other hand, water for drinking and cooking must be carried from the source to the house. The water may be transported by household members, hired help, or water vendors. Finally, other uses, such as bathing, may occur at either the source or the home, presumably depending among other factors on the price of water at the source and the cost of transporting it to the home.

To get the water from the sources to the house, members of the household incur several types of costs. They may have to pay a price for water at the handpump; certainly they will spend time going to the source, possibly waiting in a queue, and returning to the house with the water. Other inputs in the water transport process may include animals, carts, buckets, jugs, and other utensils. To "produce" water for use at the home, the individual must combine water from the source with her time and other factor inputs. If a certain quality of water is desired for drinking, additional time and inputs might be required to improve the quality of water. For example, alum could be added to remove suspended solids, and time and fuel could be expended to boil water to improve its bacteriological quality. The cost of water to the household is the sum of the price paid at the source, the value of the time spent collecting and transporting the water to the home, and the cost of the other factor inputs used in carrying and perhaps treating water. If the total transport costs are greater than the convenience of using water at home, then water will be used at the source.

From the perspective of consumer demand theory, it is thus a complex task to predict the impact of a new water source on water use patterns in a village. Formally, it is necessary to simultaneously estimate a system of demand functions for water use at the sources and at the home. The demand for water from the sources may in some cases be derived from the demand for water in the home, in the sense that there would be no water demanded from the source unless it was subsequently carried to the home. In other situations, such as water for washing, the water at the source and in the home should be considered close substitutes for each other. The information necessary to fully characterize consumer water-use behavior at the village level thus includes: (a) the individual's demand for water at the different sources as an input into the household's use of water at the home, (b) the individual's demand functions for water as a final consumption good at the source, and (c) the individual's demand function for water at the home.

For the purpose of developing a practical approach to modeling water demand relationships at the village level, this problem can be simplified by making two important assumptions. First, at any particular time a household is assumed to use only one source for a particular category of water use (such as drinking). In other words, it is assumed that in a given period a household obtains drinking water from a single source and water for washing from a single source (which may or may not be the same source used for drinking and cooking water). This assumption is generally corroborated by empirical evidence in rural areas, but its validity for any specific case must be checked. Second, a household is assumed to use all of the water of a particular use category at the home, not at the source.

Given these two assumptions the demand for water at the home can be estimated with a single equation model. Let the demand function for water at the home be:

$$Q_D = f(SP, y, S)$$

where Q_D is the quantity of water demanded,

SP is the shadow price of water,

y is the household's income, and

S is a taste vector determined by the household's socioeconomic characteristics (other than income).

Assuming a linear functional form, the demand function can be written as:

$$Q_D = a_0 + a_1 SP + a_2 y + a_3 S + e$$

where e is a random term.

If the shadow price of water can be calculated (for example, as a function of the money price and travel time per unit volume), this water demand model could be estimated from a cross section of households in a village.

This traditional demand model has not, however, been successful in explaining variations in household water use behavior at the village level. This should not be surprising given the empirical evidence which shows that when people must carry water to their homes, they consume essentially the same quantity of water over a relatively wide range of distances (White, Bradley, and White 1972; Cairncross et al. 1980). This does not mean, however, that the collection time, taste, price of water, and other explanatory variables will not have an influence on the choice of water source. Once the source choice decision is made, the amount people consume from their chosen source may or may not depend on the variables suggested by consumer demand theory. No empirical evidence exists on the question of whether households choose the quantity of water they want and then choose the source, or choose the source and then choose the quantity--or whether they make these decisions simultaneously.

Although this traditional water-demand model based on the household production function framework does not provide an adequate basis for modeling village water use, it does form the basis for one part of the discrete-continuous model described in the next section.

3.2 The Discrete-Continuous Water Demand Model

For each category of water use being modeled, it is required to estimate a relationship to explain: (a) why some households use one source and some households use another and (b) why households consume particular quantities of water. The discrete-continuous model described in this section provides a framework which explains the probability that a household would choose a particular source (a discrete variable) as a function of the characteristics of the available water sources (including the prices charged, the distance of the sources from the household, and other attributes of the sources), socioeconomic characteristics of the household (such as income, age structure, education, religion), and a random variable.

The structure of this problem is not unique to village water supply planning and has been dealt with previously in estimating the demand for housing and electricity (McFadden 1978 and 1981; Dubin and McFadden 1984). Regarding electricity, for instance, the individual decides on the electrical appliances to buy and their energy efficiency (a discrete choice), and also on how much electricity to use given the choice of appliances (a continuous choice). Because the optimal discrete choice could depend on the outcome of the continuous choice, and vice versa, the two decisions should theoretically be modeled simultaneously. Studies of other applications of the discrete-continuous model indicate that ignoring the simultaneous nature of these two decisions can lead to biased parameter estimates (Lee and Trost 1978; Dubin and McFadden 1984).

The discrete-continuous model comprises two parts. Part I is the discrete choice model describing the probability that a household will choose a particular water source:

Model I

$$Prob_{hj} = f(W_{hi}, y_h, S_h)$$

where $Prob_{hj}$ = the probability that household h selects source j

W_{hi} = the characteristics of source i, i = 1, 2, ...n, perceived by household h

y_h = household income

S_h = the socioeconomic characteristics of household h

If Model I can be estimated successfully for a village with an improved water system, a water supply planner could then collect data on W_{hj} and S_h in a village without an improved water system. If the estimated model can be assumed to be generalizable across the two villages, the probability that households in the village without the improved water system will use the new improved source(s) can be estimated.

Once it is known how many families choose to come to the new source, the planner needs to know how much water will be used from the new source if certain prices and connection fees are charged. To understand the determinants of the quantity of water used, the following demand function can be estimated, based upon the household production framework developed in the previous section:

Model II

(a) For those households who choose source j (say the improved source)

$$Q_{hj} = g_j(W_{hj}, y_h, S_h)$$

where Q_{hj} = quantity of water demanded by household h conditional on the decision to use source j.

(b) For those households who choose source i (one of the existing traditional sources)

$$Q_{hi} = g_i(W_{hi}, y_h, S_h)$$

where i and j indicate two different sources. Model II would be estimated for each source.

In Model II, the continuous demand function indicates how much water would be used if different prices were charged at the sources; this information is required to determine whether costs can be recovered. The quantities of water demanded from different sources are assumed to be modeled by different demand functions. Thus, Model II implies that a demand function would be estimated for each source. Models I and II can also be used to derive estimates of the welfare changes (that is, benefits) of the new water source(s) (Hanemann 1984b).

Source characteristics which are likely to be important explanatory variables in Models I and II are perceived water quality, cash prices for both connection and per unit use, and reliability. Household characteristics which are likely to be important explanatory variables are income (cash and in kind), household size and composition, length of residence, education of household members, expenditure patterns, and the value of time. The collection time consists of travel time to and from the water source, queue time, and fill time. The travel time will be different for different households. The queue and fill time may vary across sources but not for different households.

Because the decisions on which source to use and the quantity of water to be used are interdependent, the error term for Model I is correlated with the error terms for Models IIa and IIb. A least squares estimation procedure will

thus yield biased and inconsistent estimates. A two-step estimation procedure has been shown to be practical and provides satisfactory parameter estimates (Lee and Trost 1978; Heckman 1978; Lee 1979; Maddala 1983; Hanemann 1984a):

Step 1

(a) Maximum likelihood estimation of a multinomial logit model for the discrete probabilities alone yields consistent but not efficient estimates (because the information on the continuous choices is ignored).

(b) Ordinary least squares' estimates of the continuous choice (using the estimated values from (a) above) gives consistent estimates of the parameters.

Step 2

Use these consistent estimates for maximization of the likelihood function. Because the initial estimates are consistent, a single Newton-Raphson iteration will provide estimates with the same asymptotic distribution as the global maximum likelihood estimator. The two-step procedure gives estimates which are consistent and asymptotically normal.

On the basis of preliminary research by the authors, the discrete choice part of the discrete-continuous model (Model I) will probably be successful in accurately predicting source choice decisions by households, and this will represent a major advance in understanding water-use behavior in developing countries (Whittington et al. 1987). The research team is less optimistic about the continuous demand model (Model II) because there are significant differences in consumption depending on whether water is available outside or inside the yard and because, for a given level of service, the traditional demand model with the usual independent variables explains relatively little of the variation in the quantity used.

3.3 Sources of Data for Estimating Domestic Water Demand Relationships

Two complementary types of data can be used to estimate models describing domestic water use behavior, such as those outlined in the preceding section. The first (the "direct" approach) is data generated by answers to hypothetical questions on willingness to pay for improved water sources. The second (the "indirect" approach) is data on actual observed behavior. In the latter case, the researcher measures the quantities of water collected by different households and the time spent collecting water and, on the basis of consumer demand theory, infers how much the household would be willing to pay for an improved water supply.

3.3.1 The Direct Approach: Contingent Valuation Method

The direct approach to collecting data on willingness to pay is simply to interview an individual and ask directly how much he or she would be willing to pay for a public fountain or yard tap. In the economic literature, this direct approach to estimating willingness to pay is termed the "contingent valuation method" (CVM) because the interviewer asking the question is simply collecting information rather than actually proposing to deliver the goods or services if the individual agrees to pay a specified amount.

A willingness to pay bid obtained from a contingent valuation survey can be interpreted as a decision by the household on whether to use the new improved source. The first part of the discrete-continuous model (that is, the discrete choice model) can be used to explain this decision as a function of household characteristics and source characteristics. The data obtained from a contingent valuation survey is not, however, suitable for estimating the second part of the discrete-continuous water demand model (the traditional demand equation conditional upon source choice) because it is not possible to ask the quantity of water he or she would use if a new source such as a private connection were installed in their home. Individuals cannot be expected to give reasonable or reliable answers to such a question because they do not have any direct experience with the private connection (and even if they did could probably not quantify their expectations in volumetric units accurately).

The methodology for conducting contingent valuation studies has been developed over the last decade, largely by environmental and resource economists working on the problem of appraising the provision of public goods (Freeman 1979a; Cummings, Brookshire, and Schulze 1986). Most of the applications of the CVM have involved attempts to measure the willingness to pay of individuals for changes in environmental quality and have been conducted in the United States or Western Europe (Randall et al. 1978; Mitchell and Carson 1986). The CVM approach has been used in this area because markets typically do not exist for such public goods and thus observations on how consumers respond to changes in prices and quantities are not directly observable.

Several approaches have been used in asking the contingent valuation question(s). The simplest and most straightforward is to ask the individual directly the maximum amount he or she would be willing to pay for the proposed water supply improvement. One disadvantage of this approach is that some individuals may not understand the idea that they are being queried to give the maximum amount. Another problem is that people often need time to reflect on the question and simply do not have an immediate response. They may need help in thinking about the question, such as information about how much they are paying for other public services. Alternative approaches have been used to elicit individuals' willingness to pay, including bidding games, multiple-choice questions, payment cards, and yes-no questions regarding a single price. One of the objectives of the field study conducted as part of this project was to determine which of these approaches seems most appropriate for use in developing countries.

A major problem with the contingent valuation method is that, for a variety of reasons, the individual may not answer the questions accurately and thus not reveal his actual willingness to pay for the goods or services. Literature regarding the use of the contingent valuation method is primarily concerned with the types of biases that may arise in the respondent's answers and with means of estimating their magnitude. The following types of biases are of particular concern: "hypothetical bias," "strategic bias," "compliance bias," and "starting-point bias."

Hypothetical bias may arise for two types of reasons. First, the individual may not understand the characteristics of the good being described by the interviewer. This has been a particular problem when the CVM has been used to measure individuals' willingness to pay for changes in environmental quality; for example, it may be difficult for people to perceive what a change in sulfur dioxide or dissolved oxygen means for air or water quality. Second, the individual may not bother to answer the interviewer's questions accurately because the interviewer does not control the provision of the goods or services being described in any obvious way.

Strategic bias may arise when the individual thinks he may influence an investment or policy decision under consideration by not answering the interviewer's questions truthfully. Strategic behavior may influence an individual's answers in either of two ways. Suppose the individual is asked how much he would be willing to pay to have a yard tap in his house. He may think that the government will provide the service if the responses of individuals in the village are positive and that the government will ultimately pay for or heavily subsidize the service. Thus, he will have an incentive to overstate his actual willingness to pay. On the other hand, he may believe the government has already made the decision to give everyone in the village a yard tap (or for political reasons everyone will ultimately be connected to the system), and that the purpose of the contingent valuation questions is for the government to determine the maximum amount people will pay for the service in order to assess the connection charges and rates; in this case, he will have an incentive to understate his true willingness to pay.

Hypothetical and strategic bias are related in an unfortunate way. One would suppose that an individual would be less likely to attempt to answer strategically when he feels that his response is unlikely to have much effect on future policy or investment decisions. In this case, however, the likelihood of hypothetical bias increases because the individual does not have as much incentive to think seriously or carefully about the question being asked.

A third type of bias in contingent valuation surveys, "compliance bias," may arise when a respondent gives a willingness-to-pay bid which differs from his actual willingness to pay because he wants either to a) comply with his perception of the expectations of the sponsor of the study [sponsor bias] or b) please or gain status in the eyes of the interviewer [interviewer bias]. One might expect that this could pose serious difficulties for the application of the CVM in developing countries. Compliance bias differs from strategic bias in that the respondent is not giving inaccurate answers to influence the outcome of a policy or investment decision, but is rather responding to the immediate social pressures and cues involved in the interview process. The possibility of sponsor bias may be particularly acute if a contingent valuation survey were undertaken by a donor or funding agency.

A fourth type of threat to the validity of contingent valuation surveys is termed "starting-point bias." One means of eliciting an individual's maximum willingness to pay is called a "bidding game," in which the interviewer asks a question such as, "Would you be willing to pay $X per month for a yard tap?" If the respondent answers affirmatively, the enumerator raises the price in specified increments and repeats the question. This procedure continues until the respondent says no; the last price to which the respondent answered affirmatively is then taken as the maximum willingness to pay. Starting-point bias exists if the initial price used by the enumerator affects the individual's final willingness-to-pay bid. Empirical evidence from the United States suggests that starting-point bias can be a significant problem in contingent valuation surveys (Boyle, Bishop, and Welsh 1985).

The conventional wisdom has been that these various sources of bias make contingent valuation surveys unreliable and at best inferior to "hard" market data. In the specific case of rural water supplies, the World Bank concluded more than a decade ago that "the questionnaire approach to estimating individuals' willingness to pay has been shown to be virtually useless" (Saunders and Warford 1977). The available evidence seems to indicate that the magnitude of these biases is not as large as some economists initially feared (Cummings, Brookshire, and Schulze 1986). In a wide variety of situations, people in the United States and Western Europe appear to answer contingent valuation questions truthfully. Whether this will prove true for the water supply problem in a different culture in a developing country is an empirical question which is addressed in the next chapter.

Despite the potential problems posed by various biases, the contingent valuation method has several significant advantages as an approach for estimating the willingness to pay in developing countries for rural water supplies. First, a survey which attempts to estimate willingness to pay is relatively inexpensive and certainly a small fraction of the cost of a water system. The benefits resulting from a WTP survey in terms of improved design, technology choice, site selection, and pricing practices can be many times the cost of a study. This is a methodology which both donor agencies and governments could afford to put into practice to assist with site selection and choice of technology decisions. Second, the CVM forces donor agencies and water authorities to consult with local people and determine their preferences. It could thus provide one element of an overall approach to increase community participation and citizen involvement. Third, it can be used to assess responses to services presently unavailable. Fourth, the summation of the WTP bids over the sample households yields a readily understandable measure of the total benefits to the sample population of the improved water system. The use of sophisticated statistical techniques is necessary for the estimation of the discrete choice model of the households' water source decisions, but not for an easily interpretable indication of the average household's total willingness to pay based on the bids obtained in the contingent valuation survey. Finally, the limitations of the contingent valuation method must be considered relative to the limitations of other methods for estimating willingness to pay. Models estimated with data on observed behavior (discussed in the next section) also require assumptions which may not be realistic and may sometimes yield poor prediction.

3.3.2 The "Indirect" Approach

The discrete-continuous model discussed in section 3.2 can be estimated with data on observed behavior. This requires that the researcher collect household-level information on the quantities of water consumed for different purposes, the time spent collecting water from different sources (including those not used by the household), perceptions of the quality of different sources, and socioeconomic characteristics of the household. This data-collection effort should be carried out in a village which already has a variety of different sources (some with different money prices) and with sources located in such a way that individuals face real choices among them. In other words, individuals in one part of the village do not all go to a handpump, and individuals in another location all go to a kiosk. The households must have real options, and some must choose one and some another.

This procedure of estimating the model with data on observed behavior is appealing because the results are based on what people actually do in practice rather than what they say they will do. Limitations of the approach do exist, however. First, the planning problem is to examine communities without improved water supplies; water-use behavior must be modeled in another village with an improved supply. The results of this indirect analysis must thus be extrapolated beyond the range covered by the data. Second, there may be a discrepancy between the revealed value of a commodity to a household and the payments which a household will actually make when the commodity is provided. Third, the implementation of this approach does not require any sort of community participation. Fourth, the indirect approach will probably not be feasible in most situations because there will not be sufficient variation in either the dependent variables (source choice and quantity of water) or in the independent variables (socioeconomic characteristics and household characteristics).

Other modeling approaches exist for estimating the willingness to pay for water which use data on observed behavior, but they suffer from these limitations as well as others. Two of these are outlined below, but they do not hold as much promise as the estimation of the discrete-continuous model with data on household and source characteristics collected in household interviews.

3.3.3 Hedonic Property Value Model

The hedonic property value model has been used in the environmental and resource economics field to estimate the benefits from improvements in environmental quality (Freeman 1979a and 1979b); conceptually it could be applied to the problem of estimating the willingness to pay for improved rural water supply services. The hedonic property value model describes a house as a bundle of neighborhood, site, and structural characteristics, one of which could be the type of water supply and wastewater disposal facilities it has. If different houses in an area have different water supply facilities, variations in the equilibrium housing prices over the sites reveal the household's willingness to pay for a change in the level of water services.

In the hedonic property value approach, the household is assumed to maximize its utility through the consumption of a composite market good x and the attributes of its house (z_0, z_1, ..., z_m):

Maximize $U(x, z_0, z_1, \ldots, z_m)$

subject to $px + R(z_0, z_1, \ldots, z_m) = y$

where z_0 might be the water supply facilities available to the house,

$U(.)$ is the household's utility function,

y is household income, and

p is the price of the composite market good.

The first order conditions for a solution to this problem require that the household's marginal willingness to pay for a housing attribute z_j equal the implicit price of z_j. The hedonic price function $R(z_0, z_1, \ldots, z_m)$ relates the market price of a house to its attributes, and is assumed to be the result of the actions of many households in the housing market.

The hedonic property value technique consists of two stages: (1) the estimation of the hedonic price function and (2) using the implicit price of a housing attribute--in this case the water services available to the household--to measure the household's willingness to pay for an improvement in water supply services. The model thus assumes that the household can freely search over all houses and locations to find the optimal levels of housing attributes and that there is a competitive, active housing market.

It would appear, however, that rural housing markets in developing countries can rarely be assumed to operate in this fashion. Houses are not traded frequently or freely, and meaningful data on market prices will simply not be available in rural areas. The hedonic property value model is not thus a promising approach for estimating households' willingness to pay for improved water supply services in rural areas, although there may be situations where it can be applied in urban areas.

3.3.4 The Varying Parameter Demand Model

The varying parameter demand model also addresses the question of how much people are willing to pay for different attributes of a water source (Vaughn and Russell 1982). Suppose the factors influencing the quantity of water demanded by a household are classified into two groups: (a) variables

associated with the household, such as income and other socioeconomic characteristics, and (b) variables associated with the water sources, such as taste and odor. The household's demand function for water can be written as:

$$Q_{hj} = f[SP_{hj}, S_h, W_j]$$

where Q_{hj} is the amount of water demanded by household h which uses source j;

W_j is a vector of the characteristics of source j;

S_h is a vector of the characteristics of household h; and

SP_{hj} is the shadow price of water from source j for household h.

The varying parameter demand model attempts to separate the effects of price and water quality on water demand into two estimation stages. First, a demand function is estimated for each source. Since W_j is constant for a given source j, the demand function to be estimated for each source becomes

$$Q_{hj} = f_j[SP_h, S_h]$$

Let us assume this function takes the following linear form:

$$Q_{hj} = a_{0j} + a_{1j}*SP_h + a_{2j}*S_h + e_{hj}$$

where e_{hj} is an error term.

This demand function can be estimated from a cross section of households which choose source j. The subscript j on the estimated parameters a_0, a_1, and a_2 indicates the fact that the water quality variable W_j is not included in the function.

If there are n water sources, there will be n such demand equations, and thus n different sets of a_j's, the estimated parameters. The variation in the estimated parameters can be explained by the source attributes. This estimation is the second stage of the varying parameter demand model. In other words, the following model is estimated for a cross section of sources:

$$a_j = g[W_j] + e_j$$

The estimated coefficients of this equation reveal the average household's willingness to pay for each of the source attributes.

The varying parameter demand model requires a larger sample of sources than would be available in a single village and thus households must be pooled across villages. Data will rarely be available for a large enough sample of villages for the varying parameter demand model to be generally applicable or for it to be a feasible procedure in most practical planning contexts. It does, however, have promise as a basis for future research, and the approach could be used to collaborate other methods.

Chapter 4

A CASE STUDY OF THE USE OF CONTINGENT VALUATION SURVEYS IN SOUTHERN HAITI

4.1 The Study Area

In August 1986, the research team conducted contingent valuation surveys and source observations in two villages in southern Haiti: Laurent and St. Jean du Sud. Southern Haiti was selected as the research area for two reasons. First, decisions about the level of service and the choice of technology for water supply systems are particularly difficult in Haiti. IDB's experience shows that in most of Latin America, rural communities can afford and are willing to pay the operations and maintenance costs of yard taps. Per capita incomes in Haiti, however, are the lowest in the Western Hemisphere: in 1980 more than two-thirds of the population of 5 million people had per capita annual incomes less than $155 US. Most individuals simply cannot afford the costs associated with private connections. As one of the 30 least-developed countries in the world, Haiti thus provides a field setting similar to the situation in much of Africa and in some parts of Asia and a situation where an accurate understanding of the willingness of the population to pay for rural water services is likely to be particularly important for sound investment decisions.

Second, the United States Agency for International Development is currently funding a rural water supply project in southern Haiti that is designed to provide service to approximately 160,000 individuals in 40 villages. The project is executed by CARE which, as the implementing agency, is responsible for all site selection, construction, and community organization. CARE's standard village water supply project is a gravity-fed system supplied with water from a captured mountain spring, feeding a few public standposts in a rural community (photos 1 and 2). Because CARE had been experiencing the same problems that gave rise to this research (that is, simplistic demand assumptions not being fulfilled in practice), CARE staff participated enthusiastically in the study. CARE provided experienced enumerators for our household surveys, logistical support, and valuable advice on a wide range of issues, from questionnaire design and translation to data on local water use customs. The affiliation of this research effort with the continuing CARE project provided the research team access to villages and justified its presence and purpose to the local population, which was essential to the success of the work.

Both villages are located within a 50-kilometer radius of Les Cayes, the provincial capital of southern Haiti (see Figure 2). The region is mountainous, with numerous streams draining into the Caribbean Sea. The population of the villages varies, from approximately 1,000 in St. Jean du Sud to 1,500 in Laurent. Laurent lies approximately ten kilometers inland along the main highway from Port-au-Prince to Les Cayes, one of the best roads in the country. St. Jean du Sud is more remote but can be reached by gravel road; it is a coastal community. The coastal areas are hot and humid, but temperatures decrease considerably in the interior as elevation increases. The rainy seasons are October to January and May to June; this study was conducted during the middle of the July to September dry season.

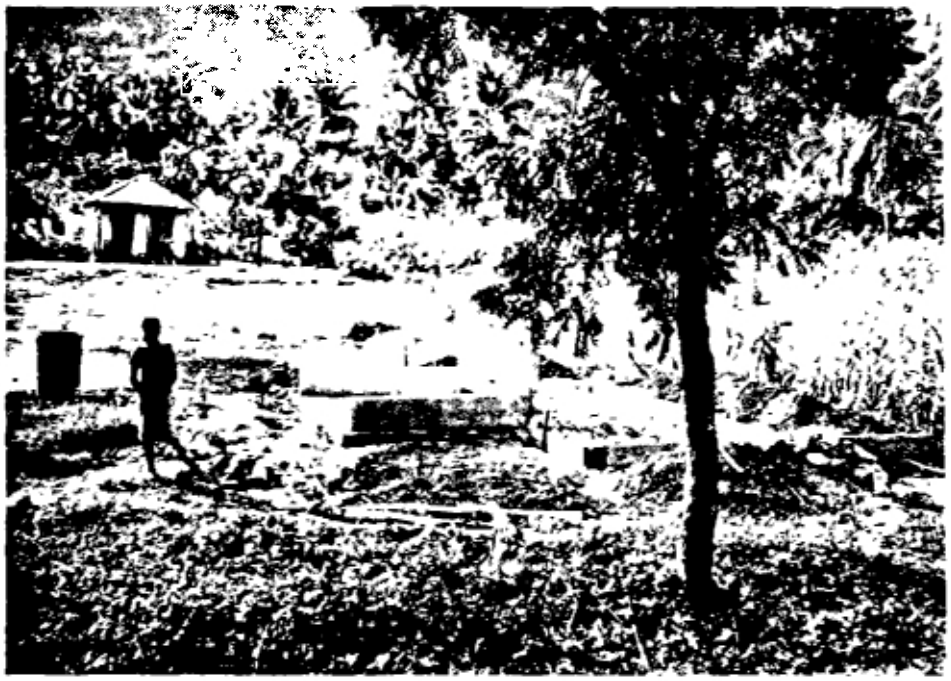

Photo 1: Public tap under construction by CARE in St. Georges, Haiti

Photo 2: Women washing clothes in outflow from captured water source in Rosier, Haiti (system constructed by CARE)

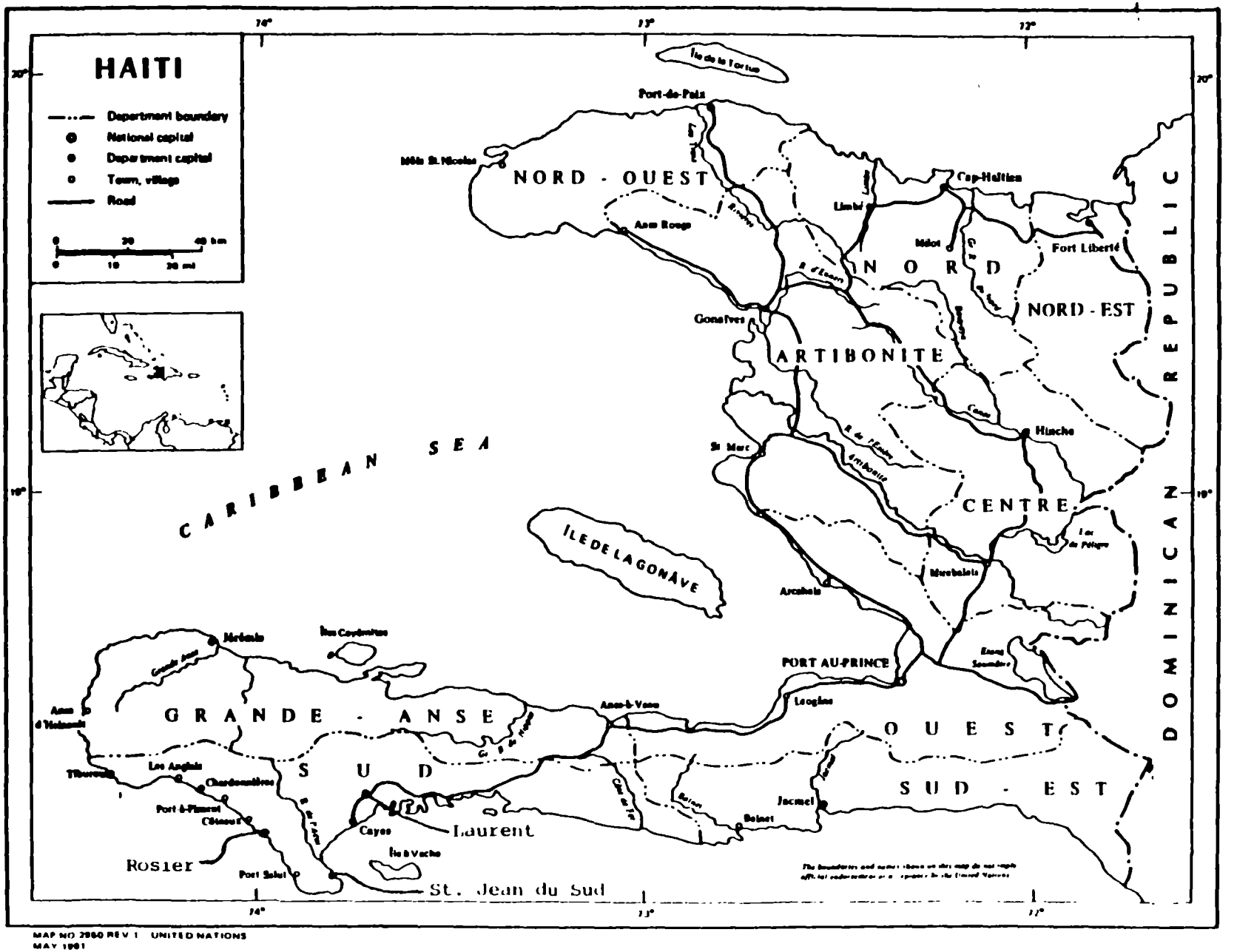

Figure 2. Map of Haiti

The populations of both villages consist primarily of small-scale farmers who cultivate sorghum, beans, corn, rice, manioc, sweet potatoes, plantains, and yams. Sugar cane, coconuts, mangos, and vetiver (a crop used in the production of essential oils for perfume) are the principal agricultural products sold in rural and urban markets. Deforestation and soil erosion are severe problems in the area, and agricultural yields have been declining as a result. Few people have regular wage employment, and remittances from relatives and friends living abroad or in Port-au-Prince are common. St. Jean du Sud has only a few fishermen; the coastal fishery has been severely depleted and yields are low. Eighty percent of the population of Haiti is illiterate; the illiteracy rate in the study area is probably even higher. Malnourishment is widespread among children in the villages studied. The typical family lives in a three-room mud house with plastered walls and a thatched or tin roof.

4.2 Water Sources and Water Use Patterns and Customs

Inhabitants of both villages have access to several sources of fresh water. In Laurent there are seven sources within approximately two kilometers of most of the population: one protected well and six springs in dry river beds. The springs provide only modest amounts of water, and individuals often wait more than an hour to draw supplies. The average three-kilometer round trip to a water source can sometimes take several hours. In St. Jean du Sud a small river runs through the community, and the village has numerous additional sources, typically small springs in mountain valleys or artesian wells.

In both villages, the populations state strong preferences for clean drinking water and sometimes walk considerable distances past alternative sources to collect drinking water from sources they consider pure. Water for drinking and cooking is usually collected by women and children and carried home in relatively standard-size containers (approximately 20 liters for adults). Although children under five years of age are usually bathed at home in basins, adults and older children express a strong preference for bathing in rivers. Clothes-washing is usually done in rivers. In Laurent, some individuals actually pay for public transport to make the roughly ten-kilometer round trip to the nearest river to do laundry.

4.3 Research Design

The research design was developed to test whether contingent valuation surveys could be used to estimate water demand relationships suggested by consumer demand theory and thus used to reliably estimate individuals' willingness to pay for improved water services. As discussed in Chapter 3, economic theory suggests that an individual's demand for goods is a function of the price of the goods, prices of substitute and complementary goods, the individual's income, and the individual's tastes, usually measured by the individual's socioeconomic characteristics.

In CARE's water supply project, the characteristics of the goods--public standposts or private connections--are the same for everyone. There is no volumetric charge for water from public standposts; an individual can use as much water as desired. Whether or not a household demands water from the

public water system thus depends on the price charged for access to the new system or for participation in the project. If the charge is higher than a given household's maximum willingness to pay, the household will elect not to use the new water system. Maximum willingness to pay will vary from household to household and should be a function of all of the variables in the demand function, except the price of the goods themselves. The WTP bids should thus be positively related to income, the cost of obtaining water from existing sources, the education of household members, and number of household members, and negatively correlated with the individual's perception of the quality of water at the traditional source that was used before the construction of the improved water supply system. The WTP bids of women respondents are hypothesized to be higher than those of men because women carry most of the water, but alternative interpretations are certainly possible.

The research design was developed to test whether WTP bids are systematically related to the variables suggested by economic theory. If the variation in bids cannot be explained by such variables, three logical explanations can be offered. First, economic theory may not be an appropriate conceptual framework for explaining the behavior and preferences involved. Second, economic theory may be correct, but the contingent valuation method may not be a sound method for collecting information to estimate the water demand relationships suggested by such theory. Third, errors in execution of the research, such as poor questionnaire design, could lead to invalid inferences about the relationship between the WTP bids and the independent variables.

Because contingent valuation surveys have seldom been attempted in developing countries, the research design was constructed to test for the existence and magnitude of several of the threats to the validity of such survey results discussed in Chapter 3.

4.3.1 The Question Format

The question format itself may affect the WTP bids. In the contingent valuation surveys, different ways of asking the questions were tried. Both open-ended, direct questions--for example, "What is the maximum you would be willing to pay per month to have a public standpost near your house?"--and two forms of bidding games that relied on a series of yes-no questions--for example, "Would you be willing to pay $X per month for a public standpost near your house?"--were used. Examples of the different question formats are included in Appendix A.

4.3.2 Strategic Bias

Most attempts to estimate strategic bias have been highly structured experiments in which one group of respondents is told one set of facts about a situation that minimizes their incentive for strategic behavior and another group receives a different set that maximizes their incentives for strategic behavior (Bohm 1972; Mitchell and Carson 1986). Because the surveys for this research were conducted within the context of CARE's continuing rural water supply project, it was impossible to construct a counterfactual situation (this would have entailed deceiving the study population about CARE policies). Instead, the magnitude of strategic bias was estimated in the following way.

In Laurent and St. Jean du Sud, the study population was divided into two groups. One group was read a statement that was intended to minimize strategic bias (Statement A), and the second group was read a statement that was accurate but left questions about the purpose of the study unanswered (Statement B). The hypothesis was that if individuals acted strategically, bids from those who received Statement B would be lower than those who received Statement A, because the former would fear that a high bid would result in a higher charge by the community water committee. (Both statements are included in the household questionnaire in Appendix A).

This may not in fact be a strong test for strategic bias because the differences in the two statements are quite subtle. In future research, it would be useful to have follow-up interviews with selected respondents to determine whether the differences that the research team wished to suggest were understood. An in-depth anthropological research effort might also elicit information on what types of strategic "thoughts" passed through respondents' minds during the interview process. If strategic behavior is found to exist, anthropological research might also yield insights into how to minimize it during the interview.

4.3.3 Starting-point Bias

To test for starting-point bias, three different versions of the questionnaire were distributed, each with different initial prices in the bidding games, to both villages. The questionnaires were randomly distributed in each sample population.

4.3.4 Hypothetical Bias

Hypothetical bias arising from the respondent's unfamiliarity with improved water services, such as public fountains, is not likely to exist. Many rural water systems have already been built in southern Haiti; the respondents were all familiar with public water fountains and private water connections and readily understood the possibility that their community would receive a new water system. Moreover, each respondent was shown two color photographs of public standposts CARE had built in nearby villages. Household members usually studied these with great interest.

Moreover, if individuals will not take the contingent valuation questions seriously--for whatever reason--the WTP bids will presumably not be systematically related to household characteristics and other factors suggested by economic theory. The test for hypothetical bias was thus the same as the test for the usefulness of the contingent valuation method and the applicability of consumer demand theory: Were bids systematically related to the variables suggested by economic theory?

4.4 Field Procedures

Field work in the two villages consisted of two parts: household surveys and source observations. Eight CARE health education promoters and two local college students were trained for two days to carry out the household

interviews. Prior to field-testing the questionnaire, a "focus group" was held in St. Jean du Sud in which individuals from the community discussed community water-use practices and attitudes. A focus group is simply an arrangement to get individuals in the community together in a group, to informally discuss the study and the survey questionnaire. The use of focus groups stems from group theory and the observation that individuals are more apt to talk about a problem or issue freely in the security of a group rather than in a one-on-one interview. During the 1950s focus groups were used in the United States to obtain qualitative data from consumers about their reactions to product advertising and promotion efforts. The use of a focus group in St. Jean du Sud was useful and facilitated the development of a sound survey instrument. Particular attention was paid in the focus group to household decision-making on water-related matters and to community expectations about operation and maintenance costs. The focus group was not intended, however, to substitute for a pretest of the questionnaire. The Creole questionnaire was pretested extensively in a nearby village before the CARE enumerators were trained, and another day of pretesting was carried out by CARE staff after training. Because microcomputers were available, revisions to the questionnaire could be incorporated literally overnight and new copies made for field work the next day.

In both Laurent and St. Jean du Sud the majority of households were interviewed. Enumerators were instructed to try to interview someone in every house. If no one was at home, a follow-up visit was usually arranged. The household interview consisted of four parts. The first dealt with basic occupational and demographic data for the family members, and summary information on where the family obtained its water. The second part consisted of additional questions on the location of each water source that the family used, perceptions of the water quality at each source, the average number of times each family member went to each source per day, and the number of containers they carried home (the enumerator asked to see the containers used to carry water and estimated their volume). In the third part of the questionnaire, the enumerator read one of the statements used to test for strategic bias and showed the respondent the photographs of public standposts CARE had built in other villages (photos 3 and 4). The respondent was then asked separately for a WTP bid per month for (a) public standposts and (b) a private connection. The fourth part was a series of questions on the health and education of family members and the household's assets (such as whether the household had a radio or a kerosene lamp). The principal investigators and the enumerators had agreed that it was not possible to obtain accurate information on household income through interviews (in fact the enumerators simply refused to ask either income or expenditure questions because of the antagonism such questions aroused). As a substitute, the enumerator recorded a series of observations about the construction of the house itself, such as whether the house was painted, whether the roof was straw or tin, and whether the floor of the house was dirt or cement.

Detailed maps of both villages were prepared that indicated the location of all houses and major structures in the village as well as all water sources. Enumerators who could read maps were given a map of the village they worked in, asked to assign a number to each household interviewed and to record that number on the map. The enumerator also gave each respondent a ribbon and an index card with the corresponding household number on it and asked the respondent to wear the ribbon or bring the index card on a designated day to

Photo 3: CARE public tap and showers in Rosier, Haiti
(Photograph used in contingent valuation survey)

Photo 4: CARE public tap in Port-a-Piment, Haiti
(Photograph used in contingent valuation survey)

the water source used. Enumerators who could not read a map were given a set of ribbons with preassigned numbers, dropped at specific points in the villages, and instructed to interview households in clearly specified areas and assign a number to each household interviewed; one of the senior members of the research team then recorded on the map which households were located in the specified areas. Data from household interviews were generally entered into the microcomputer on the same day the interviews were conducted, and processed with dBase III programs. Summary statistics were continually compiled during the course of the field work and discrepancies in the data and problems with the survey implementation could be quickly detected.

The second part of the field work consisted of observing the quantities of water collected by individuals at all the sources around the village. The objective of these observations was to verify the information individuals provided in household interviews on the sources they used and the quantities of water collected. Local residents were hired to serve as source observers; they were typically secondary school students on summer vacation. All source observers received one day of training in estimating the volumes of various containers and in recording data in their notebooks. Each time an individual arrived at a source, the source observer recorded household number, name, gender, relative age (adult or child), time of arrival, quantity of water carried away, and whether the individual bathed or did laundry. All sources were observed on the same day from sunrise to sunset. Two shifts of source observers were used for each source (for example, in St. Jean du Sud, where 15 sources were observed, the research team hired and trained 30 individuals). The source observers were monitored closely by the principal investigators to ensure the quality of the data collected.

Table 2 presents a summary comparison of the two study villages.

4.5 Analysis of the Source Observation Data

The analysis of the source observation data for Laurent increased confidence in the quality of the water use data obtained from the household interviews. In Laurent, data were recorded on 119 trips to water sources by individuals (or groups of individuals from the same household) who identified themselves to source observers either by wearing a ribbon or displaying an index card with their household number. The sources these individuals said they used for drinking and cooking in the interview were compared with the source they actually went to on the day of the source observations. Out of the 119 observations, the interview responses were consistent with the source observations for 101 households (85 percent). Next, the quantities of water people said they used in the interview were compared with the amount the source observers actually saw them collect. For Laurent, the responses obtained in the interview were on average 25 percent higher than the quantity of water recorded by the source observers.

Several possible explanations exist for this difference. First, the source observers could, of course, have simply missed a trip by a family member, which would reduce the total quantity recorded in the source observation data. This could have occurred, for example, if one family member forgot their household number or could not identify themselves to the source observer.

Table 2

Comparison of Study Villages (Laurent and St. Jean du Sud)

	Laurent	St. Jean du Sud
1. Estimated Population	1,500	1,000
2. Number of Households Interviewed	170	143
3. Number of Water Sources	7	many
4. Number of Source Observations	119	87
5. Type of Terrain	relatively rugged	flat
6. Was the Focus Group Interview Conducted?	no	yes
7. Type of WTP Question Asked:		
(a) Direct	no	yes
(b) Bidding game	yes	yes
8. Was the Test for Starting-point Bias Conducted?	yes	yes
9. Was the Test for Strategic Bias Conducted?	yes	yes
10. Mean WTP bid ($US/mo.)		
(a) For standposts	$1.15	$1.10
(b) For private connection (in addition to charge for standposts)	$1.40	$1.14

Second, the water sources were only observed for one day, which may not have been representative. Third, different groups of individuals were employed for the source observers and the enumerators for the household interviews. There may have been systematic differences in the way they recorded the volumes of water containers. The source observations for Laurent, however, generally corroborate the information obtained from the household interviews. In the analysis of the contingent valuation bids, the water use data from the household interviews was used. The conclusions for St. Jean du Sud are more tentative because it rained during the morning of the source observations, undoubtedly altering water collection patterns and reducing the quantity of water collected on this day. During the day of the source observations, information was recorded for 87 households who identified themselves by their household interview number. The average quantity of water collected by a household based on the source observations in St. Jean du Sud was only 55 percent of the quantity households reported in the household interviews.

Despite this large difference, there was other information supporting the reliability of the household interview information. Forty-four of these households said in their interview that they used only one source for water carried to the home; in the source observations 49 households used only one source. In the interviews, 38 households said they carried water home from two sources; in the source observations 34 households used two sources. In the interviews, five households said they used three sources; in the source observations, four households used three sources.

4.6 Analysis of the Contingent Valuation Bids in Laurent and St. Jean du Sud [1]

Execution of the contingent valuation survey went smoothly in Laurent. Only the bidding game question format was used in Laurent because respondents usually felt that the bidding game was similar to the type of negotiation typical of local markets in rural Haiti, and it thus worked better than open-ended questions. The mean bids of respondents who received the two opening statements designed to test for strategic bias were not statistically significant, and thus, on the basis of this test, respondents do not seem to be behaving strategically when answering WTP questions. Similarly for starting-point bias, there is no evidence that the initial starting point in the bidding game influenced the final WTP bids for either standposts or private connections. Therefore, neither of these tests for bias indicated any problems with the use of the contingent valuation methodology.

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1 A full discussion of the results of the statistical analysis of the contingent valuation bids is presented in Appendix B.

The mean of the WTP bids in Laurent for public standposts was 5.7 gourdes per household per month. This is roughly 1.5 percent of per capita income and is significantly lower than the 5 percent rule of thumb often used in rural water supply planning for maximum "ability to pay." The WTP question for private connections assumed that public standposts were already provided in the village. The mean of the WTP bids for private connections was 7.1 gourdes. This bid is in addition to the bid for the public standpost.

The variation in the WTP bids for standposts and private connections in Laurent is systematically related to variables suggested by economic theory: household wealth (as a proxy for income), education of household members, the distance of the household from their existing water source, and the respondent's perception of the quality of the water at their existing source. The results of the analysis indicate that WTP bids are not random or simply numbers "pulled out of the air." These results suggest that hypothetical bias may not be a serious problem and that the WTP bids provide meaningful information.

The results for St. Jean du Sud are less conclusive than those for Laurent due in part to implementation problems with the contingent valuation survey. Nevertheless, the results of the tests for strategic bias and starting-point bias are consistent with those from Laurent: no evidence exists of either type of bias. The overall mean bid in St. Jean du Sud for public standposts was 5.5 gourdes per household per month, 96 percent of the value for Laurent. The mean bid for private connections was 5.7 gourdes per month, 80 percent of the value for Laurent. The variations in WTP bids for St. Jean du Sud could not be explained as a function of the economic variables used in analyzing the bids from Laurent.

4.7 Conclusions from the Haiti Case Study

From this research one cannot, of course, determine whether individuals in the villages would in fact pay the amounts they indicated in the contingent valuation survey if a water agency actually tried to collect the money. To do so, it would be necessary to conduct a contingent valuation survey in a village before a water system is built, then resurvey after the system is completed and collection efforts made and compare the prior bids with the actual responses.

Nevertheless, the preliminary results of this research strongly suggest that contingent valuation surveys are a feasible method for estimating individuals' willingness to pay for improved water services in rural Haiti. This outcome has important policy implications for rural water supply projects such as CARE's because it seems to show that going into a village and conducting a relatively simple household survey can yield reliable information on the population's willingness to pay for improved water services. The potential importance of this strategy to eventual site selection and project design can be illustrated with three examples from CARE's rural water supply project in southern Haiti.

One of CARE's first projects was constructed in Port-à-Piment, a coastal town of approximately 5,000 people. Before the completion of the new water system, the town relied on poor-quality shallow wells, river water, and one spring approximately three kilometers away. The spring provides large quantities of high-quality water for drinking, but the six-kilometer round trip to fetch it imposed a heavy burden on the population. CARE designed the capacity of the new water system to provide 60 liters per capita per day from 11 public standposts and planned for 20 percent of the population to have private connections.

When CARE agreed to construct the new system, there was great enthusiasm among the population. CARE community organizers had no trouble establishing a local water committee that collected a $1 US fee from each household to establish a fund for operations and maintenance. In fact, the people of Port-à-Piment and the new water committee soon wanted to know CARE's policy for installing private connections. The National Water Authority in Haiti (SNEP) usually has responsibility for operating water systems with private taps and collecting monthly charges; their standard fees are $25 US for a tap and $3 US per month, regardless of the volume used. Many local residents--far more than planned for in CARE's standard system design--expressed a desire for private taps on these terms, signing up and making additional deposits of $5 US. Because the spring that was captured for the Port-à-Piment system could have supplied several times the amount of water that the design called for, more private connections could easily have been provided by using a larger pipeline from the source.

Regarding the findings of this research, if CARE had spent a few days carrying out a contingent valuation survey in Port-à-Piment before completing the system design, it might have been possible to predict this high demand for private connections. The high willingness to pay for private connections in Port-à-Piment indicates both that the benefits of the project are likely to be large and that a strong possibility exists that any cost-recovery objectives could be met. The information from a contingent valuation survey would have indicated that Port-à-Piment was an appropriate site for a new water system and that the system should be designed to provide higher numbers of private connections.

As a second example, consider the CARE water system in Rosier. CARE selected this site for its first project because the source was near the village and easy to capture, not because there was a shortage of water in the community. In addition to numerous nearby springs, two mountain streams flow through the village and are used for washing clothes and bathing. Because Rosier was CARE's first site, CARE staff paid close attention to water use after the project was in operation and metered the five new public standposts. Water consumption at these standposts turned out to be approximately six liters per capita per day, not the 60 liters originally planned. Because the time saved carrying water was relatively insignificant in comparison to communities such as Port-à-Piment and Laurent, and the people of Rosier were probably already satisfied with the quality of water nearby, it should have been possible to anticipate that the benefits of the Rosier project would be low. If CARE had carried out a contingent valuation survey in Rosier prior to the construction of the project, there would probably have been many zero bids and a low mean household willingness to pay for public standposts. CARE could thus probably have predicted this low water consumption in Rosier.

A third example is the problem of defining the service population for St. Jean du Sud. The CARE planning methodology called for counting the houses within a two-kilometer band on either side of the main road through town, where the public standposts would likely be located. It was then assumed that all of these households would use the new water system and that the capacity of the system could be based upon this service population. The contingent valuation survey conducted in St. Jean du Sud showed, however, that people living back in the hills away from the road were much less likely to be willing to pay for public standposts located in town and probably would not use the proposed new water system. From these results, CARE was able to develop more realistic estimates of the service population for St. Jean du Sud and thus more accurately determine the appropriate capacity of the system.

Chapter 5

SUMMARY OF FINDINGS AND CONCLUSIONS

As indicated in Chapter 1, the study had two objectives: (1) to assess and develop methodological approaches for estimating individuals' willingness to pay for rural water services and (2) to conduct a field test of one approach for estimating willingness to pay. Both of these objectives were accomplished, as summarized below.

Summary of Review of Methodological Approaches For Estimating WTP

This study examined the methodological approaches available for assessing individuals' willingness to pay for improved water supplies. On the basis of this assessment, it is concluded that the traditional demand model for explaining quantity of water demanded by a household is inadequate for rural villages in developing countries. The report describes a theoretical model for understanding village water-use behavior which attempts to explain both the household's decision regarding which water source to use and how much water to use from that source. The application of this "discrete-continuous model" of household water demand will likely be successful in accurately predicting source choice decisions and it will represent a major advance in understanding water-use behavior in developing countries.

Two complementary types of data can be used to estimate such a model describing household water-use behavior. One approach is to collect data on actual observed behavior (the "indirect" approach). In this case, the planner measures the quantities of water collected by different households, the time spent collecting water, and other source and household characteristics and, on the basis of consumer demand theory, infers how much the household would be willing to pay for an improved water supply. The major advantage of this approach is that the estimates of willingness to pay are based on what people actually do, not on what they say they will do. Some of the disadvantages are: (1) it may not be feasible in many locations because there is insufficient variation in the water source and household characteristics, (2) results may have to be extrapolated beyond the range of the data, and (3) a discrepancy may exist between the revealed value of a commodity and the payments which a household will actually make when the commodity or service is made available. Other "indirect" procedures for estimating willingness to pay are considered, but it is concluded that they do not have great promise as practical planning tools in the rural water sector.

A second approach is simply to interview an individual and ask directly how much he or she would be willing to pay for a public tap or private connection. This "direct" approach to estimating willingness to pay is termed the "contingent valuation method." Some of the advantages of using data from a contingent valuation survey are: (1) it is inexpensive, (2) it can be used to value services not presently available in the village, and (3) it provides a procedure for incorporating community preferences in the planning process. The major disadvantage is that, for a variety of reasons, in the interview process individuals may not reveal their actual willingness to pay.

Most of the applications of the contingent valuation method have involved efforts to measure the willingness of individuals to pay for changes in environmental quality and have been conducted either in the United States or Western Europe. In the specific case of rural water supplies in developing countries, a decade ago Saunders and Warford (1977) concluded that "the questionnaire approach to estimating individuals' willingness to pay has been shown to be virtually useless." No empirical support exists for this conclusion, however. Until the Haiti case study conducted as part of this project, no systematic attempt was reported in the literature to determine the suitability of the contingent valuation methodology for assessing the willingness to pay for publicly provided goods in developing countries. Because the contingent valuation approach offered the promise of a rapid, inexpensive means of determining willingness to pay for improved water supplies, high priority was placed in this study on determining whether the approach was practical.

Findings

The findings from the Haiti field study of the contingent valuation methodology have many implications for future efforts to use the method in developing countries. Among the most important findings are the following:

Finding No. 1

The research design tested for several threats to the validity of the survey results (strategic bias, starting-point bias, hypothetical bias). No evidence was found of any of these biases.

Finding No. 2

The bidding game question format was more effective than open-ended questions.

Finding No. 3

The WTP bids for Laurent were systematically related to the household and source characteristics suggested by consumer demand theory. For example, households farther away from their existing source were willing to pay more for a new public tap than a household close to the traditional source. Similarly, higher-income households were willing to pay more than low-income households.

Finding No. 4

The mean of the WTP bids in the village of Laurent for public taps was $1.15 US per month, approximately 1.5 percent of per capita income and significantly lower than the 3 percent to 5 percent of income rule of thumb. The mean of the WTP bids for private connections (assuming the public taps were already in place) was not significantly higher: $1.40 US per month.

Finding No. 5

Analysis of data collected from source observations indicates that the water use information provided by respondents in household interviews is reasonably accurate.

Conclusions

On the basis of these findings and the field experience in Haiti, the research team reached the following conclusions:

Conclusion No. 1

The contingent valuation survey for estimating willingness to pay was practical and feasible in the field.

Conclusion No. 2

Respondents took the contingent valuation questions, and indeed the entire interview, seriously. Respondents did not give wildly unrealistic or "protest" bids.

Conclusion No. 3

The WTP bids offered by individuals are meaningful and not simply numbers "pulled out of the air."

Conclusion No. 4

The results of the field test in Haiti suggest that contingent valuation surveys may provide valuable information on households' willingness to pay for improved water services. Such information could be particularly helpful in (1) identifying communities which could meet specified cost-recovery targets, (2) determining prices and connection fees to charge for the improved water services, and (3) determining the appropriate level of service and the water system capacity required.

Conclusion No. 5

A willingness-to-pay study may be useful even when a donor is committed to providing free water because the results of the study may help identify villages where an improved water supply is most desired and thus most likely to be used.

Conclusion No. 6

Additional experience is required with contingent valuation surveys in other countries to determine whether the conclusions of the Haiti case study can be generalized.

Conclusion No. 7

The implications of this study are not limited to the rural water sector; contingent valuation surveys are likely to be a viable method of collecting willingness to pay information for a wide range of public infrastructure projects and public services in developing countries. In particular, contingent valuation surveys are likely to prove useful for estimating individuals' willingness to pay for household sanitation services, operations and maintenance of water supply systems, and transportation and housing improvements.

Chapter 6

RECOMMENDATIONS

Investigation of the problem of estimating households' willingness to pay for water services is still in the preliminary stages with much work yet to be done. The following are the most important recommendations for future work:

Recommendation No. 1

USAID should support a field test of the indirect approach to estimating willingness to pay for water services. The discrete-continuous model should be estimated with data collected from such a field test of the "indirect" approach and the estimates of willingness to pay derived from the direct and indirect approaches should be compared and evaluated.

Recommendation No. 2

Research should be conducted to test (1) whether households need more time (that is, a few hours or days) to consider the question of how much they would be willing to pay for improved water services and (2) whether households' bids would differ if they were allowed to discuss the willingness-to-pay questions with other members of their family, their neighbors, or in organized community meetings.

Recommendation No. 3

Contingent valuation surveys should be conducted which explicitly incorporate (1) variations in connection fees for improved water services and (2) changes in the location of improved services in the village.

Recommendation No. 4

Anthropological studies should be conducted in conjunction with contingent valuation surveys (1) to better understand issues relevant to water use behavior and better construct the wording of the questionnaire, (2) to explore the reasons why individuals answered the way they did, and (3) to examine why the estimates of willingness to pay derived from the indirect and direct approaches are different.

Recommendation No. 5

Future research should attempt to validate the estimates of willingness to pay based on both the direct and indirect approaches. The most reliable test for both the direct and indirect approaches is whether the estimated model can predict independently observed behavior. For the contingent valuation estimates, the ex-ante WTP bids should be compared with the actual payments made after a new system is installed.

Because the indirect approach will be used in a village which already has an improved water supply, the comparison of behavior before and after the installation of a water system cannot be used to validate the model estimated with such data. For the indirect approach, the forecasting ability of the model may be tested in two other ways. First, the sample of households in a particular village could be divided into two groups. The data from one group would be used to estimate the model. The estimated model would then be used to predict the source choice (and perhaps water consumption) of the households in the second group. If the predicted and actual choices were similar, it could be concluded that the model based on observed behavior was validated for that particular village. Second, the model estimated from observations in one village could be used to predict behavior in another village. Again, if the predicted and actual choices were similar, the model could be considered to be validated.

Recommendation No. 6

USAID should support the preparation of a manual or set of guidelines for water supply planners that summarizes the lessons learned from this research effort concerning the practical details of designing and implementing a contingent valuation survey in a developing country.

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APPENDIX A

Household Questionnaire

APPENDIX A

Household Questionnaire

INTRODUCTORY STATEMENT I
(FOR THOSE VILLAGES WHERE WATER SYSTEMS ARE ALREADY COMPLETED)

We are working with CARE on a water study. CARE has helped people in _____ to build a potable water system. We will be asking questions to determine if people in _____ like this new water system and what is the best system to build for other communities.

Your responses are assisting us only on questions concerning potable water systems. These responses will aid us to better understand how to supply potable water to other communities. And, these responses are not going to change anything in regard to the water system already in _____.

If you do not want to respond to these questions you are free to stop at anytime.

INTRODUCTORY STATEMENT II
(FOR THOSE VILLAGES WHERE WATER SYSTEMS HAVE NOT BEEN STARTED)

We are working with CARE on a water study. CARE wants to help people in _____ supply water to their community. We would like to ask you some questions to be able to know what needs to be done in _____ to supply potable water.

Your responses are assisting us only on questions concerning potable water systems. And, these responses will also aid us to better understand how to supply potable water to other communities.

If you do not want to respond to these questions you are free to stop at anytime.

Questionnaire Series #: _____

Time Interview Starts: _____ Ends: _____
Household #: _____ Date of Interview: _____
Name of Locality: _____
Name of Enumerator: _____

HOUSEHOLD QUESTIONNAIRE

1ST PART

1. Name of Person Being Interviewed: _____

   Age: _____ MAN / WOMAN

   Are other people helping the respondent answer questions?

   YES / NO

2. Name of Head of Household: _____
   Is this a female-headed household? YES / NO

3. How many people live in this house? _____
   How many adults (over age 18)? _____
   How many young people (ages 13-18)? _____
   How many children (ages 5-12)? _____
   How many children under five? _____

4. What is the occupation of the head of your household?

Does he/she or other members have other occupations?

	FIRST OCCUPATION	OTHER OCCUPATIONS 1	2	3
Farmer				
Mason/Carpenter				
Sailor/Fisherman				
Craftsman				
Factory Worker				
Small Business (Madam Sara)				
Large Business				
Voudou Priest, Medicine Man, Midwife				
Professional				
Other ( )				

5. Where is your household getting water this week?

a) _____
b) _____
c) _____
d) _____

Where does your household get water for:

	1st Place	2nd Place	3rd Place	4th Place
- Drinking				
- Cooking				
- Adult Bathing				
- Children Bathing				
- Clothes Washing				
- Utensil Washing				
- Animal Bathing				
- Animal Drinking				

6. Does your household get water at these same sources during the rainy season? YES / NO

If no, where does your household get water during the rainy season?

a) _____
b) _____
c) _____
d) _____
e) _____

Where does your household get water during the rainy season for:

	1st Place	2nd Place	3rd Place	4th Place
- Drinking				
- Cooking				
- Adult Bathing				
- Children Bathing				
- Clothes Washing				
- Utensil Washing				
- Animal Bathing				
- Animal Drinking				

7. Can you show me what containers your household uses for collecting water?

	How much water does each container hold?	For each container, how many times is it filled daily?
a)		
b)		
c)		
d)		
e)		

8. Does your household collect rainwater? YES / NO

Does your household have a tank to collect rainwater? YES / NO

9. Does your household use water which comes from Cayes or another town? YES / NO

If yes,

a) What town is this? _____

b) Does your household pay for this water? YES / NO
How much does your household pay per gallon? _____

c) On average, how many gallons does your household get from _____ each trip? _____

d) Does your household pay for having this water transported? YES / NO

How much does your household pay to have this water transported? _____

e) How many times does your household get water from _____ weekly? _____

f) Does someone else transport this water for you or does a member of your household transport this water?

_____

10. In Port-au-Prince, people often sell water by the bucket. Suppose someone in _____ starts selling tap water that is of good quality. If a large bucket (7 gallon) cost __**__, would your household buy it? YES / NO

How many of these buckets would your household buy daily?

_____

** Different prices are given here, the following was used in Haiti: 0.10 or 0.20 or 0.30 or 0.40 or 0.50 gourdes.

2ND PART (Complete the following questions for each source)

1. Source name: _____

2. Does your household use this water at the source? YES / NO

3. If you have to choose three words: Good / Fair / Bad
which would you choose to describe the following for this source?

	GOOD	FAIR	BAD
a) Color			
b) Odor			
c) Taste			
d) Dirt			
e) No Microbes in the water			
f) Reliability			
g) No quarrels at the source			

	NOT FAR	FAR	VERY FAR
h) Distance			

4. (Complete the following for this source if water is carried back to the house.)

How many people in your household carry water each day? _____

How many adults? _____
How many children? _____

	How many times each day does each person go to this source to get water?	How much water does each person carry in one trip?
1)		
2)		
3)		
4)		
5)		
6)		

3RD PART WILLINGNESS TO PAY FOR WATER

Introduction [Opening Statement A]

(The enumerator should read sentence after sentence.)

I am going to ask you some questions in order to know if you or someone from your household would be willing to pay money to ensure that the CARE Potable Water Project will be successful in Laurent/Sin Jean du Sud.

We would like you to answer these questions at ease. There are no wrong answers.

The water system is going to be managed by a committee of people from Laurent/Sin Jean. This committee will be chosen by the people of Laurent/Sin Jean.

CARE has decided to help Laurent/Sin Jean by constructing a water system in this community. Your answers cannot change the fact that CARE has decided to build this water system.

CARE never demands money from those people who collect water from public fountains. You will not have to pay money at the public fountains.

We need you to tell the truth in order for CARE to construct the best water system that Laurent/Sin Jean needs.

Did you understand everything that I was saying?
(If not, the enumerator should repeat the above sentences again.)

3RD PART WILLINGNESS TO PAY FOR WATER

Introduction [Opening Statement B]

(The enumerator should read sentence after sentence.)

I am going to ask you some questions in order to know if you or someone from your household would be willing to pay money so that the CARE Potable Water Project will be successful in Laurent/Sin Jean du Sud.

The water system is going to be managed by a committee of people from Laurent/Sin Jean. This committee will be chosen by the people of Laurent/Sin Jean.

The committee will decide the amount each household will have to pay to operate and maintain the water system.

Did you understand everything that I was saying?
(If not, the enumerator should repeat the above sentences again.)

Series A WTP Questions (Open-ended Questions)

A.1 Here are pictures of CARE public fountains in Rosier and Port-à-Piment (show pictures). Households collect any amount of water and at anytime.

What is the largest amount of money your household would be willing to pay each month without difficulty to have a public fountain in your neighborhood?

Amount of Money: _____
I don't know: _____

A.2 CARE thinks if people want to have a private connection, it is a privilege and the household has to pay for it. (The enumerator should explain what this means: a private connection meaning a pipe installed in the house with a tap.)

CARE will already have set up public fountains so that, everyone will have at their disposal good drinking water. Suppose that the amount of money for installing a private connection will cost 125 gourdes plus money for the materials. The water from the private connection can be used only in your house. You won't be able to sell water or use it to water gardens. If you do not pay each month, your private connection will be disconnected.

How much would your household be willing to pay each month to have a private connection?

Amount of Money: _____
I don't know: _____

If your household could pay more, how much do you think your household would be willing to pay each month to have a private connection?

Amount of Money: _____
I don't know: _____

Series B WTP Questions (Bidding Game No. 1)

B.1 Here are pictures of CARE public fountains set up in Rosier and Port-à-Piment (show pictures).

(a) Do you think your household would be willing to pay (2 or 5 or 7) gourdes each month to use a public fountain located in your neighborhood?

Yes	_____	Go to (b)
No	_____	Go to (c)
I don't know	_____	Go to (f)

(b) We do not know how much the water committee will decide for each household to pay for using the public fountain each month. If the decision is for each household to give 10 gourdes each month, would your household be willing to pay this?

Yes	_____	Go to (f)
No	_____	Go to (d)
I don't know	_____	Go to (f)

(c) We do not know how much the water committee will decide for each household to pay for using the public fountain each month. If the decision is for each household to give 0.50 gourdes each month, would your household be willing to pay this?

Yes	_____	Go to (e)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(d) Would your household be willing to pay (5 or 7 or 8) gourdes each month to use a public fountain located in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(e) Would your household be willing to pay (1 or 2 or 5) gourdes each month to use a public fountain located in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(f) Think for a moment, what is the largest amount of money your household would be willing to pay each month to use a public fountain? If it would cost your household more than this amount, your household could not afford to pay and would not be able to use the public fountain.

Amount of Money:	____	Go to the next page
I don't know:	____	Go to the next page

B.2 CARE thinks that if your household wants to have a private connection it is a privilege and your household has to pay for it (explain if needed). It is going to be the responsibility of the water committee to fix the amount people will pay each month. This has nothing to do with this survey. Suppose your household pays 125 gourdes for the installation plus the money for the materials and CARE has already set up public fountains so that, everyone will have at their disposal good drinking water.

(a) Would your household be willing to pay (5 or 10 or 15) gourdes each month to have a private connection?

Yes	_____	Go to (b)
No	_____	Go to (c)
I don't know	_____	Go to (f)

(b) We are not able to know beforehand how much money the water committee is going to demand for a private connection each month. If the committee asks 20 gourdes each month, would your household be willing to pay to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (d)
I don't know	_____	Go to (f)

(c) We are not able to know beforehand how much money the water committee is going to demand for a private connection each month. If the committee asks 2.50 gourdes each month, would your household be willing to pay to have a private connection?

Yes	_____	Go to (e)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(d) Would your household be willing to pay (10 or 15 or 17) gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(e) Would your household be willing to pay (3 or 5 or 10) gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(f) Now, take a moment to reflect. What is the largest amount of money you think your household would be willing to pay each month to have a private connection?

Amount of Money:	____	Go to (g)
I don't know:	____	Go to (g)

(g) Do you think that your household can pay the installation charge and the amount for the materials?

Yes	_____	Go to the next page
No	_____	Go to the next page
I don't know	_____	Go to the next page

Series C WTP Questions (Bidding Game No. 2)

C.1

(a) Do you think your household would be willing to pay 0.50 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (b)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(b) Do you think your household would be willing to pay 2 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (c)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(c) Do you think your household would be willing to pay 5 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (d)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(d) Do you think your household would be willing to pay 7 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (e)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(e) Do you think your household would be willing to pay 10 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(f) Take a moment, what is the greatest amount of money your household would be willing to pay to use a public fountain. If it would cost your household more than this amount, your household could not afford to pay and would not be able to use the public fountain.

Amount of Money:	____	Go to the next page
I don't know:	____	Go to the next page

C.2 CARE thinks that if your household wants to have a private connection it is a privilege and your household has to pay for it (explain if needed). It is going to be the responsibility of the water committee to fix the amount people will pay each month. This has nothing to do with this survey. Suppose your household pays 125 gourdes for the installation plus the money for the materials and that everyone will have at their disposal good drinking water at public fountains.

(a) Would your household be willing to pay 2.50 gourdes each month to have a private connection?

Yes	_____	Go to (b)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(b) Would your household be willing to pay 5 gourdes each month to have a private connection?

Yes	_____	Go to (c)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(c) Would your household be willing to pay 10 gourdes each month to have a private connection?

Yes	_____	Go to (d)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(d) Would your household be willing to pay 15 gourdes each month to have a private connection?

Yes	_____	Go to (e)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(e) Would your household be willing to pay 20 gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(f) Take a moment to reflect. What is the largest amount of money you think your household would be willing to pay to have a private connection?

Amount of Money:	____	Go to (g)
I don't know:	____	Go to (g)

(g) Do you think that your household can pay the installation charge and the amount for the materials?

Yes	_____	Go to the next page
No	_____	Go to the next page
I don't know	_____	Go to the next page

Series D WTP Questions (Bidding Game No. 3)

D.1

(a) Do you think your household would be willing to pay 10 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (b)
I don't know	_____	Go to (f)

(b) Do you think your household would be willing to pay 7 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (c)
I don't know	_____	Go to (f)

(c) Do you think your household would be willing to pay 5 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (d)
I don't know	_____	Go to (f)

(d) Do you think your household would be willing to pay 2 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (e)
I don't know	_____	Go to (f)

(e) Do you think your household would be willing to pay 0.50 gourdes each month to use a public fountain in your neighborhood?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(f) Take a moment, what is the greatest amount of money your household would be willing to pay to use a public fountain. If it would cost your household more than this amount, your household could not afford to pay and would not be able to use the public fountain.

Amount of Money:	____	Go to the next page
I don't know:	____	Go to the next page

D.2 CARE thinks that if your household wants to have a private connection it is a privilege and your household has to pay for it (explain if needed). It is going to be the responsibility of the water committee to fix the amount people will pay each month. This has nothing to do with this survey. Suppose your household pays 125 gourdes for the installation plus the money for the materials and that everyone will have at their disposal good drinking water at public fountains.

(a) Would your household be willing to pay 20 gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (b)
I don't know	_____	Go to (f)

(b) Would your household be willing to pay 15 gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (c)
I don't know	_____	Go to (f)

(c) Would your household be willing to pay 10 gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (d)
I don't know	_____	Go to (f)

(d) Would your household be willing to pay 5 gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (e)
I don't know	_____	Go to (f)

(e) Would your household be willing to pay 2.50 gourdes each month to have a private connection?

Yes	_____	Go to (f)
No	_____	Go to (f)
I don't know	_____	Go to (f)

(f) Take a moment to reflect. What is the largest amount of money you think your household would be willing to pay to have a private connection?

Amount of Money:	____	Go to (g)
I don't know:	____	Go to (g)

(g) Do you think that your household can pay the installation charge and the amount for the materials?

Yes	_____	Go to the next page
No	_____	Go to the next page
I don't know	_____	Go to the next page

4TH PART CONCERNING HEALTH

1. How many times did you or another member of your household go to the Medical Center last month? _____

(Questions 2-3 are concerning infants only.)

2. Are there infants in the household who had diarrhea last week?

YES / NO

How many infants had diarrhea last week? _____

3. Are there infants in the household that had skin infections last week?

YES / NO

5TH PART LEVEL OF EDUCATION & MEASURE OF HOUSEHOLD ASSETS

1. Do teenagers and children in your household go to school?

YES / NO

What grades are they in?

Did you go to school? YES / NO
What grade have you completed?
Did your husband/wife go to school? YES / NO
What grade has he/she completed?
Did other adults in the household go to school? YES / NO
What grades have they completed?

LEVEL OF EDUCATION	TEENAGERS & CHILDREN # # # # # # # #	ADULTS # # # # # #
Uneducated		
Kindergarten Infant Class (1) Preparatory (2-3)		
Elementary (4-5)		
Middle Class (6-7) 6th, 5th (8-9)		
4th, 3rd, 2nd (10-12)		
Rheto		
Philosophy		
University		

2. Do you own your house or do you rent your house?

Own _____ Rent _____

3. How many rooms does your house have? _____

4. Do you have people in a foreign country who send you money?

YES / NO

OBSERVATIONS TO BE MADE BY THE ENUMERATOR

5. How is the house covered (i.e., what is the roof made of)? (Put an (x) next to the correct answer)

   a) Concrete
   b) Sheet metal
   c) Straw

6. How are the walls of the house constructed?

   a) Block/Stone
   b) Mason
   c) Lattice/Straw

7. How is the floor made?

   a) Mosaic/Brick
   b) Cement
   c) Dirt

8. Is the house (doors and windows) painted? YES / NO

9. Does the house have a front porch? YES / NO

10. Does the household have a latrine? YES / NO

11. Does the household have a radio? YES / NO

12. Does the household have a Coleman Lantern? YES / NO

13. Does the household have a glass lamp? YES / NO

6TH PART FOR THE ENUMERATOR TO COMPLETE

We would like you to respond to these questions about the survey.

1. Was the person who responded to the questions irritated? YES / NO

2. Did he/she give you a warm welcome? YES / NO

3. Do you think he/she was a little nervous? YES / NO

4. Do you think he/she made efforts to tell the truth? YES / NO

5. Was it difficult for him/her to respond to the questions on willingness to pay? YES / NO

6. How do you evaluate the responses given? (Choose one)

   Excellent / good / fair / mediocre / bad

Do you have any comments you would like to make about this survey?

DON'T FORGET TO RECORD WHAT TIME THE INTERVIEW ENDED!

APPENDIX B

Analysis of the Contingent Valuation Bids

APPENDIX B

Analysis of the Contingent Valuation Bids

B.1. ANALYSIS OF THE WTP BIDS IN LAURENT

In Laurent, 170 questionnaires were conducted out of approximately 225 households. The research team's impression from sitting in on many of the household interviews is that respondents took the contingent valuation questions, and indeed the entire interview, quite seriously. Fourteen percent of the households gave an answer of "I don't know" in response to the WTP question for public standposts; there was a 25 percent nonresponse rate for the WTP question for private connections. The mean of the WTP bids in Laurent for the public standposts, 5.7 gourdes per month ($1.14 US; $1.00 US = 5 gourdes) seems realistic. It never seemed that respondents gave widely unrealistic or "protest" bids. Based on the pretest and initial field work in St. Jean du Sud, it was concluded that the bidding game question format worked better than the direct, open-ended questions. People generally felt more comfortable with the bidding games, and in fact the enumerators remarked that the bidding game format was very familiar and easily understood because it was similar to the ordinary kind of bargaining that goes on in local markets of rural Haiti. Hence in Laurent only the bidding game question format was used.

In this section of Appendix B the results of the statistical analysis of the data obtained from the household surveys in Laurent are discussed. Table 3 presents the results of the tests for strategic bias for the WTP questions for both public standposts and private connections. The 150 total responses for public standposts were relatively evenly divided between Statement A (77 responses) and Statement B (73 responses), as were those for the private connections. As anticipated, for respondents who received Statement A, the mean bids for both public standposts and private connections were higher than for those who received Statement B, but the difference is not statistically significant. On the basis of this test, there is no reason to believe that respondents were acting strategically when they answered the WTP questions.

Table 4 presents the results of a similar statistical test for starting-point bias. If starting-point bias were a problem, it would be expected that the low starting point (2 gourdes for public standposts; 5 gourdes for private connections) would result in a lower bid, and that the high starting point (7 gourdes for public standposts; 15 gourdes for private connections) would result in higher bids. The mean bids in Table 4do not appear to vary systematically with the starting point. The null hypothesis that the three samples are from the same population (that there is no difference in the responses from individuals who received different starting points) cannot be rejected.

On the basis of these results, there was no reason to attempt to adjust the analysis of WTP bids for strategic or starting-point bias. The mean of WTP bids in Laurent for the public standposts was 5.7 gourdes per household per month. This is roughly 1.5 percent of per capita income and is significantly lower than the 5 percent rule of thumb often used in rural water supply

Table 3

Test for Strategic Bias (Laurent)

Willingness to Pay for Public Standposts

	Opening Statement A*	Opening Statement B*
Total observations	77	73
Mean WTP bid**	6.0	5.4
Standard deviation	3.8	3.9

Overall mean	5.7
Standard deviation	3.8
t-statistic	1.1
Probability	0.3

Null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level.

Willingness to Pay for Private Connections

	Opening Statement A*	Opening Statement B*
Total observations	67	65
Mean WTP bid**	7.5	6.7
Standard deviation	9.0	9.8

Overall mean	7.1
Standard deviation	9.4
t-statistic	0.5
Probability	0.6

Null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level.

* Opening Statements A and B are contained in the household questionnaire in Appendix A.

** Mean WTP bid in gourdes per month. 5 gourdes = $1 US.

Table 4

Test for Starting-point Bias (Laurent)

Willingness to Pay for Public Standposts

	Starting Point		
	2 gourdes*	5 gourdes	7 gourdes
Number of observations	56	47	47
Mean WTP bid**	5.4	6.0	5.7
Standard deviation	3.8	3.9	3.9

F: .32
Probability: .73

Null hypothesis that the three samples are from the same population cannot be rejected at an acceptable confidence level.

Willingness to Pay for Private Connections

	Starting Point		
	5 gourdes	10 gourdes	15 gourdes
Number of observations	48	41	43
Mean WTP bid**	6.7	7.4	7.1
Standard deviation	8.3	8.8	11.0

F: .06
Probability: .94

Null hypothesis that the three samples are from the same population cannot be rejected at an acceptable confidence level.

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* 5 gourdes = $1 US

** Mean WTP bid in gourdes per month.

planning for maximum "ability to pay" for public standposts. The mean of WTP bids for private connections, 7.1 gourdes, was not much higher (1.8 percent of per capita income), but this bid is in addition to the bid for the public fountains, which yields a total mean bid for a private connection of 12.8 gourdes per month (3.3 percent of per capita income).

The next step in the analysis was to model the variations in the bids for public standposts and private connections as a function of the variables that were the primary focus of the research design. The value of the WTP bid was taken as the midpoint of the last interval defined in the bidding game. To measure income an ordinal measure of the value of household assets was developed, based on eight questions and observations about the quality of housing construction and household possessions (WLTH). This was supplemented with two other indicators of income: (1) whether the household received remittances from relatives living abroad (FINC); and (2) the occupations of the principal members of the household (IOCP). Remittance data were simply treated in the model as a dummy variable. Occupation data were used to group households into two categories (farmers and nonfarmers) and were also represented by a dummy variable. Education was measured as the sum of the years of school of up to two adults in the household (HHED). From the village map the distance of each household to its drinking water source (DIST) was measured; these distances served as a measure of the cost of obtaining water from the existing source, which was treated in the model as the "price" of the close substitute of the improved water service. The measure of water quality was based on the respondent's answers to seven questions concerning taste, odor, healthfulness, reliability, color, dirt, and conflict (quarrels) at the source.

Tables 5 and 6 present the results of ordinary least squares regressions of the bids for public standposts and private connections for Laurent on the variables suggested by consumer demand theory. The F-statistics illustrate that the overall models for the WTP bids for public standposts and private connections are highly significant. The coefficients for all the independent variables, except sex of the respondent and foreign remittances in the WTP for private connections model, have the expected sign. The variables for household wealth, household education, distance from existing water source, and water quality are all statistically significant at the 95 percent confidence level. The only variables which are not significant are sex of respondent and the two dummy variables, foreign remittances and occupation. These results indicate that the WTP bids are not random (more than 30 percent of the variation in WTP bids for private connections has been explained by the independent variables), and that the WTP bids are indeed systematically related to the variables suggested by economic theory. Although the R^2's may appear low, they compare very favorably with the results of similar cross-section studies in the United States (Smith and Desvousges, 1986).

The research team thus concludes from this analysis (1) that the contingent valuation methodology can be used to develop estimates of willingness to pay for rural water services, at least in Haiti, and (2) that strategic, hypothetical, and starting-point biases do not appear to pose serious threats to the validity of the results.

Table 5

Willingness-to-pay Bids for Public Standposts (Laurent)

Dependent variable:		
Willingness to pay for public standpost (gourdes*/month)		
Independent variable:	Coefficient	t
Intercept	2.836	1.51
Household wealth index (WLTH)	0.334	2.974
Household with foreign income (FINC, =1 if yes)	0.409	0.58
Occupation index (IOCP = 1 if primary occupation is farmer)	-0.706	-1.14
Household education level (HHED)	0.369	3.28
Distance from existing source (DIST)	0.003	4.86
Quality index of existing source (QULT = 1 if respondent is enthusiastic about the quality of the water)	-0.307	-3.16
Sex of respondent (RSEX, =1 if male)	-0.091	-0.17
Adjusted R^2	0.255	
F value	8.034	
Degrees of freedom	137	

* 5 gourdes = $1 US

Table 6

Willingness-to-pay Bids for Private Connections (Laurent)

Dependent variable:		
Willingness to pay for private connections (gourdes*/month)		
Independent variable:	Coefficient	t
Intercept	-1.468	-0.32
Household wealth index (WLTH)	1.280	4.73
Household with foreign income (FINC, =1 if yes)	-0.654	-0.42
Occupation index (IOCP = 1 if primary occupation is farmer)	-2.463	-1.69
Household education level (HHED)	0.986	3.83
Distance from existing source (DIST)	0.003	2.24
Quality index of existing source (QULT = 1 if respondent is enthusiastic about the quality of the water)	-0.664	-2.79
Sex of respondent (RSEX, =1 if male)	0.307	0.25
Adjusted R^2	0.338	
F value	10.251	
Degrees of freedom	120	

* 5 gourdes = $1 US

B.2 ANALYSIS OF THE WTP BIDS IN ST. JEAN DU SUD

For a variety of reasons, the research team has much less confidence in the results of the contingent valuation survey in St. Jean du Sud than in the results from Laurent. The water source situation turned out to be much more complex in St. Jean du Sud than was initially anticipated. There were no clear boundaries to the community or to CARE's anticipated service area, and thus it was difficult to know a priori what the service population would be if public fountains were installed along the main street in town. During the course of the interviews, as the enumerators moved back into the hills away from town, they continually "discovered" small sources (springs) that had been unknown to them and that were often used by only a few households. This diversity of water sources and the fact that households collect water from multiple sources makes any attempt to explain the variation in WTP bids much more problematic than in Laurent.

For example, consider the explanatory variable for distance of the household from the existing water source. In Laurent it was straightforward to measure this on the village map. In St. Jean du Sud, for those households which used multiple sources, it was not clear which source to use. The research team chose to measure the distance to the closest source used, but clearly the underlying water use behavior is more complex than this procedure would indicate. Moreover, in Laurent almost all individuals traveled over relatively flat terrain from their homes to existing water sources.

In St. Jean du Sud, however, the land was much more rugged, and the measure of distance does not take into account elevation changes.

There was a high nonresponse rate in St. Jean du Sud (25 percent for public standposts; 65 percent for private connections). The overall mean bid for public standposts in St. Jean du Sud was 5.5 gourdes per household per month, 96 percent of the value for Laurent. The mean bid for private connections in St. Jean du Sud was 5.7 gourdes per month, 80 percent of the value for Laurent. The latter result is consistent with the facts that Laurent is in general a wealthier village than St. Jean du Sud, and that the existing water situation in Laurent is worse than in St. Jean du Sud.

Table 7 compares the mean of the bids obtained from the direct question and the bidding game for both public standposts and private connections. The null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level, but the mean for the bidding game for public standposts is over 20 percent higher than for the direct question. Tables 8 and 9 present the results of the tests for strategic bias and starting-point bias in St. Jean du Sud for both public standposts and private connections. These results are consistent with the findings from Laurent: there is no evidence of either type of bias.

Tables 10 and 11 present the results of ordinary least squares regressions of the bids for public standposts and private connections for St. Jean du Sud on the same explanatory variables reported for Laurent. Both the adjusted R^2 values and the F-statistics for the two regressions are much lower than the values obtained for Laurent. Only one of the explanatory variables is significant in both regressions: the household wealth index. The sign of the coefficient on the household education index is in the expected direction, but the coefficient is not significant. In both regressions the sign of the coefficient on distance is not in the direction expected.

Table 7

Test for Direct Question and Bidding Game (St. Jean du Sud)

Willingness to Pay for Public Standposts

	Direct Question	Bidding Game
Total observations	27	79
Mean WTP bid	4.8	5.7
Standard deviation	5.4	4.5

Overall mean	5.5
Standard deviation	4.7
t-statistic	0.85
Probability	0.40

Null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level.

Willingness to Pay for Private Connections

	Direct Question	Bidding Game
Total observations	11	39
Mean WTP bid	2.7	6.5
Standard deviation	6.1	7.3

Overall mean	5.7
Standard deviation	7.1
t-statistic	1.57
Probability	0.12

Null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level.

Table 8

Test for Strategic Bias (St. Jean du Sud)

Willingness to Pay for Public Standposts

	Opening Statement A*	Opening Statement B*
Total observations	65	41
Mean WTP bid	5.2	6.0
Standard deviation	4.4	5.2

Overall mean	5.5
Standard deviation	4.7
t-statistic	0.91
Probability	0.37

Null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level.

Willingness to Pay for Private Connections

	Opening Statement A*	Opening Statement B*
Total observations	31	19
Mean WTP bid	5.7	5.6
Standard deviation	7.7	6.3

Overall mean	5.7
Standard deviation	7.1
t-statistic	0.04
Probability	0.97

Null hypothesis that the two samples are from the same population cannot be rejected at an acceptable confidence level.

* Opening Statements A and B are contained in the household questionnaire in Appendix A.

Table 9

Test for Starting-point Bias (St. Jean du Sud)

Willingness to Pay for Public Standposts

	Starting Point		
	2 gourdes	5 gourdes	7 gourdes
Number of observations	23	32	24
Mean WTP bid	6.7	6.0	4.4
Standard deviation	5.8	3.6	3.9

F: 1.66
Probability: 0.20

Null hypothesis that the three samples are from the same population cannot be rejected at an acceptable confidence level.

Willingness to Pay for Private Connections

	Starting Point		
	5 gourdes	10 gourdes	15 gourdes
Number of observations	18	12	9
Mean WTP bid	7.2	5.9	5.9
Standard deviation	8.0	7.4	6.1

F: 0.14
Probability: 0.87

Null hypothesis that the three samples are from the same population cannot be rejected at an acceptable confidence level.

5 gourdes = $1 US

Table 10

Willingness-to-pay Bids for Public Standposts (St. Jean du Sud)

Dependent variable:		
Willingness to pay for public standpost (gourdes*/month)		
Independent variable:	Coefficient	t
Intercept	-1.71	-0.80
Household wealth index (WLTH)	0.37	2.69
Household with foreign income (FINC, =1 if yes)	1.20	0.88
Occupation index (IOCP = 1 if primary occupation is farmer)	-0.125	-0.14
Household education level (HHED)	0.192	1.02
Distance from existing source (DIST)	0.02	1.72
Quality index of existing source (QULT = 1 if the respondent is enthusiastic about the quality of the water)	0.29	1.79
Sex of respondent (RSEX, =1 if male)	0.68	0.72
Adjusted R^2	0.09	
F value	2.50	
Degrees of freedom	98	

* 5 gourdes = $1 US

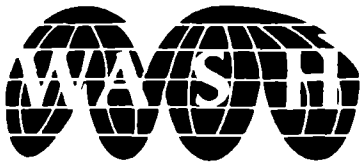
Table 11

Willingness-to-pay Bids for Private Connections (St. Jean du Sud)

Dependent variable: Willingness to pay for private connections (gourdes*/month)		
Independent variable:	Coefficient	t
Intercept	0.35	0.10
Household wealth index (WLTH)	0.60	2.11
Household with foreign income (FINC, =1 if yes)	-3.40	-1.12
Occupation index (IOCP = 1 if primary occupation is farmer)	1.65	0.78
Household education level (HHED)	0.25	0.57
Distance from existing source (DIST)	0.001	0.30
Quality index of existing source (QULT = 1 if the respondent is enthusiastic about the quality of the water)	-1.09	-0.50
Sex of respondent (RSEX, =1 if male)	-1.19	-0.54
Adjusted R^2	0.02	
F value	1.14	
Degrees of freedom	42	

* 5 gourdes = $1 US

This analysis of the WTP bids for St. Jean du Sud adds a note of caution about whether the contingent valuation methodology yields reliable results which are systematically related to the factors suggested by consumer demand theory. However, the poor quality of the results for St. Jean du Sud in comparison to Laurent is more likely to be related to the different question formats and implementation difficulties (i.e., the complex water sources situation and the rugged terrain) than to any generic problems with the methodology itself.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