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I am submitting herewith a dissertation written by Timothy John Essenburg entitled "Financing Publicly Provided Goods in Less Developed Countries: A Contingent Valuation Study of Potable Water Services in Rural Philippines." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Economics.

William F. Fox, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor
and Dean of The Graduate School

FINANCING PUBLICLY PROVIDED GOODS IN LESS DEVELOPED COUNTRIES: A CONTINGENT VALUATION STUDY OF POTABLE WATER SERVICES IN RURAL PHILIPPINES

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Timothy John Essenburg

August 1991

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DEDICATION

This dissertation is dedicated to those who provided the ". . . strong arm of a comrade kind to help me onward with my load" (Sherman 1965).

First and foremost to God, the Father, Son and Holy Spirit. Your grace is more than sufficient, Your power magnificent and Your love sublime.

> Then she made a vow and said, "O LORD of hosts, if You will indeed look on the affliction of Your maidservant and remember me, and not forget your maidservant, but will give Your maidservant a male child, then I will give him to the LORD all the days of his life, and no razor shall come upon his head" (I Samuel 1: 11).

May I be wholly Yours.

To Joani and Laura – we did it! Thank you for giving of your time, energy and encouragement. You, Joani, were with me each step of the way (too many anxious nights, right?), and for that my love and admiration for you has grown. May we together celebrate God's calling and enjoy His blessings.

To Doug, Jenny, Philip, Katie and Meg – our Knoxville family. The business world requires the settling of accounts. Thankfully ours is not such a relationship for our debt to you is beyond repayment. We marvel at your acceptance, support and encouragement of a couple desperately needing a respite from graduate school pressures. "Friends are friends forever, if the Lord is the Lord of them. And a friend will not say 'never', 'cause the welcome will not end" (Smith 1983).

Finally, I am grateful to my parents, especially my father who encouraged me to pursue a graduate degree in economics.

ACKNOWLEDGEMENTS

In the course of my dissertation research, a number of individuals have given assistance.

I would like to thank my committee, Dr. William Fox, Dr. Thomas Boehm, Dr. Robert Bohm, and Dr. William Cole. Most especially my thanks go to Dr. William Fox, my major professor, for his guiding this research to its conclusion and for securing some funding from the World Bank.

Besides these, there are a host of others, a few of whom deserve recognition by name. I also acknowledge the kindness of Susan Bott. Since I appreciate user-friendly software but have little patience for computer activities, you are a godsend to me. Patricia Price helped with the data sets, and Janine McFarland helped with the typing and proofreading. Finally, while still a student in residence, Donna Kemper and Holly Bell provided secretarial support in a most cheerful manner.

ABSTRACT

The sustainability of development assistance projects in less-developed countries is an issue of preeminent importance. There is no lack of evidence that these projects often fail to remain viable after the initial investment period. Part of this undesirable state of affairs stems from a lack of finance to cover recurrent costs.

In an effort to determine unserved households' willingness to pay (WTP) for improved water a contingent valuation study was undertaken in rural Philippines. WTP for water presupposes the choice of the water source, therefore the empirical analysis was motivated by a discrete-continuous model. Regression statistics indicate that both household and water source characteristics are relevant to the interdependent decisions. This finding was confirmed by a similar analysis using actual behavior of served households and villages.

Despite the fact the WTP values were substantially less than observed payments, it is argued that the contingent valuation methodology is a viable tool for ascertaining WTP for nonmarket goods. Finally, the comparison of WTP data with water system costs indicated that subsidies are necessary if sustainability is to be achieved.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION AND PURPOSE	1
	The Issue of Sustainability	1
	The International Drinking Water Supply and Sanitation Decade	4
	Methods for Determining WTP	9
	Study Objectives	16
	Summary	18
II.	LITERATURE REVIEW	20
	Literature Review	20
	Summary	40
III.	THEORETICAL FRAMEWORK AND ECONOMETRIC METHODS	42
	Theoretical Framework	42
	Econometrics	49
	Summary	52
IV.	EMPIRICAL RESULTS	53
	Data	53
	Empirical Models	68
	Willingness to Join an RWSA for an Improved Water Source	74
	Willingness to Pay for an Improved Water Source	85
	Expenditures in a Served Community	102
	RWSA Findings	107
	Summary	112

V. ACTUAL COSTS VERSUS WILLINGNESS TO PAY 114

Cost and User Fee Estimates 114

The Need for Subsidies 122

Implications for the Contingent Valuation Methodology 123

Summary 126

VI. SUMMARY 128

Introduction 128

Determinants WTJ and WTP 129

Financial Viability and WTP 131

The Efficacy of CVM for Development Efforts 131

BIBLIOGRAPHY 134

APPENDIXES 147

APPENDIX A. SURVEYED AREAS AND INTERVIEWER INSTRUCTIONS 148

APPENDIX B. HOUSEHOLD QUESTIONNAIRE 156

APPENDIX C. RWSA QUESTIONNAIRE 176

APPENDIX D. ALTERNATIVE ESTIMATIONS AND RELEVANT STATISTICS FOR HOUSEHOLD WTJ AND WTP 198

APPENDIX E. ALTERNATIVE ESTIMATIONS AND RELEVANT STATISTICS FOR SAN JUAN AND RWSA 206

VITA 210

LIST OF TABLES

TABLE		PAGE
1.	Estimated Number of Free-Riders Bidding Game	57
2.	Selected Population Characteristics of Unserved and Served Villages	61
3.	Selected Socioeconomic Characteristics of Unserved and Served Villages	62
4.	Ten-Point Housing Quality Index	64
5.	Professional and Skilled Residents of Unserved Villages	66
6.	Selected Water Consumption Characteristics of Unserved and Served Villages	67
7.	Willingness to Join for a Public Faucet	75
8.	Willingness to Join for an Individual Connection	77
9.	Willingness to Join for an Improved Water Source	82
10.	Willingness to Pay for a Public Faucet Substitutions Across Source	86
11.	Willingness to Pay for a Public Faucet No Substitutions Across Sources	88
12.	Willingness to Pay for an Individual Connection Substitutions Across Sources	90
13.	Willingness to Pay for an Individual Connection No Substitutions Across Sources	92
14.	Willingness to Pay for an Improved Water Source	97
15.	Household Willingness to Join and Payment for an Individual Connection	105
16.	Payment for Water Services	111
17.	Household Fees Necessary to Finance Level III Water Systems Using Different Loan/Grant Options	116

18. Costs for Level III Systems Assumed in the Fee Analysis 117

19 Household Fees Necessary to Finance Level II Water Systems Using Loan/Grant Options 120

20. Costs for Level II Systems Assumed in the Fee Analysis 121

D-1. Selected Elasticities 199

D-2. Willingness to Join for an Improved Water Source Weighted Least Squares 200

D-3. Willingness to Join for an Improved Water Source Scale-Adjusted Coefficients 202

D-4. Willingness to Pay for an Improved Water Source Above the Limit Values 203

D-5. Willingness to Pay for an Improved Water Source Adjusted Coefficients 205

E-1. Household Payment for an Improved Water Source Adjusted Coefficients 207

E-2. Household Payment for an Individual Connection San Juan 208

E-3. Payment for Water Services 209

CHAPTER I

INTRODUCTION AND PURPOSE[1]

A. The Issue of Sustainability

A paper coauthored by the United States Department of Agriculture and the University of Maryland at College Park (1987)[2] addresses an issue of preeminent importance to less-developed countries (LDCs). The issue is the sustainability of development assistance efforts.

There is no lack of evidence that development projects often fail to remain viable after the initial investment period. In fact USDA reports that a

> review of 1985 and 1986 evaluations of AID-financed projects found that only 11 percent of 212 projects have a strong probability of being sustainable after the conclusion of U.S. assistance. . . . Similarly, a recent World Bank study found that only 13 of 31 projects assessed to have a high probability for sustainability at completion were regarded as sustainable during audits made five years after their completion. The stark reality is that a large majority of donor-assisted development efforts are not bringing about lasting changes . . . (USDA 1987, p.1).

More to the focus of this study, a conclusion of the classic work on rural water supply in developing countries (Saunders and Warford 1976) was that the failure of many systems can be traced to poor operating and maintenance procedures. For example, they report a litany of cases where systems are misused, not repaired, or fail to provide a reliable water supply due to lack of financial and administrative resources. Ten years later, this was identified by the US Agency for International Aid as a significant problem in the

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[1]In addition to this dissertation three other papers were generated from the research (Bohm et al. 1988, 1990 and 1991). Thus, not only did this work result in those papers it also draws from them.

[2]Hereafter, "USDA."

Philippines and was reiterated by Whittington et al. (1987a, 1989) as they point to these same problems as a major impediment to providing sustainable and replicable water systems in rural areas of other LDCs.

Delving into this undesirable state of affairs led USDA to the conclusion that a major part of the problem is the defining of the term sustainability. Many studies define a project as sustainable if it has one of the following characteristics: "(1) covers recurrent costs or becomes self-financing; (2) maintains a continued stream of benefits; or (3) puts in place organizations or institutions that will continue" (USDA, p. 2). USDA argues that although "[e]ach of these [characteristics] is relevant to sustainability . . . none of them taken alone provides a sufficient definition or description of sustainability" (USDA, p. 2).

In their study, sustainability is defined more broadly as the ". . . collective ability to continue a flow of valued benefits or outcomes beyond a given investment period at an acceptable cost" (USDA, p. 3). This definition highlights four salient features of sustainability:

1. maintaining, by collective ability, the capacity of the project;
2. providing valued benefits or outcomes (emphasis is on results of the benefits, not the provision of the benefits themselves);
3. continuing the project beyond the investment period at least to the point where results can be evaluated;
4. rendering the activity at acceptable costs.

Given this definition USDA proceeds to elaborate on four factors that encourage sustainability. These factors are:

1. implementing appropriate macro policies;

2. assigning development activities to institutions which can sustain them;
3. managing the design and implementation of development efforts from the viewpoint of sustainability;
4. identifying various financial sources and mechanisms for meeting recurrent costs.

In this study, we seek to address the fourth aspect of this definition of sustainability, namely, financial viability or the ability to finance the recurrent costs of development projects. Financial viability is defined to exist when user charges are sufficient to cover the financial costs of delivering the good or service.[3] Revenues must therefore be of sufficient measure to cover recurring annual costs, such as operating and maintenance costs, capital replacement, and any required loan repayment. Often initial costs, such as construction, fixed capital, and equipment, are covered by a combination of loans, grants, and subsidies from the relevant government authority or from international lending agencies. Though the primary sources of revenue must be user charges collected from customers, a second less desirable revenue source is additional subsidization. Viewing the problem in this way is consistent with the donor community's increasing emphasis on requiring benefitting recipients to contribute substantially towards the payment of recurrent costs. Equity may be used as a counter argument because an inability to pay may preclude many people from receiving a service, but the choice may be either a sustainable project providing services only to those

[3]For ease of exposition, "good" and "service" will be used interchangeably, and also will imply the other.

who have the ability and the willingness to pay (WTP) or the eventual waste of investment resources as the project falls into disrepair because of insufficient resources for the project's operation.

Examples of development projects amenable to user charges in an effort to achieve financial viability include housing, irrigation, roads, health care, education, potable water systems, sanitation facilities, and agricultural services. If a LDC wants these for its people it must confront the issue of financing recurrent costs. Public sector decision makers need figures reflecting the potential consumer's ability and willingness to pay for specific quantities.

An example of generating these figures is housing. There is a growing body of literature which addresses the issue of WTP for housing and housing attributes (e.g., rooms, size, type of floor, roof, or sanitary facility) in LDCs.[4] The need for WTP figures highlights the necessity for a method which is used to determine these values. But before we expatiate the different methods it will be instructive to understand why it is that within development assistance efforts potable water systems are particularly vulnerable to the sustainability issue.

B. The International Drinking Water Supply and Sanitation Decade[5]

We began by focussing our attention on the sustainability of development efforts and specifically with the problem of financing recurrent

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[4]For example, Follain and Jimenez (1985a, 1985b), Follain et al. (1982), and Gross (1988).

[5]Hereafter, "Decade." The goal was to provide ". . . all people with water of safe quality and adequate quantity and basic sanitation facilities by 1990. . . " (World Health Organization 1986, p. 52, emphasis added).

costs. The Decade is an appropriate example of how good intentions were thwarted because proper research, regarding the availability of finance, was not done. A brief history of the beginnings of the Decade (1981 - 1990) will demonstrate why it is that from the Decade's inception the sustainability of water systems was particularly susceptible to problems and thus elucidates the need for determining the WTP for potable water systems in rural areas of LDCs prior to the implementation of the project.

The international community, notably the World Health Organization (WHO), considers the health and well-being of the general populous to be of primary importance on two accounts. First, it is recognized as an individual's right, and second, it contributes to the overall economic development of LDCs. In regard to rural environs, which may lack ready access to water supplies, while simultaneously being subjected to water-borne, water-washed, and water-based diseases (Churchill 1987, Saunders and Warford 1976), and typically having low levels of per capita income, the consensus was that ". . . the provision of a safe and convenient water supply [would be] the single most important and cost-effective activity that could be undertaken to improve the health of rural populations" (World Bank 1976, p. 20). Thus "[t]he Decade represents an essential first stage in the global programme of health for all by the year 2000." Although WHO is not a funding agency it approves of the United Nation's creation of the Decade and concerns itself with Decade goals by providing ". . . coordination and technical cooperation . . ." (World Health Organization 1981, p. 1 and preface).

WHO claims that the desire of the Decade was to facilitate the provision of ". . . reproducible, self-reliant and self-sustaining programmes. . ." (World Health Organization 1981, preface). However, a careful reading of both the

"United Nations Water Conference--Resolution II and Plan of Action" and "Resolution 35/18 of the General Assembly of the United Nations"[6] reveals no explicit effort for determining whether rural areas of LDCs want a potable water system, and if they do, whether or not the peoples demonstrate the ability and willingness to pay for it.

Resolution II and Plan of Action set the tone of this international endeavor by stating:

> "All peoples, whatever the stage of development and their social and economic condition, have the right to have access to drinking water in quantities and of quality equal to their basic needs. . . .
>
> . . . . . .
>
> [A]ppropriate external assistance should be available in order to assist in building, operating and maintaining these systems. . . .
>
> . . . . . .
>
> Action must focus on promoting . . . commitment of national Governments to provide all people with water of safe quality and adequate quantity . . . by 1990. . . .
>
> . . . . . .
>
> Develop a national revolving fund . . . [to] include a flexible combination of rates and, where necessary, explicit subsidies or other measures designed to achieve the economic and social objectives of the programmes" (World Health Organization 1981, pp. 50-53, emphasis added).

These statements portray potable water as a merit good. There was room for the collection of fees to help offset the costs incurred (World Health Organization 1981, section A.4 of the Plan of Action), but the overriding theme is that regardless of ability and willingness to pay the service must be made available with the national and/or international governments and agencies incurring the ultimate liability for expenses. No emphasis on individual payment is found. The Decade's inception was an international

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[6]This resolution created the Decade. See World Health Organization (1981).

agency's initiative. The individual's willingness to pay was not an important factor; it was noticeably absent.

Interestingly, by 1983 WHO recognized the problem of insufficient financing, and in 1986 stated the following.

> As new systems are commissioned, the need to provide financial resources for operations and maintenance will increase. This is an additional recurrent burden which has to be recognized in financial planning for the sector in order to ensure the success of the Decade Programmes.
>
> Financial self-reliance of the sector is being promoted, and this should increase the flow of funds and enable investment to be increased and operational efficiency to be improved. The main means of achieving self-reliance is by charging a tariff for water that at least covers the production costs (World Health Organization 1986, p. 7).

Furthermore, WHO queried various Decade-participating nations in an effort to ascertain "constraints" which impaired the successful operation of water systems. The top three constraints were: (1) lack of capital funds, (2) insufficient personnel, especially at the local management level, and (3) inadequate operation and maintenance, both financial and physical. At the bottom of the list were the lack of: (1) appropriate technologies, (2) planning and design criteria, and (3) definite government policy for the sector (World Health Organization 1986).

In addition to the cost recovery problem, the central argument for water systems, a means to better health, encountered empirical conflicts.[7] The argument is that provision of the service (i.e., building a system) does not necessarily guarantee that the peoples will avail themselves of it. The claim is substantiated by the fact that many potable water systems are currently abandoned and/or in disrepair (Brookshire and deFerranti 1988).

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[7]See Churchill (1987) and Brookshire and deFerranti (1988).

This state of affairs begs the question as to why services are not used. Possible answers include:

1. the system may not reflect the customers' preferences;
2. the three to five percent of household income judged readily available for services is excessive;[8]
3. the lack of personnel to manage the system.

These answers provide areas of further research.

Despite the question of health benefits stemming from the simple provision of potable water systems, we need not conclude that no other potential benefits remain. A major benefit is the reduced time devoted to hauling water. It is not uncommon for one or more family members to spend two or three hours per day procuring one day's water supply (Churchill 1987, Saunders and Warford 1976, White et al. 1972). Time is an opportunity cost representing activities such as leisure, tending children or other household tasks, or doing money or in-kind generating activities. Human energy is also saved. Carrying water is strenuous work and has implications for minimum caloric intake (White et al. 1972, Churchill 1987).[9]

The above demonstrates that the Decade's approach fostered the tenuous nature of financial sustainability and elucidated a need to determine WTP prior to building a system. Benefits are readily available, but continuing the flow of benefits beyond the investment period requires a stream of funds other than from external sources.

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[8]Despite the numerous cites of these figures (World Bank 1976, Saunders and Warford 1976, Brookshire and deFerranti 1988) the author is unable to uncover the defense for these percentages.

[9]Churchill identifies additional benefits from potable water systems such as ". . . reliable service, convenient hours of operation, [and improved] taste, clarity, and odor. . ." (Churchill 1987, p. 3).

C. Methods for Determining WTP

The issue facing LDCs is not to develop a benefit-cost analysis which, depending on assumptions, can give approval for such development efforts.[10] Instead the focus must be on building, sustaining and replicating water systems. This entails research into three areas:

1. determining water-system preference;
2. ascertaining the institutional arrangements to supervise the program;
3. identifying the sources of finance and estimating their respective contributions.

As a stronger emphasis on community involvement surfaces these three areas increase in importance. One key piece of data is an estimate of the recipient's WTP for various types of service. This information ties the first and last areas together and is important for determining the financial viability of the project.

Our focus is on defining and measuring WTP. WTP is the integral of the demand curve between the relevant quantities. It can be measured by using market data, explicit or implicit, or by use of a survey instrument. One can argue that the preferred method is to use explicit market data. However, there may be compelling reasons for estimating WTP with implicit market data (indirect method) or by use of a questionnaire (direct method). Indirect methods make use of ancillary market information from which a WTP value

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[10]Jan S. Hogendorn writes that "[a] planner can justify about any project with cost-benefit analysis by manipulating selected assumptions about shadow prices and externalities" (Hogendorn 1987, p. 316). The point is that benefit-cost analysis does not necessarily consider sources of finance, an important factor of sustainability.

is generated and include the hedonic pricing method (HPM) and the travel cost method (TCM). In contrast, the direct or survey method asks the individual for a value by utilizing the contingent valuation method (CVM). Let us review the options.

When appropriate cross-section and/or time-series data are available, one can estimate a Marshallian demand curve. However, calculation of WTP requires the use of Hicksian demand curves. Therefore unless one assumes that income effects from price changes are insignificant, the use of market data and the resulting demand curve will yield incorrect WTP values. Yet even if theoretically incorrect, the use of market data does afford the researcher observable values.

Calculating WTP is complicated further when there is no market allowing for individuals to evaluate the good. For example, we do not have market data which explicitly reflect the valuation of public or club goods such as noise or air pollution, or recreational use of parks, rivers, and lakes. Yet there may be a need to estimate these values. Similar problems arise with private goods when no market is in place. In general, the dearth of relevant market information for nonmarket goods requires research efforts beyond those for market goods when deriving WTP values. Many policy decisions require a value for WTP, one in which confidence may be placed. However,

> [o]btaining accurate information for individual valuation of nonmarket . . . commodities can be costly. In many cases to actually derive true values, a 'market' must be set in a place where one did not exist and operated to record prices and demands where the . . . commodity is actually purchased and sold. However, to construct and operate such a market may be extremely costly, especially if there are irreversibilities associated with its operation (Schulze et al. 1981, p. 152).

Let us use, as an example, an irrigation system in a rural area of a LDC where no system currently exists. In this context it is a nonmarket good. Ideally one would build the facility and let the various households buy their desired amounts of water at specified prices and thus determine WTP. But as Schulze et al. wrote, this investment involves irreversibilities. If the system proves to be unused or underused, a significant cost to the suppliers of capital is incurred. That fact elucidates the need for other methods of ascertaining WTP for nonmarket goods.

Indirect Methods, HPM and TCM

HPM, a derivative of attribute theory (Lancaster 1966), was pioneered in the mid-1970s in an effort to assess demand for nonmarket goods (Rosen 1974, Muellbauer 1974, Hori 1975). The assumption is that an underlying relationship exists between the price of a composite market good, having a set of attributes, and the nonmarket commodity (e.g., one may hypothesize that air pollution levels are an attribute of the composite good housing).

The hedonic technique typically involves two distinct steps. First, the hedonic price equation is used to determine the marginal implicit prices of the composite good's attributes. Second, these prices are used to estimate the nonmarket commodities' demand curves. From these we can estimate WTP.

Proper use of HPM requires a number of restrictions. First, the necessary market data must be available to the researcher, a potential obstacle when researching rural areas in LDCs (Brookshire et al. 1982). Second, accurate results ". . . require perfect and complete specification of the model. . . " (Randall et al. 1974, p. 135) since the nonmarket commodity's value depends on its hedonic price, regression coefficient. Finally, the range of applicability is restricted to the experienced range of provision (Randall et al. 1983). For

example, the use of housing values to measure benefits of pollution abatement may be appropriate in more developed countries where the market allows locational mobility. An analogous market in the rural environs of LDCs is unlikely to exist.[11]

TCM uses travel costs from which a WTP value is derived. The literature reflects two such models. The "zonal" model, as developed by Clawson (1959) and Knetsch (1963), makes use of aggregated individual trips of equal distance to determine costs on a zonal basis. Brown and Naivas (1973) and Gum and Martin (1975) make use of individual trips, of differing length, and associated costs. Again, as with HPM, necessary assumptions may restrict the use of TCM. In regard to the zonal model one encounters the need for trips of equal distance, traveler homogeneity within zones, and the use of constant unit cost of travel between zones. The latter necessitates frequent trips. A single trip per year precludes its application (Duffield 1984).

The major assumption regards the valuing of travel costs, most importantly the time involved in the trip. What is the opportunity cost of the time? Is it zero or some positive value proxying a forgone hourly wage (McConnell 1975)? What is the time value of children (Bishop and Heberlein 1979)? Clearly, the price parameter attributed to the traveler is not readily observable and ultimately necessitates that ". . . [c]onsiderable judgment [be] involved . . . " in determining this price (Duffield 1984, p. 68).

Direct Method, CVM

In defense of the explicit assumptions and/or requirements enumerated for HPM and TCM, let it be said that they are not intended to discredit these

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[11]See Freeman (1979) for an elaboration of the issues surrounding the use of HPM.

methods, in fact they have not. They are given in an effort to put CVM into perspective as this research utilizes this latter method. It too has many potential problems, but its service may prove helpful, even necessary, in some cases. Before we identify the potential drawbacks we first give a definition for CVM and a brief history of its rise to acceptability.

The essence of CVM is the specifying of a hypothetical market for a nonmarket good and a query to individuals regarding the value placed on increments (decrements) of that good. A more comprehensive definition is given by Randall et al.

> Contingent valuation devices involve asking individuals, in survey or experimental settings, to reveal their personal valuations of increments (or decrements) in unpriced goods by using contingent markets. These markets define the good or amenity of interest, the status quo level of provision and the offered increment or decrement therein, the institutional structure under which the good is to be provided, the method of payment, and (implicitly or explicitly) the decision rule which determines whether to implement the offered program. Contingent markets are highly structured, to confront respondents with a well-defined situation and to elicit a circumstantial choice contingent upon the occurrence of the posited situation. Contingent markets elicit contingent choices (Randall et al. 1983, p. 637).

Three salient features characterize CVM. First, it is hypothetical. Both the market (a mental construct) and the payment (values elicited) are hypothetical.[12] Second, CVM is used for valuing nonmarket goods. Third,

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[12]Because of this feature, many economists doubt the efficacy of CVM. Their argument is twofold. First, if one asks a hypothetical question, one gets a hypothetical answer, which may convey no meaningful information (Brookshire et al. 1976, Rowe et al. 1980, Thayer 1981). Second, and closely related to the first, is that the individual incurs no real sacrifice for the bid and therefore it may not reflect the "true" value (Bishop et al. 1983, Bohm 1972).

the value or behavior under analysis is contingent, and therefore direct verification requires implementing the contingent market.

Awareness of allocation decisions by public policy makers concerning recreational areas and the environment heightened in the 1960s and 1970s. From an economic vantage one helpful piece of information would be a benefit-cost analysis. In an effort to quantify the recreation benefits of the Maine Wood, Davis (1963) pioneered[13] the rudiments of CVM by using a bidding game to elicit consumers' WTP.[14] From this relatively innocuous beginning the use of CVM has burgeoned. CVM studies usually focus on environmental issues.[15] Most analyze public goods,[16] but a few surveys estimated the value of private, nonmarket goods (e.g., goose hunting permits by Bishop and Heberlein, 1979, and Bishop et al., 1983).

Concomitant with the proliferation of CVM studies has been an increasing emphasis of defining and understanding the potential biases stemming from the method itself and its particular implementation.[17]

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[13]Randall et al. (1978) donned him with this distinction.

[14]Davis used no formal terminology to describe potential biases, but much of what is currently researched is found in his article. One puzzling fact is that he does not address the issue of strategic bias despite Samuelson's (1954) seminal article on public goods published nearly a decade earlier.

[15]It is acknowledged that many of the nonmarket goods are not true public goods but are club goods (e.g., boating on a small lake). However, for ease of exposition we use the term "public good(s)."

[16]For example, air quality (Brookshire et al. 1982, Randall et al. 1974), scenic vistas and visibility (Brookshire et al. 1976, Rowe et al. 1980, Schulze et al. 1983), water quality for recreational purposes (Gramlich 1977, Greenly et al. 1981, Seller et al. 1985), hunting amenities (Brookshire et al. 1980), maintenance/protection of the wilderness (Walsh et al. 1984).

[17]We define a "bias" as an influence upon the valuation process which results in an elicited WTP that differs from the true value. "True value" is defined as the value forthcoming under conditions which mirror the market's.

Hypothetical and strategic bias were the first to receive attention. Following close behind were starting point bias, information bias, and interviewer bias.[18] However, the optimism spawned by Davis (1963) continued and culminated with the Schulze et al. (1981) article. They concluded that the biases were not observed empirically or that their effects could substantially be mitigated by use of careful survey techniques.

Responding to this near carte blanche of CVM, Rowe and Chestnut (1983) raised two major questions. Does the respondent have a mental delineation of the impact of the good upon his well-being? Are the claims of little or no bias substantiated by valid tests? Rowe and Chestnut gave qualified affirmations to theses questions. Subsequent CVM studies addressed the relevant biases.

Despite the debate over the encumbrance of biases, researchers continue to use CVM. Numerous reasons may be posited; three important ones follow. The first reason is federal legislation. Beginning with the Flood Control Act of 1936 federal legislation has encouraged economists to measure both the benefits and costs associated with alternative uses of natural resources. Since February, 1981, any new major regulation must undergo a regulatory impact analysis as stipulated by former President Reagan's Executive Order 12291 (Smith and Desvousges 1986). In these cases CVM can generate pertinent information where market data is lacking.

Second, CVM may be referred to as a research program. In this sense it is observed to be progressing as practitioners learn more of the nuances involved with its proper use. The method is not perfected to a level of routinization, but Mitchell and Carson argue that in terms of a learning curve

[18]These biases will be defined and analyzed in Chapter II.

it ". . . has passed beyond the experimental prototype stage . . ." (Mitchell and Carson 1987b, p. 31). Continued progress as a research program lends credibility to its use. Third, as alluded to above, there are times when HPM and TCM are precluded as a means for deriving values necessary for informed decision making. CVM is a viable alternative in these situations.

D. Study Objectives

In 1987 the Government of the Philippines enlisted the services of an interdisciplinary team of professionals (engineers, economists, and sociologists) in an effort to assess existing Rural Waterworks and Sanitation Association (RWSA) projects. The team was ". . . to report successes, problems, new approaches, new appropriate technologies, and ways to make the RWSA water systems more self-reliant and able to cope with significant recurrent cost and operation and maintenance 'real world' issues" (Comprehensive Marketing Systems, Inc. 1988, p. 11). One aspect of this directive involved determining an amount that households not serviced by a RWSA water system will pay for potable water services and the ensuing quantity demanded.

The key factor in determining the financial viability of a water system is the willingness of consumers to pay sufficiently high user charges to cover system costs. Financial viability can be established first by examining determinants of the choice of water source, second by determining the willingness to pay for water in rural villages (i.e., what it is that affects demand), and third by conducting a cost analysis of rural water systems at alternative scales of operation. Putting these investigations together will allow us to answer two questions. First, under what conditions will the

operation of a rural water system yield revenues sufficient to cover costs? Second, under what conditions will revenues be less than costs and what subsidy will be required if the system is to become sustainable and replicable?

Specifically, we will examine WTP for an improved system to deliver potable water in the rural Philippines. The major portion of our empirical investigation uses CVM. Our CVM study implicitly assumes a well-functioning water system. The contingent market presented to potential consumers assumes that the water system, if installed, will be capable of delivering the product. The respondents may not be so sure, especially if they are familiar with the operating problems of in-place systems elsewhere. As a result, bids could be downward biased unless there are assurances that these problems will not occur.

Viewed from the perspective of the sustainability question, it is clear that failure to pay user fees or delinquency can be due to a number of supply-side and institutional factors. In the Philippines, two issues seem paramount. First, the water system may be unreliable due to inadequate equipment. It is important that the technical specifications of the water system fit the characteristics of the village, for example, with respect to the availability of electricity and geographic distribution and number of households. If this is done, then problems associated with improper pump-motor assembly, inadequate piping systems and storage should disappear.

The second issue encompasses management and training. The personnel running the water system must be competent if confidence is to be instilled in prospective users. In addition, the users must be made to feel that they have access to system managers when they wish to report a problem. Several types of expertise seem essential. For example, every system needs an

overall manager with good interpersonal skills, a financial manager, and a technical troubleshooter whose responsibility is to keep the system mechanically operational.

The use of improper equipment and poorly trained personnel have been common problems in Philippine water programs (Comprehensive Marketing Systems, 1988, pp. 10-28). Thus while we follow the convention of presenting bidders with a hypothetically well-run system, we will take care as we interpret our results to remain cognizant of the intervention of these supply-side and institutional factors.

Two other pieces of empirical work are used to substantiate the findings of CVM. These are based on household water consumption behavior in a village served by a well-functioning water system, and by a cross-section analysis of water consumption in 52 villages with operating water systems. The former allows us to determine the extent to which the demand curve may shift to the right once the product is actually available. That is, preferences may change and/or the CVM WTP values may not reflect the respondent's maximum. Both the served village and the cross-section analysis allows us to address the understatement of CVM bids noted by Brookshire, et al. (1982). At the conclusion, estimated WTP is compared with estimated delivery costs for the service to determine the share of costs which beneficiaries can be expected to pay.

E. Summary

The sustainability of development assistance efforts is of preeminent importance to LDCs. Failure to achieve sustainability results in a squandering of investment resources and inhibits continued overall development. USDA

focussed the issue by defining sustainability as the ". . . collective ability to continue a flow of valued benefits or outcomes beyond a given investment period at an acceptable cost" (USDA 1987, p. 3).

One of the four factors contributing to sustainability is the identification of various financial sources and mechanisms for meeting recurrent costs. Once a source is identified there must be a means for estimating its contribution. The Decade highlights the need for the determination of WTP, other than the rule-of-thumb three to five percent of household income, prior to the implementation of the project.

Estimating WTP values for market goods is accomplished by analyzing the relevant demand curve. Generating WTP values is more difficult when confronted with nonmarket goods. Methods for doing this fall into two categories, indirect and direct. Proper use of HPM and TCM (indirect methods) necessitate certain restrictions and/or assumptions. These were given to put CVM into perspective.

We will address the financial viability of the sustainability issue by analyzing the determinants of demand and conducting a cost analysis. This can provide policy guidance for those implementing these water projects.

Although CVM has gained acceptance there are a number of biases which may decrease the efficacy of its use. These are discussed in Chapter II, "Literature Review." Chapter III presents the theoretical model used for the empirical results presented in Chapter IV. Finally a cost analysis of existing systems is undertaken in Chapter V, and Chapter VI provides a summary.

CHAPTER II

LITERATURE REVIEW

Since this research utilizes CVM, the review has two components. First, there is an account of the types of biases, methods for testing for biases and the measures of mitigating their potential effects. Second, there is a review of studies which used CVM for determining WTP for potable water systems in rural areas of LDCs.

A. Literature Review

Contingent Valuation Methodology and Potential Biases

CVM studies have devoted energies to defining biases, testing for and reporting the presence of biases and enumerating possible guidelines to minimize them. A literature review uncovered the following biases: hypothetical bias, strategic bias, information bias, vehicle bias, compliance bias, starting point bias, framing bias, and sampling bias. As stated above, a bias is an influence upon the valuation process which results in an elicited WTP value which differs from the true (market) value. Determining the presence of a bias is done by an empirical test or by a subjective analysis.

Hypothetical Bias. Hypothetical bias refers to the ". . . potential error due to not confronting [the] individual with a real situation" (Rowe et al. 1980, p. 6). CVM, by its very nature, is hypothetical. Since the fundamental nature of CVM cannot be changed, the focus is on presenting the respondent with a realistic and credible situation (Cummings et al. 1986, Randall et al. 1974, Schulze et al. 1981). When "hypothetical bias" is addressed, authors are not

trying to take the C out of CVM, leaving only a real market. They are attempting to make the survey mirror a market while realizing the value elicited is always contingent.

Suggestions for doing this include the following. Respondents must understand and be familiar with the commodity being valued (Cummings et al. 1986, Randall et al. 1974, Schulze et al. 1981). An example which violates this principle would be asking respondents to value a ten percent reduction in nitrogen oxide (NO_2) in the air. Unless one is a chemist or well versed in the implications of this reduction, the bid will not convey a value for the reduction but possibly only confusion on the part of the respondent. Another suggestion is that the created hypothetical market should include a "substantial degree of institutional behavior" (Brookshire et al. 1981, p. 134). This includes naming the provider of the good, the mechanism for exclusion and the method and rules for payment (Bohm 1972, Brookshire et al. 1976, 1981, Schulze et al. 1981, Thayer 1981).

In addition to presenting respondents with a realistic and credible situation, there are three ways to "test" for hypothetical bias. First, one may analyze the explanatory power of the regression analysis. R-squared values in the acceptable range (for micro or macro data) may indicate that responses were not given arbitrarily (Whittington 1987a). Second, WTP values derived from separate CVM and market populations may be compared. Finally, one may create an actual market for the population in question, thus allowing the comparison of CVM and market values (Schulze et al. 1981, Seller et al. 1985, Thayer 1981).

In summary, the hypothetical nature of CVM is an inherent attribute of it. But this does not mean that the bias is necessarily inherent. A number of

tests are available; however, researchers tend to focus on mitigating its effect. This is done by providing realism and credibility with regard to the good and market.

Strategic Bias. Opponents of CVM follow their hypothetical bias argument with the contention that strategic behavior by the respondents will flaw the study. One aspect of this bias antedates the CVM literature as its acknowledgement came with Samuelson's seminal articles on the theory of public expenditures (Samuelson 1954, 1955). Samuelson demonstrated that the nature of public goods, nonrivalry and nonexclusion, provides an opportunity for individuals to give "false signals" (Samuelson 1954, p. 388). This is where the "free-rider" issue arose (Bohm 1979, Randall et al. 1974). Strategic behavior is also problematic when the rules and method of payment provide respondents with the opportunity and incentive to over- or underestimate their true valuation in an effort to affect the outcome (Gramlich 1977, Rowe et al. 1980).

The two situations (free-rider and over/underestimates) are similar in that "false" values are given. The difference is that "free-riders" want the benefits but do not register their bid, whereas respondents attempting to influence the outcome increase (decrease) their true bid accordingly.

Researchers have responded to strategic bias in four ways. First, one can ignore the problem by mentioning it as a potential bias but not grappling with the issue (Gramlich 1977). Second, citations are given to defend one's position. In this case Brookshire et al. (1982), Smith and Desvousges (1986) and Thayer (1981) cite, among others, Bohm (1972), Brookshire et al. (1976) and Rowe et al. (1980), all of whom conclude that strategic bias is not a problem. Reference to these articles leads one to presume that a test (the third

response) was performed and the appropriate results ensued. Below we give a brief analysis of each and conclude that they leave one in doubt as to their conclusions.

Bohm's experiment with public television programs had a significant realism to it. Actual collective choices and payments were made, not the contingent ones of CVM. However, one encouraging finding was that "counter strategic" arguments did in fact appear to mitigate these behavioral tendencies (Bohm 1972, p. 124).

Brookshire et al. tested for strategic bias by visibly analyzing the distribution of bids. The assumption was that strategic bids would give the distribution heavy tails. Bids which were greater than ten standard deviations from the mean were deleted. On this test no bias was found. Others argue that this test may only give some insight into the problem, since without a knowledge of the true bid distribution the test is insufficient (Rowe and Chestnut 1983, Walsh et al. 1984).[19]

The Rowe et al. study informed all respondents that the overall mean bid would be the payment (hypothetically) required of everyone. The test for strategic behavior involved informing half of the sample's respondents of a false mean bid (they did not know it was false) but not the other half. The two subsample mean bids were compared. They concluded that ". . . if zero and very large bids are closely analyzed and possibly rejected, strategic bias, if it exists, has a negligible effect on the bid distribution" (Rowe et al. 1980, p. 15). But by culling these bids one may inadvertently reject the strategic bids, and therefore their conclusion may be in error.

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[19]Schulze et al. (1981) postulate that a bimodal distribution may result if strategic bias is present.

The fourth approach is similar to the advice given concerning hypothetical bias. One can attempt to mitigate strategic behavior by carefully defining a credible and realistic market and by minimizing obvious opportunities for strategy.[20] Minimizing such opportunities is exemplified by avoiding the following. In a study concerning the cost of water pollution the control subsample was told that local households would pay abatement costs and furthermore that their bids would influence local taxes. The other subsample was told that the federal government would incur all costs and that federal taxes would change very little. The opportunity for strategy was seized as the later group's mean bid was significantly higher than the former's (Cronin 1981).

Smith and Desvousges (1986) encourage careful consideration for the use of CVM. Specifically they advocate that it not be used for the ". . . setting of undesirable facilities or for some other highly emotional issue . . ." (p. 77). The good itself may encourage strategic behavior.

In summary, strategic bias has been considered a potential problem. In some studies tests have determined its absence, but these tests are not definitive. The advice is to minimize the opportunity for strategy by providing a credible, realistic, and carefully delineated market to the respondents and by selecting goods amenable to CVM.

Information Bias. Rowe and Chestnut define information bias as arising from "[i]nformation [that] may be conveyed, explicitly or implicitly, to

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[20]Brookshire et al. (1976) note that strategic behavior of the non-free-rider type requires that the respondents know the underlying bid distribution and then be willing to lie about their true valuations. Some people may have no inhibitions about lying, but the knowledge of the bid distribution may not be accessible to these individuals. Informational constraints may preclude strategic behavior.

respondents, which, given uncertainty about their true valuations, may influence or bias their revealed valuations" (Rowe and Chestnut 1983, p. 407). Although each piece of information may influence the valuation, this does not mean it biases the bid. However a more operational definition is "[a] potential set of biases induced by the test instrument, interviewee, or process, and their effects on the individual's responses" (Rowe et al. 1980, p. 6).[21] These include new information bias, vehicle bias and starting point bias.[22] In each case a piece of information may bias the bid. Others look only at the use of additional information, such as informing recreationers of the true distance to substitute facilities (Thayer 1981) or the lack of sufficient and understandable data from which to make an intelligent decision (Schulze et al. 1981). The important feature in each of these is that the bias does not arise from information possessed by the respondent prior to the survey but from the information conveyed.

Information does affect elicited values. But a major goal when using CVM is the consistent presentation of sufficient, credible, and realistic information to the respondent. Therefore unless one wants to test the sensitivity of individuals to new data a carefully specified amount of information will be given. The researcher must find a balance between relevant information and the respondents' processing capabilities. We conclude that the rubric "information bias" serves no real useful purpose (Cummings et al. 1986). A more narrow view may highlight the role of

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[21]With respect to the interviewee, Rowe et al. are referring to respondent "fatigue or impatience" and not to information possessed by the individual prior to the survey (Rowe et al. 1980, p. 7).

[22]See below for an elaboration of vehicle and starting point bias.

payment vehicles, interviewers and starting points. We next turn to these biases.

Payment Vehicle Bias. CVM must have a vehicle for "transferring funds" from the respondent to the provider. Examples include fees (Brookshire et al. 1976, Seller et al. 1983, Thayer 1981), taxes (Gramlich 1977, Greenly et al. 1981) and utility bills (Duffield 1984). The bias is encountered when the vehicle itself biases the bid (Brookshire et al. 1976, Thayer 1981). This may arise on two accounts. First, the vehicle may be disliked or interpreted as something other than just a form of payment (Brookshire et al. 1981). For example, increasing taxes may be irksome to some respondents. Second, the vehicle may imply a range of "appropriate" values. Brookshire et al. (1976) used an entrance fee to the Glen Canyon National Recreation Area as the vehicle for valuing the decline in aesthetic beauty due to the presence of the Kaiparowits power plant and its visible plume. If respondents associate entrance fees with a three to five dollar range, bids probably will fall in this range.

Studies undertaking the analysis of vehicle bias will use two or more vehicles and compare the mean average bids and/or number of protest bids across vehicles.[23] Significant differences imply vehicle bias (Brookshire et al. 1981). Here again, one may cite those studies favoring a certain position. Some studies conclude there is no bias (Brookshire et al. 1980, Randall et al. 1978) while others clearly state that different vehicles are associated with statistically different average WTP values (Greenly et al. 1981, Rowe et al. 1980). The majority of studies do not test for vehicle bias but implicitly or

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[23]A protest bid reflects the respondent's refusal to value the good or extreme dislike of the payment vehicle (Randall et al. 1974, Thayer 1981).

explicitly argue that the vehicle chosen is familiar, realistic, feasible and appropriate, and therefore it does not bias the bids (Brookshire et al. 1981, Thayer 1981).

On this point Arrow (1986) makes an insightful comment. He notes that the specified vehicle is part and parcel of the commodity. The payment vehicle and good are, in a sense, inseparable. Thus rather than having vehicle bias, the different bids reflect values of the "same" commodity, with the exception of one of its attributes, the payment vehicle. This reasoning emphasizes the need for appropriate vehicles.

Compliance Bias. Compliance bias has received little attention. Neither sponsor bias nor interviewer bias, the two forms, is discussed by Cummings et al. (1986). It does surface in the literature so we will review the findings.

Sponsor bias is said to occur when the respondent gives a valuation with the intention of pleasing the sponsor of the good. Interviewer bias arises when respondents do not give true WTP bids but values they interpret as pleasing to the interviewer (Davis 1963, Thayer 1981, Whittington et al. 1987a). Interviewer bias may also surface when different enumerators present the CVM in different ways [e.g., greater detail and explanation may be given or the interviewer's personality may be inappropriate for survey work (Birdsall and Chuhan 1987)].

Sponsor bias has not been tested. To mitigate its presence the researcher will use nonsponsor agents or some mechanism for disassociating the sponsor and respondent (Whittington et al. 1987a). A few of the surveys tested for interviewer bias by comparing bids across interviewers (Brookshire et al. 1980, Thayer 1981). In each case the results were negative. A further test might be to include each interviewer as an explanatory variable (by means of

dummy variables) in regression analysis and to check their corresponding level of significance.[24]

The examples of interviewer bias elucidate the precautionary measures necessary when interpreting the test results. A statistically significant dummy variable (which represents an interviewer) may be capturing the influence of other unspecified variables. For example, Birdsall and Chuhan (1987) argue that the difference of rainfall, not interviewer bias, is evidenced by the statistically significant dummy (interviewer) variable.

Starting Point Bias. An integral part of any CVM study is the instrument or question format (direct or bidding) used for eliciting values. There are two variants of the direct question format. When using an "open-ended" version the respondent can choose any value (Bishop et al. 1983, Walsh et al. 1984) or select one from a payment card (Boyle and Bishop 1984).[25] In the "closed-ended" version the respondent indicates the acceptance or rejection of a stated value. It is a "take it or leave it" proposition (Brookshire et al. 1982, Seller et al. 1985)

The bidding game format makes use of a starting point value to which the respondent gives a "yes" or "no," indicating approval or disapproval of the bid. A "yes" ("no") response signals the enumerator to raise (lower) the value by a fixed increment. The process ends when the individual indicates no further increases (decreases) are necessary. By count, this format is the preferred method (Brookshire et al. 1976, Davis 1963, Duffield 1984, Gramlich 1977, Greenly et al. 1981, Randall et al. 1974, Rowe et al. 1980, Thayer 1981).

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[24]Mail surveys preclude the possibility of interviewer bias.

[25]The payment card lists values from zero to a level judged outside the respondent's WTP range.

The starting point ". . . is merely a tool for initiating the bidding process and . . . [is not intended to] affect respondents' final bids" (Boyle et al. 1985, p. 189). However, a number of items may frustrate the ideal. Respondents may interpret the starting bid as indicative of the appropriate range of bids. Reasons for this may stem from a poorly defined or unintelligible good (Boyle et al. 1985) or the time it takes to arrive at the individual's maximum WTP. If an individual's true bid differs substantially from the starting point by a large number of increments, boredom, impatience or fatigue may occur. This may lead to a truncation of the game and a biased bid (Rowe et al. 1980, Thayer 1981). If an individual's final bid is influenced by the starting bid, the bid is considered biased.

Researchers are encouraged to design bidding games which mitigate the potential for starting point bias. One means of achieving this goal is to begin with relatively large increments (decrements) and finish with smaller increments (decrements). This procedure quickly closes upon the respondent's true bid and may help to minimize fatigue and boredom effects (Brookshire et al. 1976, Freeman 1986).

Rowe et al. (1980) tested the mean average bids for each of three starting points ($1, $5, $10) in their study of visibility. They reported that for each one-dollar increase in the starting point the mean bid increased by sixty cents. This represents a significant bias. Brookshire et al. (1981) also found this bias to be problematic in some of their surveys. Other studies which compare mean values found no starting point bias (Brookshire et al. 1980, Thayer 1981).

Thayer (1981) provides two additional tests, both involving regression analysis. The two equations are

(1) $BidF_i = \beta_0 + \beta_i BidS_i + \varepsilon_i$ and,

(2) $BidF_i = \beta_0 + \beta_k Socioeconomic\ variables_{ki} + \delta BidS_i + \mu_i$,

where, with respect to individual i, $BidF_i$ is the final bid, $BidS_i$ is the starting bid and β_k is a vector or coefficients. Two starting points were used ($1 and $10) in his study of environmental amenities in the Jemez Mountains of New Mexico. Results in both regressions led him to conclude that starting point bias was not present. Boyle et al. (1985) used regression (1) and reported no bias.

In conclusion, there are measures which may reduce the likelihood of starting point bias. But tests should be performed and results stated.

Format Bias. The different formats, specified above, may also induce biased WTP values. Format bias is similar to what Tversky and Kahneman (1981) call framing bias. Although their work is more relevant to CVM research which involves probabilities ("uncertainties"), the analysis helps one to understand the issue of format bias.

They state that ". . . rational choice requires that the preference between options should not reverse with changes of frames" (Tversky and Kahneman 1981, p. 453). But their empirical investigation shows that when the same problem is framed in different ways preference reversals arise. Analogous to this is format bias. The format should play a roll similar to the starting point such that an ". . . ideal format would be understandable to the respondent and simple and convenient to use. . . . In addition, it would not artificially influence the magnitude of the respondent's bid" (Smith and Desvousges 1986, p. 79). The emphasis is on providing a format with which the respondent feels comfortable. A few studies have used multiple formats and then compared the corresponding WTP bids.

Seller et al. (1985) used the two direct formats (closed- and open-ended) in a mail survey regarding recreational boating on four lakes in east Texas. The open-ended WTP values were significantly lower than those of the closed-ended format. They concluded that an open-ended format was a method unfamiliar to the respondent. Most markets confront the consumer with a price — a take it or leave it decision. On this basis closed-ended formats would be better understood by the respondents and allow for routinized behavior.

Whittington et al. (1987a) compared the mean values of both the bidding game and open-ended formats. Although the two WTP values were not statistically different, the bidding game gave rise to noticeably higher bids.

Most surveys use the bidding game, yet a few choose to use a direct question format. Due to the respondent's unfamiliarity with open-ended questions, problems are encountered. Individuals are more comfortable with giving a "yes" ("no") to a value (Randall et al. 1974). This type of response is amenable to both bidding and closed-ended questions.

Sampling Bias. Invariably only a subset of the population is surveyed. One might therefore expect discussion concerning sampling bias in the CVM literature. Generally this is not the case. Brief references, at best, are found (Rowe et al. 1980, Schulze et al. 1981, Thayer 1981). Even Cummings et al. (1986) fail to address this important issue.

Two pieces in the literature do discuss the issue of sampling bias, Edwards and Anderson (1987) and Mitchell and Carson (1987a). Both articles enumerate four potential sampling biases:[26]

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[26]The four terms used are those of Mitchell and Carson (1987a), while the definitions are drawn from both articles.

1. Population choice bias: When the survey population does not properly reflect the population which accrues the benefits and/or costs of the commodity.
2. Sampling frame bias: When the frame does not use random sampling designs with respect to the population chosen.
3. Sampling nonresponse bias: When the sample statistics derived from records having valid WTP values differs significantly from the population parameter related to WTP as a result of nonresponses.
4. Sample selection bias: When the error term of the WTP regression equation does not have an expected value of zero but is related to some selection rule, i.e., the sample's error distribution differs significantly from the population's.

Population choice bias can be avoided by identifying the individuals who would incur costs and/or accrue benefits should the project be implemented. Sampling frame bias may be minimized by proper selection of a frame and use of a random sampling design.

Sample nonresponse and sample selection bias are problems of a different degree but not beyond identification and correction. Indication of nonresponse bias can be suggested by use of a chi-square analysis to test for differences in explanatory socioeconomic variables, in the WTP regression, between respondents and nonrespondents. However, securing the data for nonrespondents may be difficult. Follow up interviews may prove costly, time-consuming and unfruitful.

Selection bias may occur when protest bids and outliers are culled, when nonresponses are indicative of a self-selection process, or when the probability of observing a valid WTP bid is related to the respondent's

expressed value. Protest bids (zero bids) indicate disapproval of the proposed collection mechanism or an unwillingness to play the game (Randall et al. 1974, Thayer 1981).[27] In either case follow up questions are necessary to determine if the zero bid is an honest value or a protest (Brookshire et al. 1976, Schulze et al. 1983). Protest bids are then extracted from the sample.

Outliers are also identified by various selection rules. For example, Rowe et al. (1980) deleted bids which were greater than ten standard deviations from the mean. Smith and Desvousges (1986) made use of regression diagnostics.

Regardless of the selection process, error sample selection bias ". . . occurs when fitted regression functions confound the behavioral parameters that are of interest with the parameters of a different function that determines the probability of entrance into the sample" (Edwards and Anderson 1987, p. 171). The two-stage estimator to test and correct for this bias is given by Heckman (1976, 1979).

Four potential sampling biases were enumerated. Population choice bias and sampling frame bias may be avoided and minimized, respectively, by carefully delineating the affected individuals and by use of a proper frame. If one is to test for nonresponse bias, follow-up interviews are required. Heckman's two-stage estimator may be used to test and correct nonresponse and other selection biases.

Summary of CVM Biases. This section provided a literature review on the biases which arise with CVM studies. The eight biases are hypothetical

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[27]See "Vehicle Bias." Protest bids in closed-ended formats are indicated not by zero bids but by verbal objections (Seller et al. 1985).

bias, strategic bias, information bias, vehicle bias, compliance bias, starting point bias, format bias, and sampling bias.

The hypothetical nature of CVM is an inherent attribute of the method. Researchers are encouraged to design a contingent market which is credible and realistic. These efforts purportedly mitigate the probability of meaningless responses. Strategic bias likewise is thought to be minimized by following the advice for reducing the hypothetical nature of CVM and by denying the respondent obvious incentives to behave strategically. Adherence to these principles is advocated, as the tests for strategic bias are not definitive and may lead to improper deletion of bids.

Information bias is too broad a rubric but can be operationalized by studying vehicle bias, compliance bias and starting point bias. These three are selected from the innumerable pieces of information which may influence the bid on the assumption that the researcher designs a survey which consistently gives adequate, understandable and appropriate information to all respondents.

Studies show that payment vehicles may influence WTP bids. However, the emphasis is on the proper selection of vehicles, knowing that it is an inseparable part of the commodity being valued. Compliance bias is of two types. Sponsor bias is avoided by not disclosing the sponsor to the individual. Interviewer bias appears to be insignificant. The tests for it are relatively simple and may be performed as a check. However, the results may reflect some other underlying influence.

CVM surveys necessitate a question format for eliciting WTP values. Direct question formats (open- or closed-ended) avoid the use of a starting bid. Bidding games use a starting bid. Applicable tests for starting point bias give

mixed results. One method of mitigating the influence of fatigue or boredom is to close in upon the respondent's bid quickly by use of large and then small iterations. The choice of a format is also of importance. Open-ended questions may be problematic if the respondent is not engaged in the routinized behavior afforded by the use of bidding or closed-ended formats.

Sampling bias is a relatively recent addition the the list of biases. Proper sampling procedures and regression techniques can remedy the effects of this bias.

One final word is in order. The emphasis on biases appears to be on avoidance by proper design and use of CVM surveys. Tests are nonetheless utilized as checks. If certain biases do occur then qualification of results is in order.

Contingent Valuation and WTP for Potable Water

A literature search of refereed journals produced no articles on the use of CVM for determining WTP for potable water systems. Non-journal sources produced two relevant pieces. Birdsall and Chuhan (1987) estimate WTP by use of CVM for a public tubewell.[28] Whittington et al. (1987a) do likewise for a public fountain and a private connection.

Motivating their paper with a positive externality argument (improvement in health), Birdsall and Chuhan engage in a CVM study to estimate WTP for a hand-operated tubewell. Their hypothesis is that if a fee is charged for the service, the revenues can be used to decrease travel distances and time spent securing these services and improve quality with the

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[28]This study originally was issued in 1983. See its reference in the bibliography.

result that private demand will actually increase to a level in accordance with "social" demand.

Two surveys were used, a household survey and a small-group, village survey. One hundred eighty-six households were randomly selected and surveyed from thirty-six villages in the Kayes region of Mali. The data gathered consisted of the standard socioeconomic variables, cash expenditures, morbidity, ownership of wells, and WTP bids for the services.[29] The small-group survey collected information on the existing service's price, quality and accessibility in terms of distance.

The average household WTP amounted to less than 0.4 percent of household income. Regression results indicated that income, distance (proxy for price) and a number of dummy variables used as proxies for health had the hypothesized signs and were statistically significant. The income elasticity was 0.34 and the adjusted R^2 was 0.312.

Using the sample averages as representative of the population bids, aggregate WTP bids were determined sufficient to cover costs for a tubewell in twenty-three of the thirty-eight villages surveyed.[30] An admitted and important caveat is that inferences were made based upon four to six household surveys per village. Furthermore, a tubewell can serve a maximum of 500 persons, but the average village population was closer to 800 persons. Thus households were bidding for full service but would likely receive partial service.

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[29]Closed-ended questions were used.

[30]Tubewell costs included spare parts, labor for minor repairs and servicing and a small contribution towards investment costs.

The potential impact of three biases was entertained, hypothetical bias, strategic bias and interviewer bias.[31] Prior to the surveys, groups of villagers were gathered together for the expressed purpose of explaining the services to be valued. Despite the potential ignorance concerning the health effects from potable water, time saving and reliability was an understood benefit. Both the explanation of the service and the understanding of some of the benefits were assumed to mitigate the effects of hypothetical bias.

Neither a payment rule nor a vehicle was specified. By assuming that the respondents thought they would pay the amount bid, underbidding (strategic bias) may have occurred. However, the downward bias in mean average bids actually strengthens their conclusion that many villages are able and willing to pay for the service. No tests were undertaken.

The regression equations contained dummy variables for two of the three regions encompassing the thirty-eight villages. Each region had one enumerator. These variables were statistically significant. On the surface one could argue for interviewer bias. Birdsall and Chuhan argue that the statistical significance of the regional dummy variables reflect other influences, most notably the differences in yearly rainfall.

More recently Whittington et al. (1987a) made a CVM study of WTP for potable water in two Haitian villages, Laurent and St. Jean du Sud (population 1500 and 1000 respectively).[32] Data collection consisted of two parts. Household surveys obtained socioeconomic data. Water source observations consisted of follow-up work to verify quantities and sources of

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[31]Starting point bias was not an issue as a closed-ended format was used.

[32]See Whittington et al. (1990) for the subsequent, and modified, published version.

water as reported in the household surveys. Following the questionnaire's opening statement, the respondent was shown pictures of the systems and asked to bid for a public fountain and a private water connection.[33] Laurent's mean WTP for the fountain and private connection was approximately 1.5 percent and 3.3 percent of income, respectively.[34] Regression analysis showed wealth, education, and distance to and quality of the existing water source(s) to be statistically significant. They also had the hypothesized signs. The adjusted R^2s were 0.225 (public fountain) and 0.338 (private connection).

Average WTP bids in St. Jean du Sud were only slightly below Laurent's, but regression results were found wanting. Only the wealth variable came in statistically significant and the adjusted R^2 was 0.02 for a private connection.[35] Reasons given for the inability of the regression to account for the variations in WTP included the diversity of water sources used (making difficult the calculation for the distance explanatory variable), the rugged terrain (there was no scaling factor to account for difficulty of travel), relatively high nonresponse rate,[36] and the use of a direct, open-ended

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[33]The service was familiar to the villagers since many rural water systems were already in place in southern Haiti.

[34]The mean WTP bid for a private connection was 1.8 percent of household income. However, the true percentage was assumed to be 3.3 percent as the private connection bids were to be understood as "payment" in addition to the bid for the public fountain (mean bid of 1.5 percent). The phrasing of the questionnaire makes tenuous this assumption.

[35]The adjusted R^2 was not available for the the public fountain regression.

[36]Nonresponses were not defined.

format in 34 percent of the surveys for public fountain bids and 28 percent in private connection bids.[37]

A number of biases were tested for but none were determined significant in either village. Hypothetical bias was argued as not being present on two accounts. First, the respondents were familiar with both the water systems and the question format, except for a number of open-ended questions in St. Jean du Sud. Second, WTP bids were explained by the independent variables (but only in Laurent).

Two different opening statements were used in the section eliciting WTP values for a public fountain. These afforded a test for strategic bias. Statement A informed the respondent that regardless of their response, a system would be built and fees assessed. Statement B told the respondent that a committee comprised of local villagers would establish a fee which each household would pay to operate and maintain the system. Comparison of the corresponding mean WTP bids suggested that strategic bias was not problematic.

The bidding game utilized three different starting points. Mean WTP bids were not found significantly different. Starting point bias, therefore, was argued as not present.

Finally, they tested for bias arising from the question format. The St. Jean du Sud survey used both the open-ended and bidding formats. Testing the null hypothesis that both samples were from the same population led to its not being rejected.

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[37]The respondents were unfamiliar with stating outright a maximum WTP. They preferred the bidding game which was similar to the type of bargaining of their rural markets.

Whittington et al. apparently were successful in eliciting bids for private connections which exceeded 3 percent of household income in both villages.[38] This is within the 3 to 5 percent range previously thought to be collectable when significant water improvements were made available. However, the percentage drops to approximately 1.5 percent of income for public fountains. Considering that micro data were used, the Laurent regression was able to explain a significant portion of the WTP variation. The explanatory power of the St. Jean du Sud regression was poor and reasons were posited for this.

B. Summary

The focus of this study proposes to use CVM analysis in an effort to examine the determinants of WTP for an improved potable water system. The review of CVM as a methodology revealed that CVM is subject to a number of biases which may mitigate its efficacy. However, proper design and implementation of the survey instrument does much to render these biases inconsequential. In addition, appropriate testing of biases and reporting of results is standard practice. Two studies have been undertaken, Birdsall and Chuhan (1987) and Whittington et al. (1987a). Both met with limited success. However, neither study compares the CVM values with actual household payments for existing services or with the actual costs of operating an improved water system. Furthermore, no adequate theoretical model is given from which the empirical investigation of the interdependent behaviors (choosing the source and WTP) is undertaken. This research fills these voids.

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[38]But see footnote 34.

We now turn to Chapter III to provide the theoretical and econometric models for the study. These are motivated from a consumer choice theory of discrete - continuous demand. The discrete choice involves choosing a water source, and the continuous choice indicates the individual's valuation of the potable water service (WTP).

CHAPTER III

THEORETICAL FRAMEWORK AND ECONOMETRIC METHODS

This chapter begins with a theoretical model of consumer behavior for an improved water source. It is developed as a two-part, interdependent choice model, better known as a discrete - continuous choice model. The discrete part involves choosing the improved water source and the continuous part is associated with the financial amount the consumer is willing to pay. The second section describes the econometric techniques that are consistent with the theoretical model and will be utilized in the empirical investigation found in Chapter IV.

A. Theoretical Framework

Economic demand analysis conventionally focuses on the consumers' continuous choices. However, there are occasions which involve both the qualitative, or discrete choice, and the continuous choice. For example, Lee and Trost (1978) studied the discrete choice of renting versus owning a home and the continuous choice of the size of home. Dubin and McFadden (1984) analyzed the decisions to purchase a gas or electric appliance and the amount of energy (gas or electricity) to consume. These two examples elucidate the fact ". . . that the optimal discrete choice . . . depends partly on the outcome of the continuous choice and vice versa. Therefore, the two choices should be modeled in a mutually consistent manner" (Hanemann 1984, p. 541).[39]

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[39]This paragraph was motivated by Hanemann's (1984) introductory paragraph.

This section will set forth a theory of consumer behavior for an improved water source. The consumer engages in two interdependent decisions, the choice of water source and the WTP for the quantity of water demanded from this source.

When analyzing consumer choices, it is helpful to remember the elements of such a theory. The elements are: (1) a decision maker, (2) a set of alternatives, (3) the attributes of these alternatives, and (4) the decision rule.[40] We will begin by describing each of the elements.

The decision-making unit can vary from an individual to a group of individuals such as a household or a firm. For our purposes the unit is the household.[41] The household makes its water source choices from a non-empty set of alternatives, the choice set (CS). This set is constrained by known alternatives, monetary resources, time, etc. Household h chooses from CS_h.

There are two type of CSs. A discrete choice set involves alternatives which are discontinuous or discrete. For example, the choice of automobile, housing or educational institution. In each of theses examples the individual chooses from a discrete set of alternatives, distinct separable points, not from a continuum in CS. The choice of water source is a discrete choice. Continuous sets are those typically associated with the demand optimums derived from an objective function and subject to some constraint(s). For us the continuous sets are the quantity of water demanded and corresponding WTP value.

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[40]See Ben-Akiva and Lerman (1985).

[41]We will use the terms "household" and "respondent" interchangeably.

With the advent of attribute theory (Lancaster 1966) choice analysis may be denominated in terms of attributes of the good. This is particularly helpful in the case of discrete - continuous choices. Attribute theory allows the researcher to define the utility function as a function of the attributes for the alternative goods. Finally, the decision rule employed to explain the household's choice of source and payment is based upon consumer utility theory.

Following the theoretical work by Ben-Akiva and Lerman (1985), Hanemann (1984) and Lerman (1975) on random utility models and Manski (1977) on discrete - continuous choices, we set up the following theoretical model.[42]

Assume each household has a utility function defined for N different types of water (according to source), $x_1, ..., x_N$, and a numeraire, r, to account for all other goods. It is likely that the household's utility function or preference ordering is dependent on the attributes of each source, denoted by $z_1, ..., z_N$, and household characteristics (e.g., membership, income, type of home) symbolized by the vector s. This allows us to write the household's utility function as

(1) $$u = u(x, r, z, s).$$[43]

Furthermore, the attributes of source j are relevant only if water from source j is consumed,

(2) $$x_j = 0 \quad \text{implies } \partial u/\partial z_j = 0 \quad (j = 1, ..., N).$$

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[42]The format of our explanation draws most substantially from Hanemann (1984)

[43]The household identifier, subscript h, is suppressed throughout the theoretical exposition.

The household selects (x, r) so as to maximize its utility subject to the budget constraint

$$(3) \qquad y = \sum_{j=1}^{N} p_j x_j + r,$$

where p_j is the price of water from source j and y is household income, and to the non-negativity constraints

$$(4) \qquad x_j \geq 0 \quad (j, ..., N)$$
$$r \geq 0.$$

The element of discreetness is elucidated by the fact that the solution to the household's utility maximization results in strict equalities in (4) for some x_j's. Thus, the discrete choice indicates which water source(s) are used and which are not. The continuous aspect is seen in the magnitude of the chosen x_j('s).

The model is most useful when stated in a random utility framework. Manski (1973)[44] motivates the use of random utility models by noting that there are four sources of randomness in u(·):

1. omitted or unobserved attributes and/or elements of the attributes
2. unmeasured or unobserved preference/taste variations across individuals,
3. measurement errors in the variables, and
4. instrumental (proxy) variables.

Thus, a random utility model is appropriate when the utility function for the household is deterministic, yet some components are unobservable to the investigator. These unobservables may be attributes of the water source (z) and/or characteristics of the household(s). For these components we identify

[44]As cited in Lerman (1975) and Ben-Akiva and Lerman (1985).

an N-dimensional vector e. Although e is known to the household, for the analyst it is a random variable which causes the observed $u(\cdot)$ to have a frequency distribution.[45]

Consider the case where the household decides only to consume water from source j.[46] The conditional (denoted by the bar) utility function becomes

(5) $$\bar{u}_j = \bar{u}_j (x_j, r, z_j, s, e_j).$$

which represents the utility values when all other water sources are set equal to zero. $\bar{u}_j(\cdot)$ is maximized subject to

(6) $$y = p_j x_j + r \quad \text{and} \quad x_j \geq 0, r \geq 0.$$

The resulting conditional Marshallian demand functions are denoted by

(7) $$\bar{x}_j = \bar{x}_j(p_j, y, z_j, s, e_j)^{47} \quad \text{and} \quad \bar{r} = \bar{r}(p_j, y, z_j, s, e_j)$$

From these we can define the conditional indirect utility function as

(8) $$\bar{v}_j(p_j, y, z_j, s, e_j) = \bar{u}_j[\bar{x}_j(p_j, y, z_j, s, e_j), z_j, \bar{r}(p_j, y, z_j, s, e_j), s, e_j]$$

WTP for improved water equals the peso-valued difference between the indirect utility function evaluated for improved water and evaluated for the traditional water source. This can be directly measure with unbiased CVM

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[45]See Ben-Akiva and Lerman (1985), Hanemann (1984), and Lerman (1975) for a more detailed exposition of random utility models.

[46]It may be most useful to think of each x_j as representing a particular water use from a given source. For example, in the Philippines it is observed that water prices often are two-part tariffs. Household charges for individual connections include a large, one-time fee for pipe and water meter installation and a fixed price per consumption unit. Therefore, a household decision to purchase the improved water for a particular use (e.g., drinking) may be the optimal decision. However, households likely continue using alternative sources for other purposes.

[47]This form of the conditional Marshallian demand function indicates that z_j is a vector of water source characteristics exclusive of price (p_j), and s is a vector of household characteristics exclusive of income (y).

bids. The remainder of this section illustrates measurement of WTP using demand curve analysis for comparison.

Assuming the indirect utility function possesses all the standard properties, $\bar{v}_j(\cdot)$ satisfies Roy's Identity so that

$$\bar{x}_j(p_j, y, z_j, s, e_j) = - \frac{\partial \bar{v}_j(\cdot) / \partial p_j}{\partial \bar{v}_j(\cdot) / \partial y} . \tag{9}$$

Equations (8) and (9) provide the essential information for a discrete - continuous choice model. The discrete choice can be given by comparing the conditional indirect utilities associated with each source. Alternative source i (the improved source) is selected by the household if

$$\bar{v}_i(p_i, y, z_i, s, e_i) > \bar{v}_j(p_j, y, z_j, s, e_j), \text{ (all } j, i \neq j). \tag{10}$$

Recall that e represents unobservables and is treated as random, and the remaining factors represent the deterministic part of $\bar{v}_j(\cdot)$. Specifying the random term to be additive,[48] we can rewrite the random utility function as

$$u_j = v_j(p_j, y, z_j, s) + e_j, \; j = 1, \ldots, N. \tag{11}$$

If we define a qualitative variable q such that

$$q_i = 1 \quad \text{if } \bar{v}_i(p_i, y, z_i, s) + e_i > \bar{v}_j(p_j, y, z_j, s) + e_j \tag{12}$$

$$q_i = 0 \quad \text{otherwise,}$$

then we can rewrite the discrete choice decision in probability (P) terms as

$$P(q_i = 1) = P[\bar{v}_i(p_i, y, z_i, s) + e_i > \bar{v}_j(p_j, y, z_j, s) + e_j] \tag{13}$$

or

$$P(q_i = 1) = P[e^* < \bar{v}_i(\cdot) - \bar{v}_j(\cdot)], \text{ where } e^* = e_j - e_i. \tag{14}$$

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[48]This simplifies the discrete-choice model (Lerman 1975).

The probability of a household being observed as choosing the improved water source i, given household and water source characteristics, is given by equations (13) or (14).[49]

The continuous WTP choice also is derivable from the conditional indirect utility function of equation (8). From a theoretical perspective WTP represents the maximum payment for water services for each marginal price. That is WTP is the integral of the relevant portion of the individual's compensated or Hicksian demand curve. If instead of marginal prices a flat fee is charged for unlimited use (point of satiation) then WTP represents the total area under the household's compensated demand curve. Thus, WTP can only be directly derived from the Marshallian demand curve (equation 9) when there are no income effects. Otherwise, income effects must be deleted from equation (9) when WTP is measured.

We saw in (9) how the conditional demand is derived from the conditional indirect utility function. The conditional willingness to pay ($\overline{WTP}$) is then represented as

(15) $$\overline{WTP}_i = \int_{\bar{u}} \bar{x}_i(p_i, y, z_i, s, e_i)\, d\bar{u}$$

Bringing the discrete and continuous choices together, we have

(16) $$\overline{WTP}_i = \begin{cases} \int_{\bar{u}} \bar{x}_i(\cdot)\, d\bar{u} & \text{if } \bar{v}_i(\cdot) + e_i > \bar{v}_j(\cdot) + e_j \quad (WTJ = 1) \\ 0 & \text{otherwise} \quad (WTJ = 0). \end{cases}$$

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[49]As explained in Chapter IV, a household must first join a Rural Waterworks and Sanitation Association (RWSA) before being able to purchase water from the improved source. The qualitative variable q represents a household's willingness to join (WTJ) the RWSA.

B. Econometrics

In this section we describe the econometric techniques consistent with the theoretical model. We are interested in analyzing the determinants of both water source and the WTP decisions. As stated above, these two decisions are interdependent and therefore should be modeled accordingly. The analysis will use Heckman's two-step model (Heckman 1976, 1979).

The above theoretical formulation does not limit the number of water source alternatives j, except that $j \in CS_h$. That is, equation (13) is a general model for choice of a water source. However for estimation purposes (13) is simplified by stipulating that the household makes its choice from two alternatives, the major, traditional source and the contingent or improved source. Limiting j to two alternatives results in a binary choice model. Operationalizing this model requires a number of assumptions.[50]

First, choice models generated from random utility theory which are available make use of two assumptions:

1 the random elements for each source are independently and identically distributed;

2. the deterministic part of $v_j(\cdot)$ is linear in parameters.

Second, the distribution of e^* must be specified. The two most widely used functional forms are the probit and logit. Their respective cumulative density distributions closely resemble each other with the logistic curve having flatter tails (Kmenta 1986). We assume that e^* is normally distributed with a zero mean and utilize the probit model. Therefore, equation (13) is specified as

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[50]See Ben-Akiva and Lerman (1985) and Lerman (1975).

$$(17) \qquad P(i) = \int_{e=-\infty}^{V(\cdot)i-V(\cdot)j} \frac{1}{\sqrt{2\pi\sigma}} \exp\left[\frac{-1}{2}\left(\frac{e}{\sigma}\right)\right] de, \ \sigma > 0,$$

or

$$(18) \qquad P(i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{(V(\cdot)i - V(\cdot)j)/\sigma} \exp\left[\frac{-1}{2}u^2\right] du = \phi\left(\frac{V(\cdot)i - V(\cdot)j}{\sigma}\right)$$

where $1/\sigma$ is the scale parameter for the utility function and is usually set at $\sigma = 1$, and $\phi(\cdot)$ is the standardized cumulative normal distribution.

Econometric analysis of WTP requires a technique other than ordinary least squares (OLS) because a positive WTP value is observed only if a household is willing to join. A tobit or Heckman correction model (Heckman 1976, 1979), which employs a "selectivity variable" (Lee 1978, p. 424) better known as the inverse of Mill's ratio (λ), is appropriate because of the potential censoring problem. The need for such a technique is shown below.

WTP is given by equation (16). Note that households must first join a RWSA before having access to the improved water system. This indicates that WTP values are censored due to the sample selection rule, WTJ = 1. Using OLS without accounting for the censoring leads to biased and inconsistent results when the error term does not have an expected value of zero (Kmenta 1986, Maddala 1983).

The problem may be shown as follows.

$$(19) \qquad \begin{aligned} WTP &= \beta X + \mu && \text{if WTJ = 1 (selection rule)} \\ &= 0 && \text{otherwise,} \end{aligned}$$

where β is a vector of coefficients for the vector of explanatory variables X. In terms of expected values we have

$$(20) \qquad E(WTP \mid X, \text{selection rule}) = \beta X + E(\mu \mid \text{selection rule}).$$

If the error terms of the WTP and WTJ (selection rule) functions are independent (i.e., the the records for the WTP function are censored randomly), then the conditional mean of μ, $E(\mu \mid$ selection rule), is zero. Using OLS to estimate (18) will yield estimates with the desired properties. Generally, the sample selection rule has more serious consequences. If the conditional expectation of μ does not equal zero, estimating equation (18) will lead to biased and inconsistent results as the regression does not account properly for the non-random selection rule.

The Heckman model is used here. Heckman writes that ". . . if $h(U_{1i}, U_{2i})$ is assumed to be a singular normal density ($U_{1i} \equiv U_{2i}$) and $X_{1i} = X_{2i}$, $\beta_1 \equiv \beta_2$, the 'Tobit' model emerges" (Heckman 1979, p. 155). For our purposes the subscript 1 corresponds with the WTP model and 2 with the WTJ model. Because $X_1 \neq X_2$, as DUMBID and DUMSTRAT are unique to the WTP decision allowing for substitution across sources and there is no a priori reason for $\beta_1 \equiv \beta_2$, the tobit model does not emerge.[51] Additionally, QUALS1 and WALKTIME are unique to the WTJ decision when substitutions across sources are not permitted. A tobit model constrains both decisions to a single structure, thus implying that the WTJ and WTP decisions are explained by the same variables.[52]

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[51]The variables are defined in Chapter IV.

[52]There are three potential problems with the Heckman model. First, the replacement of λ with $\hat{\lambda}$ leads to heteroskedasticity and therefore biased and inconsistent calculated standard errors in the second stage of the model (Kmenta 1986). This problem is rectified by employing the variance-covariance matrix as given in Amemyia (1984). Second, the use of $\hat{\lambda}$ in the second stage can be a source of multicollinearity. Appropriate testing can detect this. Finally, some available evidence suggests that the two-step estimator is not as efficient as the tobit maximum likelihood estimator (Nelson 1984, Paarsch 1984).

C. Summary

The household choices of water source and the amount willing to pay are interdependent. This discrete - continuous choice was given theoretical underpinnings by use of a random utility model. The model informs us that the set of explanatory variables include water source (p_j, z_j) and household (y, s) characteristics. Furthermore, the theoretical, optimum choice reveals that alternative source characteristics are not relevant to the continuous WTP decision as the theory assumes no substitution across sources. But households do make such substitutions. Therefore the empirical analysis will focus on the model allowing for substitution.

The statistical significance of the determinants for WTJ and WTP will be determined by using the Heckman econometric technique. Chapter IV delineates these findings.

CHAPTER IV

EMPIRICAL RESULTS

The major focus of this chapter is to understand the determinants of a household's WTJ and WTP. Thus, in parts C and D household data are used to generate the regression results for these two decisions. The empirical equivalents of equations (13) and (16) are estimated individually for each of the four unserved villages (Banaga, Coral Na Munti, Pakigne and Santol) and with the pooled data generated from the same villages. Our focus will be on the pooled data results derived from the Heckman model. Additionally, part E considers expenditures at the household level for a served village (San Juan) and part F uses the RWSA cross-section data. The latter two analyses are done in an effort to provide statistics for comparison with the CVM study. Before presenting the above, part A places the research in context by describing the data and questionnaires used to gather the data, and part B specifies the empirical models used to generate the results.

A. Data

Data and Questionnaires

The institutional setting has an important influence on how people articulate their demand for water services in the Philippines. Rural Waterworks and Sanitation Associations (RWSAs) are established as the

water providers to one or more rural barangays.[53] These associations set the rates and fees, oversee collections, and manage system operations. Households must join a RWSA (by payment of a one-time fee of approximately 10 pesos) prior to having access to the potable water service.

Three types of water service are available (though not from every RWSA). Level I is a well and point-source standpost. Level II involves providing public faucets to service six to eight households. Level III service is a private or individual household connection. Many RWSAs offer both Level II and Level III service with a monthly fee established for each level. No fees are imposed for Level I service. Households desiring Level III also must pay for a water meter and installation costs (approximately 1000 pesos).

Efforts to examine water services involved gathering data using a household questionnaire and a RWSA questionnaire. Each was designed by the interdisciplinary team, field tested and implemented by a number of field workers in selected provinces during the period July 16 to August 28, 1987. All interviews were conducted in the local language.[54]

Household Questionnaire. The household questionnaire (see Appendix B) closely follows the format developed by Whittington et al. (1987a). It was used to collect micro data on household socioeconomic characteristics, water use patterns, perceptions of current water sources, perceptions of the need for a potable water system, and the desired improvements it should have over

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[53]A "barangay" is the Filipino name for a small village. A number of barangays comprise a town, which is itself identified as part of a province (see Appendix A).

[54]See Appendix A for the schedule of selected survey areas (unserved and served barangays and the RWSAs) and for the interviewers' role, duties and instructions.

the existing sources, WTJ an RWSA and WTP. The household questionnaire was administered in two barangays which were served with improved water, San Juan and Tangil-Tapon, and four unserved barangays, Banaga, Coral Na Munti, Pakigne, and Santol. Data were collected from the served barangays for the express purpose of comparing these responses with those from unserved barangays. Criteria used to select served barangays included:

1. The water system must have been operational and working since January 1, 1985.
2. The system must be Level III or Level II - III, allowing for the determination of household consumption.
3. The corresponding RWSA must have proper records on operations since January 1, 1985.
4. There were unserved households within the village.
5. 200 usable interviews could be collected.
6. One of the served barangays surveyed should be outside of Luzon.

Criteria used to select unserved barangays included:

1. At least one unserved barangay should be outside of Luzon.
2. Current improved water sources may not exceed Level I.
3. At least 200 interviews were possible, i.e., the number of households located in the barangay must be greater than 200.

Also, the selection of sample sites was designed to maximize variation between barangays with regard to degree of prosperity, remoteness (i.e., nearness to urban activity), and availability of traditional water sources. Finally, an effort was made to vary the barangay settlement pattern (clustered, semi-clustered, or scattered) and reliability of existing village water supplies (i.e., use of shallow wells, use of rainwater).

The questionnaire for unserved households constitutes the CVM part of this study. Therefore, as stated in Chapter I, potential CVM biases should receive proper attention.

Each of the four unserved barangays lacked an improved water system (Level II or Level III). One might argue that hypothetical bias is a serious problem. However, enumerators were careful and patient when describing, both verbally and with pictures, the system so that although household familiarity may be lacking it is hoped the description was sufficient.[55] With regard to the payment vehicle, respondents were informed that monthly fees would be assessed and collected by the local RWSA. Failure to join the RWSA and pay the appropriate water fees would preclude their use of the system. No other vehicle was tried as this is the method used by the existing RWSAs.

WTP values were elicited by asking respondents to play a bidding game. The bidding game was set up in four different ways to allow testing for strategic bias and starting point bias. The opening statement briefly noted that the respondent's barangay was (was not) served by a water system, that fees were required to maintain its operation, and that membership in a RWSA was a prerequisite for utilizing the service. However, versions A and C also explicitly stated that "the actual water charges would be decided on by the local water association." Versions B and D had no such statement. This difference furnished the possibility of testing for strategic bias by use of regression analysis. Table 1 indicates that each barangay had a number of

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[55]However, see Table 5, specifically the percentage not familiar with an RWSA in another village.

TABLE 1

ESTIMATED NUMBER OF FREE-RIDERS
BIDDING GAME

Village	Observations	Public Faucet	Individual Connection
Banaga	200	36	51
Coral Na Munti	200	1	7
Pakigne	200	4	3
Santol	200	10	13
Pooled	800	51	74

free-riders, respondents willing to join the RWSA for improved water but indicating they would make no payment for water consumption. This bias is addressed by imputing a WTJ value based on effective WTP (i.e., if WTP > 0 then WTJ = 1, else WTJ = 0).[56]

Ascending and descending bids were employed in different versions of the questionnaire. The WTP starting point was ten (public faucet) and twenty (individual connection) pesos for the ascending bids (versions A and B) and fifty-five (public faucet) and seventy (individual connection) pesos for descending bids (versions C and D). The difference in starting bids allows testing for starting point bias in regression analysis. Format bias is not a concern as WTP values were secured solely by the bidding game.

Sponsor bias was not an issue as there was no sponsor guaranteeing the implementation of a water system, and testing for interviewer bias was precluded as the relevant data were not collected. Within sampling bias, population choice bias is not problematic as the surveyed households represent a cross-section from rural barangays and are the ones which would accrue the benefits and costs if a water system was installed. Although random sampling within each barangay did not occur, efforts were made to obtain a representative sample. Except for Banaga, nonresponse bias was not a problem, and any selection bias can be tested and corrected by employing a Heckman model.[57]

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[56]See section B for the definition of JOINPF(IC).

[57]Forty households in Banaga's original sample were not interviewed. The reasons were:

1. acceptable respondents were not present at the interview time;
2. field workers feared the presence of area dogs;
3. respondents refused to be interviewed.

RWSA Questionnaire. Data on fifty-two operating water systems were collected with the RWSA questionnaire (see Appendix C).[58] The data include information on membership, rate structure, operations, financing and technical system characteristics. Information was obtained from RWSA officials and records. Except for eight to ten barangays selected from each of the provinces of Bulacan, Batangas, Pangasinan, and Cebu in an effort to minimize costs, the selection criteria for surveyed RWSAs were the same as those used for choosing served villages for the household questionnaire. The remaining RWSAs were chosen from surrounding provinces.

Characteristics of Surveyed Households and Barangays

A rich data set was generated on households in the six barangays where the household questionnaire was administered. The purpose of this section is to present a descriptive evaluation which will serve as an introduction to the WTJ and WTP analysis in the following sections.

Of the six barangays surveyed, four are located in Luzon. Santol, considered a relatively well off barangay, is located approximately 40 kilometers from Manila in the province of Bulacan. Despite its proximity to the capital, it is somewhat difficult to access. Banaga, located in Pangasinan, is 193 kilometers north of Manila. It is considered relatively poor but has good access to provincial cities and roads. Coral Na Munti, located in Batangas, is 135 kilometers south of Manila and is considered remote and poor. San Juan, a served barangay, is located in Bulacan 35 kilometers from Manila. Incomes

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Instead of follow-up work, the sample number was met by interviewing forty other households.

[58]A barangay data form designed to augment the socioeconomic data available from the RWSA questionnaire was contemplated but never implemented.

are quite high in this barangay and it has good access to towns and transportation facilities.

Two barangays included in the study are located in the Visayas on the island of Cebu. Pakigne does not have an RWSA. It is located approximately 12 kilometers from Cebu City which is 625 kilometers south of Manila and is considered poor but not isolated. Tangil-Tapon is 72 kilometers southwest of Cebu City. This served barangay is also considered poor. It is somewhat more remote than Banaga and considerably more remote than is San Juan vis a vis Manila.

Population Characteristics. Table 2 presents data on general population characteristics of the six barangays. They range in population size from 1,244 to 4,429, according to census data. The number of households present was often disputed by local officials, though the number given is the official census figure from which is calculated the population per household given in line three of Part A. This figure can be compared with the population per household computed from survey statistics in Part B. The later figure is highly consistent across the sampled barangays, providing some credence to the claims that census data are unreliable. Two other population statistics based on survey data are presented in Table 2. These show two rather striking consistencies with regard to the sex and age of the surveyed respondents: they were predominantly female (percentage female ranged from 62.5% to 80.0%) and their age was tightly clustered (average age between 39.0 and 42.8).

Socioeconomic Characteristics. A wide range of socioeconomic characteristics derived from the survey are presented in Table 3. Line 1 of Part A correlates well with other parameters of economic well-being. Looking at

TABLE 2

SELECTED POPULATION CHARACTERISTICS
OF UNSERVED AND SERVED VILLAGES

Variable	Unserved Villages				Served Villages	
	Banaga	Coral Na Munti	Pakigne	Santol	San Juan	Tangil-Tapon
A. Census Data						
Total Population	1,244	1,598	4,270	3,634	4,429	2,744
Number of Households	262	276	400	635	630	463
Population/Household	4.7	5.8	10.7	5.7	7.0	5.9
B. Sample Data (n = 200)						
Population/Household	5.4	5.4	5.7	5.7	5.8	5.6
Sex of Respondent (Percent Female)	65.0	62.5	80.0	72.0	76.5	75.5
Age of Respondent (mean)	40.5	42.7	41.4	39.0	42.2	42.8

TABLE 3

SELECTED SOCIOECONOMIC CHARACTERISTICS
OF UNSERVED AND SERVED VILLAGES

Variable	Unserved Villages				Served Villages	
	Banaga	Coral Na Munti	Pakigne	Santol	San Juan	Tangil-Tapon
A. Income						
Annual Average Household Income (Pesos)	18,452	14,335	16,770	34,616	37,148	16,311
Percent Receiving Foreign Income	6.0	7.5	7.0	9.5	14.0	4.0
Nonfarm Employment Opportunities	Limited	Yes	Yes	Yes	Yes	Limited
B. Housing						
Housing Type (Scale = 1 - 10, mode)	4	3	3	5	6, 8	3
Percent Own House	89.0	98.5	81.0	83.0	79.5	88.0
Percent with Electricity	73.0	79.0	61.5	99.5	98.0	60.5
Percent with Bathroom	37.0	59.5	3.5	33.0	49.5	15.0
Percent without Toilet Facilities	22.5	35.0	42.5	7.5	9.5	38.0
C. Education and Infrastructure						
Education of Respondent (Years)	7.4	5.6	5.6	7.2	8.1	6.7
Elementary School Present	Yes	Yes	No	Yes	Yes	Yes
High School Present	No	Yes	No	No	Yes	No
Village Market Present	No	No	Yes	No	Yes	No

the data, it can be seen that the two barangays in Bulacan (Santol and San Juan), near Manila, have average incomes approximately twice those of the other four villages. On the other hand, Tangil-Tapon, which has an RWSA, has an income level on a par with the more remote, unserved barangays. Likewise, a higher percentage of households in the two Bulacan barangays receive income from nonlocal sources. All the barangays have developed some form of nonfarm employment opportunities (e.g., embroidery, furniture making, woodworking), although these are quite limited in Banaga and Tangil-Tapon.

The housing data reported in Part B correlate well with the reported levels of average income. Using the ten-point housing quality index commonly employed in the Philippines (see Table 4 for descriptions), the modal house is type 3 in the three poorest barangays, corresponding to a single-story, native structure made of bamboo or sawali. Banaga, the barangay with the third highest income level, has type 4 as its modal type. This is a multi-room native structure. Santol, the second richest barangay, has level 5, which is a simple non-native material structure. In San Juan, the modal house is either a level 6, simple non-native material multi-story structure, or level 8, elaborate medium-sized home. While home ownership seems common in all barangays, the percentage with electric service again correlates closely with reported income. The last two lines in Part B pertain to sanitary facilities. These data relate to barangay water use characteristics as well as to socioeconomic status. The figures on percentage of households with bathrooms do not seem consistent with income levels (e.g., Coral Na Munti).

TABLE 4

TEN-POINT HOUSING QUALITY INDEX

Index Number	Description
1	squatter type; roof and walls of salvaged materials; no flooring
2	semi-squatter; improved or semi-permanent roof and walls; no flooring
3	native structure; bamboo or sawali walls; raised floor; one room
4	same as (3) but multi-room
5	non-native materials; wood walls; multi-room or unfinished hollow block; single story
6	multi-story, non-architectural; usually concrete lower floors and walls; wooden upper story walls
7	small, less than 30 square meters; decorated or architecturally treated; either wood or concrete
8	medium, 30 - 60 square meters; same as item (7)
9	large, 60 - 100 square meters; same as item (7)
10	very large, over 100 square meters; same as item (7) or any commercial structure; sari-sari stores in residences are not considered commercial

However, the data for percentage of houses without toilet facilities, perhaps a better indicator of public health and hygiene, show the more familiar pattern.

The final part of Table 3 contains information on education and infrastructure. The number of years of formal education of the respondent is greatest in the three wealthiest barangays, with the highest being 8.1 years in San Juan. Other data sources (Barangay Health Station, Barangay Captain) corroborate these levels of education in the unserved villages, excepting Banaga. Specifically, Table 5 gives the number of professional or skilled residents in each village.[59] Note that Santol, the wealthiest unserved village, has the greatest number of skilled residents at seventy-seven. All barangays except Pakigne have at least one elementary school. Only San Juan and Coral Na Munti have a high school. A village market, a measure of local infrastructure development, is present in San Juan and Pakigne. In general, the data presented in Table 3 suggest that residents in San Juan and Santol are relatively well off. Banaga is less well off but better off than the remaining three barangays.

Water Consumption Characteristics. The first three lines of Part A of Table 6 provide water source information. Specifically the most common source used is given in the first line and the respondents' most frequent evaluation of that in the second line. Three barangays, Banaga, Coral Na Munti and Pakigne have the poorest water quality situation. Residents in two of these barangays, Banaga and Coral Na Munti, appear to use multiple sources because of poor quality at the principal source (see line 3). The

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[59]Data on professional and skilled residents for the served barangays were not available.

TABLE 5

PROFESSIONAL AND SKILLED RESIDENTS
OF UNSERVED VILLAGES

	Banaga	Coral Na Munti	Pakigne	Santol
Accounting (certified public accountant, clerk, bookkeeper)	6	7	5	0
Agriculturalist	0	0	0	4
Architect	0	0	0	2
B.S. Psychology Graduate	0	0	0	1
Commerce Graduate	0	0	0	13
Computer Programmer	0	0	0	1
Electrician	3	8	5	0
Engineer	4	8	10	15
Lawyer	0	1	2	0
Mechanic	2	1	7	0
Medical (dentist doctor, nurse, pharmacist, technologist)	1	4	6	19
Plumber	3	0	1	0
Social Work	0	0	0	2
Tailor/Dressmaker	0	0	0	10
Teacher	6	22	8	0
Totals	25	51	44	77

TABLE 6

SELECTED WATER CONSUMPTION CHARACTERISTICS
OF UNSERVED AND SERVED VILLAGES

Variable	Unserved Villages				Served Villages	
	Banaga	Coral Na Munti	Pakigne	Santol	San Juan	Tangil-Tapon
A. Type and Quality						
Source	Own Well	Public Well	Public Well	Own Well	Own Connection	Public Connection
Water Quality (Principal Source)	Fair	Bad	Bad	Good	*	Good
Percent of Households Using Single Source	24.0	0.0	42.5	59.5	45.0	28.5
Average Distance to Principal Source (m)	42.0	69.0	400.0	19.4	5.4	77.6
Number of Trips/Week by Primary Water Carrier	21	14	14	21	21	28
Percent Willing to Travel Farther for Better Water	73.4	39.5	6.0	34.5	12.5	25.5
B. Willing to Participate in RWSA						
Percent Willing to Join Public Faucet	87.5	93.5	73.5	84.0	*	38.5
Percent Willing to Join Individual Connection	89.0	76.5	65.5	92.5	*	32.0
Percent Not Familiar with RWSA in Other Villages	81.0	42.5	29.0	49.5	*	*
Percent Served by RWSA	*	*	*	*	80.0	47.0
Percent Served with Level III Service	*	*	*	*	100.0	8.6

*Not Applicable

average distance to the principal source (line 4) correlates inversely with number of trips (line 5), as would be expected. At first glance the data for Tangil-Tapon may seem inconsistent. Although it is a served village, much of the data are similar to those for unserved villages. The explanation is best given by observation of the last two lines of Table 6. Only 47.0 percent of the households in Tangil-Tapon are served by its RWSA. Also, of those served only 8.6 percent have Level III service. Thus, this barangay represents a mixed situation with a larger number of households having to rely on traditional water sources. In effect, San Juan in Bulacan is the only truly "served" community in the sample, with 80.0 percent of its households served and 100 percent of these with Level III service.

The percentage of households willing to join an RWSA to obtain improved water service is shown in Part B. In the wealthier barangays, the preference is slightly higher for household connections. The poorer communities, perhaps more cost conscious, show a slight preference for public faucets. A surprisingly large number of households indicated that they lacked familiarity with RWSA type service in other barangays. In particular, the potential for hypothetical bias in the analysis would appear to be most likely in Banaga.

B. Empirical Models

Chapter III outlined the theoretical model of the interdependent discrete - continuous choices. With the use of random utility analysis we modeled the household's choices in equations (13) and (16). These specify that both the WTJ and WTP decisions are explained by water source characteristics (p_j and

z_j) and household characteristics (y and s). The model would exclude price and quality for alternative sources because it assumes no substitution across sources once a decision for improved water has been made. However, households frequently make such substitutions so we included price and quality characteristics for the traditional source in the econometric analysis.[60] The no substitution model drawn from the theoretical framework is estimated also. Price and quality for the improved water source are not included because no separate value can be estimated for individual consumers. Price is unique to the improved water system in place, and since this does not exist, no price is available.[61] Similarly, an evaluation of the improved source's quality is dependent on the household having used it. The only difference between variables used in the WTJ and WTP models are the dependent variables and the exclusive use of Heckman-correction variable (λ) and the bias control variables used in the WTP model that allows for substitution. The following variables are used in the analysis.

1. Dependent Variables

JOINPF: 0 = household does not join,
1 = household does join the RWSA for access to a public faucet.

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[60]Line 3 ("Percent of Households Using Single Source") of Table 6 shows that many households use multiple sources and they can shift between these. For example, in the served barangays of San Juan and Tangil-Tapon only 45.0 percent and 28.5 percent of the households, respectively, use one water source. However, one can argue that for a particular use only one source is chosen (Mu et al. 1990).

[61]The two served villages do have price structures. However, data is not available.

JOINIC: 0 = household does not join,
1 = household does join the RWSA for access to an individual connection.[62]

WTPPF: respondent's WTP bid for access to a public faucet when given the opportunity to rethink the bid stated in response to the bidding game.[63]

WTPIC: respondent's WTP bid for access to an individual connection when given the opportunity to rethink the bid stated in response to the bidding game.

2. Independent Variables

a. Village Dummy Variables

DUMBAN: 1 if the observation is from Banaga and 0 otherwise.
DUMPAK: 1 if the observation is from Pakigne and 0 otherwise.
DUMST: 1 if the observation is from Santol and 0 otherwise.

b. Respondent Characteristics

SEX: 0 = male,
1 = female.
AGE: age of the respondent.
POSITION: 0 = adult other than husband/wife,
1 = husband/wife.[64]

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[62]Following the WTP questions respondents were asked, "Would you be willing to join [a barangay water association] in order to have a public faucet [(individual connection)] near [(next to or in)] your house for a one-time membership fee of P10?" For those having stated positive WTP values the logical answer is "yes." However, the respondents with WTP bids equal to zero were now afforded the opportunity to "free-ride" (see Table 1). Therefore, a WTJ based on effective demand was imputed to the households.

[63]See Whittington et al. (1989) for a discussion of allowing respondents time to evaluate their bids.

[64]The original variable (PORES) was defined as 1 = husband, 2 = wife and 3 = other adult earning member. However, this definition presented multicollinearity problems with SEX. Therefore it was redefined as POSITION.

c. Household Characteristics

YRSCHO: total years of formal schooling.[65]

FAMILIAR: 0 = respondent is not familiar with improved water systems in other barangays,
1 = respondent is familiar with improved water systems in other barangays.[66]

MEMHH: number of people living in respondent's house.[67]

HOME: a description of the respondent's house based on a ten-point quality index commonly used in the Philippines (see Table 4).

TUTILITY: total monthly pesos spent on lighting and cooking.[68]

d. Major Water Source Characteristics

QUALS1: respondent's overall opinion of household's first major water source: 0 = good, 1 = fair or bad.[69]

WALKTIME: the minutes needed to walk to the household's first major water source and back.[70]

e. Bias Control Variables

DUMBID: 0 = descending bidding game,
1 = ascending bidding game.

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[65]This represents the years corresponding to the respondent. We use this as a proxy for the head of household and therefore employ YRSCHO as a household characteristic.

[66]Although this characteristic pertains to the respondent, it is assumed that the other household members possess the same information. Therefore, the variable is listed as a household characteristic.

[67]This is a proxy for the quantity of water consumed by the household.

[68]This is a proxy for income and performed much better in the equations than respondents' reported income.

[69]The original variable was defined as 1 = bad, 2 = fair and 3 = good. The variable was restated as a binary variable as only 6.7 percent of the observations reported a "bad" rating.

[70]This is a proxy for price of water. The price should reflect both cash payment and the opportunity cost of time. No cash price is levied at the household's traditional water source. A more precise variable which attempted to measure the opportunity cost was defined as OPPCOST = [(wage/hour)(hours of walking time/week)]/(liters/week). The values pertained to the primary water carrier and yearly income was used as a proxy for hourly wage. It did not perform well in the regression analysis.

DUMSTRAT: 0 = version A or C, the opening paragraph informed the respondent that "[t]he amount you say will not determine how much you actually pay. . . . [This] would of course be decided on by the local water association." 1 = version B or D, where the opening statement did not contain this information.

f. Heckman Correction Variable

LAMBDA (λ): the inverse of Mill's ratio calculated from the WTJ probit equation.

Empirical models, corresponding to equation (13) and (16), are listed in equations (21) and (22). Note that there are four models: WTJ for (1) a public faucet and (2) a private connection and WTP for (3) a public faucet and (4) a private connection.

(21) JOINPF, JOINIC = (INTERCEPT, DUMBAN, DUMPAK, DUMST, SEX, AGE, POSITION, YRSCHO, FAMILIAR, MEMHH, HOME, TUTILITY, QUALS1, WALKTIME).

(22) WTPPF, WTPIC = (INTERCEPT, DUMBAN, DUMPAK, DUMST, SEX, AGE, POSITION, YRSCHO, FAMILIAR, MEMHH, HOME, TUTILITY, QUALS1, WALKTIME, DUMBID, DUMSTRAT, LAMBDA).

SEX, AGE and POSITION are all characteristics of the respondent and are used to control for differences unique to the respondent. Economic theory provides little guidance on the relationship between these variables and WTJ or WTP, but some expected effects can be deduced. We might expect a positive sign for SEX if adult women are the primary water carriers. Yet a negative sign may be appropriate if females are more tentative bidders than males. AGE may have a positive sign signifying that as age increases the task of water carrying becomes more onerous. But AGE also may reflect the hypothesis that patterns of behavior are not easily changed (status quo is

preferred). In this case a negative sign is hypothesized. We expect POSITION to have a positive sign if we assume that the husband or wife of the household is the primary decision-maker. But a negative sign may occur if the adult other than husband/wife gives a relatively high bid because he/she does not incur the costs of participating in the RWSA.

The household characteristics YRSCHO, FAMILIAR, MEMHH, HOME and TUTILITY are somewhat easier to sign. YRSCHO would have a positive sign if it reflected knowledge of potential health benefits or potential income generating power. FAMILIAR is more complex. Assuming that the enumerator's description of the improved water source precludes the possibility of a household not understanding the good to be valued, it may reflect the perception of existing RWSAs. Specifically, if households are familiar with well-run systems, a positive sign is hypothesized. However, familiarity with poorly run systems may result in a negative sign. We hypothesize a positive sign for MEMHH, reflecting the influence of larger water consumption. A positive sign is anticipated for the quality of the respondent's home (HOME) as greater wealth leads to higher WTJ and WTP. Income (TUTILITY) is expected to have a positive effect on WTJ and WTP.

The two water source characteristics are hypothesized to have positive signs. WTJ and WTP are expected to be greater when the current major water source's quality (QUALS1) is determined to be fair or bad. It is expected that as the price of this same source (WALKTIME) increases, so would WTJ and WTP.

The statistics generated from the regressions provide insights into the decision regarding the choice for an improved water source. Both the individual barangay and the pooled regressions are given. No counterpart to

the Chow test (Chow 1960) exists for limited dependent variable regression analysis. However, the Chow test, based on ordinary least squares (OLS), was performed for the four unserved barangays using the null hypothesis of equal coefficients for the socioeconomic variables at the 5 percent level of significance. By this test pooling is generally supported. Specifically, the null hypothesis was not rejected for the public faucet and individual connection WTP equations and the public faucet WTJ equation. This would indicate that the sampled unserved households from Banaga, Coral Na Munti, Pakigne, and Santol come from the same underlying population. The null hypothesis was rejected for the individual connection WTJ equation. We will focus on the pooled regression results as these yield more insights, in terms of statistically significant variables, than those of the individual villages. This is due to the increased number of observations and greater diversity of values for the variables used.

C. Willingness to Join an RWSA for an Improved Water Source

The results of the first stage (probit) WTJ equations of the Heckman model for public faucets and individual connections are reported in Tables 7 and 8, respectively. In the public faucet equation a number of variables are found to have a statistically significant effect on the probability of joining.[71] The intercept indicates a strong WTJ independent of respondent, household and water source characteristics. Each of the village dummy variables decreases the probability of joining relative to the omitted village, Coral Na

[71]Unless indicated otherwise, the variables mentioned are equal to or better than the 10 percent level of statistical significance.

TABLE 7

WILLINGNESS TO JOIN FOR A PUBLIC FAUCET[a]

Econometric Technique: Probit					
Data Set:	Pooled	Banaga	Coral Na Munti	Pakigne	Santol
Number of Observations:	757	198	172	192	195
Mean Value of WTJ:	0.844	0.909	0.977	0.818	0.841
Variables					
Intercept & Village Dummies					
INTERCEPT	2.72***	1.89*	5.18	0.76	4.44***
	(5.12)	(1.73)	(1.18)	(0.98)	(3.74)
DUMBAN	-0.48				
	(-1.55)				
DUMPAK	-0.81***				
	(-2.84)				
DUMST	-0.78***				
	(-2.64)				
Respondent Characteristics					
SEX	-0.01	-0.43	1.36	0.35	-0.50
	(-0.07)	(-1.18)	(1.39)	(1.28)	(-1.58)
AGE	-0.02***	-0.03**	-0.01	-0.008	-0.02**
	(-2.96)	(-2.07)	(-0.31)	(-0.93)	(-2.09)
POSITION	0.16	0.08	0.36	0.37	-0.99
	(0.66)	(0.15)	(0.13)	(0.84)	(-1.49)
Household Characteristics					
YRSCHO	-0.03	0.03	-0.10	-0.008	-0.11**
	(-1.44)	(0.56)	(-0.62)	(-0.19)	(-2.29)
FAMILIAR	0.30*	0.81	0.87	0.44*	0.36
	(1.94)	(1.27)	(0.89)	(1.66)	(1.36)
MEMHH	-0.03	0.02	-0.53**	-0.03	0.02
	(-1.12)	(0.24)	(-2.10)	(-0.66)	(0.45)
HOME	-0.08*	-0.08	0.005	-0.04	-0.21**
	(-1.90)	(-0.62)	(0.02)	(-0.57)	(-2.27)
TUTILITY	0.0006	0.002	-0.006	-0.0003	0.001
	(0.822)	(0.627)	(-1.08)	(-0.18)	(1.29)

TABLE 7
(Continued)

Data Set:	Pooled	Banaga	Coral Na Munti	Pakigne	Santol
Water Source Characteristics					
QUALS1	0.79***	0.95***	5.45	0.38	0.96***
	(4.71)	(2.71)	(0.04)	(1.12)	(3.12)
WALKTIME	0.02	0.43*	0.01	0.05	0.03
	(1.38)	(1.93)	(0.79)	(1.43)	(0.38)
Likelihood Ratio Index[b]	0.158	0.332	0.534	0.076	0.177

[a]t-values are in parentheses.

[b] LRI = 1 - [$L(\hat{\Omega}/L(\hat{\omega})$] where $L(\hat{\Omega})$ is the maximum value of the log-likelihood function and $L(\hat{\omega})$ is the maximum value of this function under the condition that $\beta = 0$. LRI is a measure of the goodness of fit.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

TABLE 8

WILLINGNESS TO JOIN FOR AN INDIVIDUAL CONNECTION[a]

Econometric Technique: Probit					
Data Set:	Pooled	Banaga	Coral Na Munti	Pakigne	Santol
Number of Observations:	757	197	171	193	196
Mean Value of WTJ:	0.882	0.949	0.901	0.720	0.959
Variables					
Intercept & Village Dummies					
INTERCEPT	1.34***	5.70	2.86	-0.93	7.46
	(2.69)	(0.04)	(0.04)	(-0.13)	(0.08)
DUMBAN	0.15				
	(0.60)				
DUMPAK	-0.84***				
	(-4.17)				
DUMST	0.03				
	(0.11)				
Respondent Characteristics					
SEX	0.05	-0.19	-0.41	0.07	0.40
	(0.35)	(-0.17)	(-1.01)	(0.28)	(0.86)
AGE	-0.01*	-0.02	-0.01	-0.01	-0.02
	(-1.72)	(-0.98)	(-0.76)	(-1.00)	(-1.01)
POSITION	-0.13	-4.84	-3.92	0.60	-4.28
	(0.48)	(-0.04)	(-0.06)	(1.46)	(-0.05)
Household Characteristics					
YRSCHO	0.004	0.05	0.08	0.04	-0.15*
	(0.18)	(0.72)	(1.20)	(1.09)	(-1.80)
FAMILIAR	0.20	3.96	0.68*	-0.17	1.04**
	(1.36)	(0.03)	(1.93)	(-0.72)	(2.16)
MEMHH	-0.01	0.08	0.03	-0.40	-0.13
	(-0.36)	(0.90)	(0.35)	(-0.87)	(-1.39)
HOME	0.09*	-0.02	0.79***	0.07	-0.02
	(1.80)	(-0.16)	(3.18)	(0.85)	(-0.13)
TUTILITY	0.004**	0.002	-0.008	0.007**	0.004
	(2.02)	(0.486)	(-1.03)	(2.15)	(1.13)

TABLE 8
(Continued)

Data Set:	Pooled	Banaga	Coral Na Munti	Pakigne	Santol
Water Source Characteristics					
QUALS1	0.15	0.75*	-0.92***	0.33	0.62
	(0.99)	(1.82)	(-2.55)	(1.11)	(1.18)
WALKTIME	-0.004	0.31	-0.003	-0.03**	0.40
	(-1.12)	(1.40)	(-0.86)	(-2.33)	(1.38)
Likelihood Ratio Index[b]	0.163	0.285	0.306	0.122	0.316

[a] t-values are in parentheses.

[b] LRI = 1 - [$L(\hat{\Omega}/L(\hat{\omega})$] where $L(\hat{\Omega})$ is the maximum value of the log-likelihood function and $L(\hat{\omega})$ is the maximum value of this function under the condition that $\beta = 0$. LRI is a measure of the goodness of fit.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

Munti.[72] Recall that Coral Na Munti is a poor and remote barangay with bad water quality at existing sources.[73]

Respondent characteristics indicate that AGE negatively affects WTJ. This may show that older respondents are more comfortable with the status quo. The other respondent characteristics (SEX and POSITION) were statistically insignificant. Among the household characteristics, households familiar (FAMILIAR) with an improved water system have a greater WTJ. This may evidence that among the sampled households existing RWSA's have a good reputation, and that an educational program may be effective at generating interest in a Level II water source. The negative sign for HOME suggests that as the quality of the respondent's house increases, WTJ decreases. This result is unexpected, but may indicate that a public faucet is considered an inferior improved water source.[74] Of interest is the fact that neither income (TUTILITY) nor current price (WALKTIME) is significant although both do have the expected positive signs. This latter result may reflect the respondent's conclusion that there is not a significant difference between walking time to the current source and a nearby public faucet. The household's perception of water quality from its existing major source (QUALS1) has the expected positive relationship and is highly significant. Thus if the household perception of its current major water source is fair or bad, we find a higher probability of joining for improved water quality.

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[72]DUMBAN is significant at the 15 percent level but not at the 10 percent level.

[73]See Table 6.

[74]The positive sign for HOME in the individual connection equation (Table 8) lends support to this hypothesis.

Looking at the village equations we see that no statistically significant variable in the pooled regression consistently is significant in the village models. For example, AGE is significant for Banaga and Santol but not for Coral Na Munti and Pakigne. A similar pattern is found for QUALS1. We argue that pooling gives a better analysis for the reasons stated in section B.

Findings for WTJ for individual connections are in Table 8. Once again, the intercept indicates a strong WTJ independent of other respondent, household and water source characteristics. The village dummy variables indicated that Pakigne (DUMPAK) decreases the probability of joining relative to the other villages. Since the perception of the major traditional water source is bad this is puzzling. However, Pakigne is a poorer barangay and the village dummy variable may be indicating the presence of the difficulty of paying the one-time fee of P1000.

As with the public faucet equation, the respondent's age (AGE) negatively affects the probability of joining. Household characteristics indicate that wealth (HOME) and income (TUTILITY) positively affect WTJ. This evidences that wealth and income are important in desiring the convenience associated with the household connection. Note that of the village equations only Banaga has HOME significant while TUTILITY is significant for Pakigne. If wealth and income are important to the joining decision, one would expect these variables to be significant for Santol. But this is not found. Again, the argument is made that with a larger number of observations and the greater diversity of values in the pooled data set, a better understanding of the influence of wealth and income is found in the pooled regressions. Neither water source characteristic is statistically significant.

When comparing the decisions to join for a public faucet and for an individual connection we see a major distinction. Specifically, households join for a public faucet for improved water quality. This is evidenced by the village dummy variables and the household's perception of its existing major water source. The importance of wealth and income for the decision to join for an individual connection tells us that convenience is the motivating factor. It is also interesting to note that the respondent's age negatively influences the WTJ in both cases, indicating that older respondents may prefer the status quo.

No statistically significant variable in either the public faucet or individual connection equation has a corresponding point elasticity greater than one.[75] Several elasticities of interest for public faucets are AGE (-0.13) and HOME (-0.06) and for individual connections are AGE (-0.09), HOME (0.07) and TUTILITY (0.04).

Pooled WTJ logit and ordinary least squares (OLS) results are reported in Table 9.[76] These results generated from different econometric methods can be compared with a probit model (Tables 7 and 8) with respect to (1) goodness

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[75]These point elasticities are calculated by use of the mean value for each relevant variable. See Appendix D, Table D-1.

[76] The linear probability (OLS) technique suffers from heteroskedasticity. Specifically, $E(\varepsilon_i^2) = E(Y_i)[1 - E(Y_i)]$ so that the necessary weight is given by $w_i = [\hat{Y}_i(1 - \hat{Y}_i)]^{1/2}$ (Kmenta 1986). The problem with this weight is that $[\hat{Y}_i(1 - \hat{Y}_i)]$ may be less than or equal to zero. For these cases the observation can not be used in the regression analysis. In an effort to keep all possible observations, OLS is used here. The weighted least squares results are reported in Appendix D, Table D-2.

TABLE 9

WILLINGNESS TO JOIN FOR AN IMPROVED WATER SOURCE[a]

	Public Faucet		Individual Connection	
Econometric Technique:	Logit	OLS	Logit	OLS
Data Set: Pooled				
Number of Observations:	757	757	757	757
Mean Value of WTJ:	0.884	0.884	0.882	0.882
Variables				
Intercept & Village Dummies				
INTERCEPT	4.87***	1.14***	2.11**	0.88***
	(4.79)	(14.33)	(2.25)	(11.15)
DUMBAN	-1.00	-0.06*	0.30	0.01
	(-1.56)	(-1.64)	(0.61)	(0.35)
DUMPAK	-1.59***	-0.13***	-1.55***	-0.20***
	(-2.65)	(-3.42)	(-4.06)	(-5.33)
DUMST	-1.56***	-0.12***	0.05	-0.01
	(-2.54)	(-3.07)	(0.09)	(-0.32)
Respondent Characteristcs				
SEX	-0.05	-0.01	0.09	0.12
	(-0.16)	(-0.34)	(0.30)	(0.48)
AGE	-0.03***	-0.003***	-0.02*	-0.002*
	(-3.07)	(-3.32)	(-1.69)	(-1.73)
POSITION	0.37	0.03	-0.11	-0.006
	(0.87)	(0.78)	(-0.22)	(-0.12)
Household Characteristics				
YRSCHO	-0.06	-0.008**	0.02	0.002
	(-1.57)	(-1.97)	(0.45)	(0.60)
FAMILIAR	0.51*	0.04*	0.34	0.02
	(1.82)	(1.65)	(1.20)	(1.29)
MEMHH	-0.05	-0.005	-0.03	-0.001
	(-1.09)	(-1.06)	(-0.61)	(-0.03)
HOME	-0.14*	-0.01*	0.19*	0.02**
	(-1.69)	(-1.73)	(1.93)	(2.25)
TUTILITY	0.001	0.0001	0.009**	0.0002
	(0.92)	(0.77)	(2.15)	(1.15)

TABLE 9
(Continued)

Econometric Technique:	Public Faucet Logit	Public Faucet OLS	Individual Connection Logit	Individual Connection OLS
Water Source Characteristics				
QUALS1	1.50***	0.12***	0.21	0.02
	(4.40)	(4.81)	(0.72)	(0.72)
WALKTIME	0.04	0.0007	-0.008	-0.001
	(1.38)	(1.00)	(-1.18)	(-1.35)
Likelihood Ratio Index[b]	0.155	0.182	0.166	0.220

[a] t-values are in parentheses.

[b] LRI = 1 - [$L(\hat{\Omega}/L(\hat{\omega})$] where $L(\hat{\Omega})$ is the maximum value of the log-likelihood function and $L(\hat{\omega})$ is the maximum value of this function under the condition that $\beta = 0$. LRI is a measure of the goodness of fit.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

of fit, (2) levels of statistically significant variables, (3) magnitude of the coefficients, and (4) signs of the coefficients. For the public faucet equations the likelihood ratio index is virtually the same for the probit (0.158) and logit (0.155) probability models, while for the OLS model (0.182) it is slightly higher.[77] Statistically significant variables and their levels of significance are nearly the same except that DUMBAN and YRSCHO are significant in the OLS regression. For example, each of the public faucet equations shows that water quality (QUALS1) is statistically significant at the one percent level. Comparing the coefficients across the models requires that the corresponding coefficients be scaled appropriately.[78] Amemyia (1981) suggests the following scaling adjustment: (1) $\alpha_{OLS} \cong 0.4\alpha_P + 0.5 \cong 0.25\alpha_L + 0.5$ and (2) $\beta_{OLS} \cong 0.4\beta_P \cong 0.25\beta_L$.[79] The probit and logit "scale-adjusted" coefficients are reported in Appendix D (see Table D-3) and show that there is little difference between the three models. The probit and logit results, as expected, are very similar though the OLS coefficients are somewhat smaller. The variables' signs are the same in each regression.

The WTJ regression for individual connections reveals similar comparisons. The OLS goodness-of-fit measure is 0.220 compared with 0.163

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[77]The conventional R^2 goodness-of-fit measure is not appropriate for models with qualitative dependent variables. An acceptable measure is the likelihood ratio index (Maddala 1983, 1988). See Table 7 for the definition of the likelihood ratio index.

[78]The coefficient estimates are not directly comparable as the variances of the probit and logit models differ (Maddala 1988).

[79]The ordinary least squares model is subscripted by OLS, probit by P and logit by L.

for the probit and 0.166 for the logit model. Levels of significance are very nearly the same for statistically significant variables across all three regressions. The exception to this pattern of similarity is household income (TUTILITY). The probit and logit equations show TUTILITY significant at the five percent level while in the OLS model TUTILITY is not statistically significant. The scale-adjusted coefficients again indicate that the coefficients for the probit and logit regressions are highly similar, with the OLS coefficients being smaller (see Appendix D, Table D-3). Finally, the variables' signs are the same across each regression, except DUMST which is negative only in the linear probability model.

In general, the logit and OLS regression techniques (Table 9) provide statistics which are similar to the probit findings reported in the Tables 7 and 8. The probit or logit techniques are preferred to OLS for reasons specified in footnote 76. Following our assumption that the error term of the WTJ model is normally distributed, we focussed on the probit results.

D. Willingness to Pay for an Improved Water Source

The behavioral results of the WTP models are presented in Tables 10 and 11 for public faucets and 12 and 13 for individual connections.[80] Unless otherwise noted, the discussion focuses on the estimates reported in Tables 10 and 12, which are consistent with the ability to substitute across sources, and therefore include characteristics for the traditional water source as

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[80]An individual connection WTP bid of P300 was recorded for a household in Coral Na Munti. This represents a significant differential from the mean WTP. We were unable to ascertain if this was a data entry error or a valid bid. Nonetheless, the record was dropped from the village and pooled data sets.

TABLE 10

WILLINGNESS TO PAY FOR A PUBLIC FAUCET
SUBSTITUTIONS ACROSS SOURCES[a]

Econometric Technique: Heckman (second stage)					
Data Set:	Pooled	Banaga	Coral Na Munti[b]	Pakigne	Santol
Number of Observations:	669	180	172	157	164
Mean Value of WTP:	16.10	15.77	16.31	14.33	17.53
Variables					
Intercept & Village Dummies					
INTERCEPT	11.31***	10.47**	14.44**	14.66	15.95*
	(3.48)	(2.16)	(1.98)	(1.58)	(1.76)
DUMBAN	-0.18				
	(-0.11)				
DUMPAK	-0.27				
	(-0.13)				
DUMST	0.01				
	(0.006)				
Respondent Characteristics					
SEX	-0.88	0.98	-5.06**	-1.23	2.39
	(-0.92)	(0.59)	(-2.15)	(-0.34)	(1.01)
AGE	-0.03	-0.07	-0.02	0.05	-0.19*
	(-0.68)	(-1.04)	(-0.20)	(0.49)	(-1.68)
POSITION	-0.76	-0.81	-3.82	-4.44	3.55
	(-0.50)	(-0.35)	(-0.90)	(-1.01)	(1.06)
Household Characteristics					
YRSCHO	0.40***	0.19	0.40	0.93***	0.26
	(2.42)	(0.70)	(1.11)	(2.67)	(0.57)
FAMILIAR	0.83	2.45	-1.09	-2.13	2.89
	(0.79)	(1.17)	(-0.48)	(-0.57)	(1.53)
MEMHH	0.44**	0.69**	0.72	0.26	-0.73*
	(2.29)	(2.17)	(1.55)	(0.56)	(-1.90)
HOME	0.47	-0.03	0.48	1.02	0.29
	(1.35)	(-0.05)	(0.62)	(1.44)	(0.36)
TUTILITY	0.04***	0.03*	-0.004	0.04***	0.05***
	(6.94)	(1.89)	(-0.15)	(2.44)	(5.95)

TABLE 10
(Continued)

Data Set:	Pooled	Banaga	Coral Na Munti[b]	Pakigne	Santol
Water Source Characteristics					
QUALS1	-1.75	-0.17	2.65	-1.48	-0.50
	(-1.06)	(-0.08)	(0.99)	(-0.43)	(-0.15)
WALKTIME	0.06**	0.29	0.03	-0.09	-0.41
	(2.02)	(1.54)	(0.70)	(-0.38)	(-1.32)
CVM Bias Control					
DUMBID	-2.13**	-5.13***	3.60	-3.91**	-1.56
	(-2.40)	(-3.03)	(1.48)	(-2.01)	(-0.80)
DUMSTRAT	0.97	5.22***	-2.44	-2.14	1.39
	(1.14)	(3.46)	(-1.00)	(-1.18)	(0.84)
Heckman Correction[c]					
LAMBDA	-6.68	2.64		-18.68	-0.32
	(-0.91)	(0.41)		(-0.92)	(-0.03)
R-Squared	0.166	0.216	0.103	0.310	0.357
Adjusted R-Squared.	0.145	0.155	0.036	0.247	0.301

[a]t-values are in parentheses.

[b]OLS statistics are reported as less than ten percent of the bids were equal to zero.

[c]Two statistics in addition to the β and t-statistics are {1} the standard error corrected for selection and [2] the squared correlation between the disturbance in the second stage and the selection criterion known as rho-squared.

{1}	11.25	9.98		13.70	9.83
[2]	0.353	0.071		1.00	0.001

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

TABLE 11

WILLINGNESS TO PAY FOR A PUBLIC FAUCET
NO SUBSTITUTIONS ACROSS SOURCES[a]

Econometric Technique: Heckman (second stage)					
Data Set:	Pooled	Banaga	Coral Na Munti[b]	Pakigne	Santol
Number of Observations:	669	180	172	157	164
Mean Value of WTP:	16.10	15.77	16.31	14.33	17.53
Variables					
Intercept & Village Dummies					
INTERCEPT	13.54***	11.17**	15.28**	11.47**	15.48**
	(4.41)	(2.42)	(2.11)	(2.41)	(2.15)
DUMBAN	-2.47*				
	(-1.94)				
DUMPAK	-2.57				
	(-1.67)				
DUMST	-2.43*				
	(-1.67)				
Respondent Characteristics					
SEX	-0.98	1.29	-5.37**	0.001	2.22
	(-1.02)	(0.78)	(-2.29)	(0.001	(1..12)
AGE	-0.05	-0.07	-0.02	0.02	-0.19**
	(-1.27)	(-0.99)	(-0..17)	(0.39)	(-2.22)
POSITION	-0.55	-0.54	-3.64	-3.39	3.50
	(-0.37)	(-0.23)	(-0.86)	(-1.26)	(1.20)
Household Characteristics					
YRSCHO	0.33**	0.14	0.46	0.92**	0.21
	(2.18)	(0.53)	(1.28)	(3.65)	(0.61)
FAMILIAR	0.87	1.82	-1.30	-0.82	2.96*
	(0.90)	(0.89)	(-0.59)	(-0.45)	(1.71)
MEMHH	0.43**	0.70**	0.76*	0.15	-0.75**
	(2.29)	(2.19)	(1.65)	(0.51)	(-1.98)
HOME	0.33	-0.02	0.49	0.86*	0.24
	(1.05)	(-0.02)	(0.64)	(1.91)	(0.37)
TUTILITY	0.039***	0.024*	-0.001	0.040***	0.049***
	(7.04)	(1.76)	(-0.33)	(3.30)	(7.13)

TABLE 11
(Continued)

Data Set:	Pooled	Banaga	Coral Na Munti[b]	Pakigne	Santol
Water Source Characteristics					
QUALS1					
WALKTIME					
CVM Bias Control					
DUMBID	-1.65*	-4.98***	3.35	-4.01***	-2.18
	(-1.88)	(-3.31)	(1.61)	(-2.86)	(-1.17)
DUMSTRAT	0.64	5.31***	-1.99	-2.25*	1.34
	(0.75)	(3.51)	(-0.92)	(-1.71)	(0.82)
Heckman Correction[c]					
LAMBDA	-1.96	-0.10		-10.01	-2.02
	(-0.48)	(-0.02)		(-1.38)	(-0.36)
R-Squared	0.157	0.204	0.094	0.308	0.350
Adjusted R-Squared.	0.139	0.152	0.037	0.255	0.303

[a]t-values are in parentheses.

[b]OLS statistics are reported as less than ten percent of the bids were equal to zero.

[c]Two statistics in addition to the β and t-statistics are {1} the standard error corrected for selection and [2] the squared correlation between the disturbance in the second stage and the selection criterion known as rho-squared.

{1}	10.85	9.90		9.94	9.95
[2]	0.032	0.0001		1.00	1.00

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

TABLE 12

WILLINGNESS TO PAY FOR AN INDIVIDUAL CONNECTION
SUBSTITUTIONS ACROSS SOURCES[a]

Econometric Technique: Heckman (second stage)					
Data Set:	Pooled	Banaga[b]	Coral Na Munti	Pakigne	Santol[b]
Number of Observations:	668	197	154	139	196
Mean Value of WTP:	23.47	21.58	21.60	22.07	25.68
Variables					
Intercept & Village Dummies					
INTERCEPT	9.08*	8.40	-0.47	12.03	21.74**
	(1.92)	(1.21)	(-0.05)	(0.89)	(2.17)
DUMBAN	0.63				
	(0.31)				
DUMPAK	2.23				
	(0.59)				
DUMST	2.07				
	(1.07)				
Respondent Characteristics					
SEX	-1.11	-0.74	-3.15	0.17	1.91
	(-0.83)	(-0.32)	(-1.19)	(0.06)	(0.63)
AGE	-0.09	-0.07	0.04	0.04	-0.33***
	(-1.54)	(-0.81)	(0.37)	(0.36)	(-2.83)
POSITION	0.74	1.29	-3.41	-5.26	1.60
	(0.37)	(0.40)	(-0.72)	(-0.82)	(0.38)
Household Characteristics					
YRSCHO	0.80***	0.53	1.34***	1.37***	-0.005
	(3.96)	(1.36)	(3.26)	(2.73)	(-0.01)
FAMILIAR	1.02	7.45***	-0.89	1.32	0.82
	(0.71)	(2.59)	(-0.33)	(0.50)	(0.31)
MEMHH	0.58**	0.59	1.24**	0.49	-0.20
	(2.31)	(1.30)	(2.42)	(0.93)	(-0.35)
HOME	1.21**	1.13	1.27	0.67	1.79**
	(2.42)	(1.25)	(1.10)	(0.85)	(1.99)
TUTILITY	0.04***	0.03	0.08**	0.04	0.04***
	(4.43)	(1.49)	(2.17)	(1.50)	(3.94)

TABLE 12
(Continued)

Data Set:	Pooled	Banaga[b]	Coral Na Munti	Pakigne	Santol[b]
Water Source Characteristics					
QUALS1	1.05	2.00	3.03	-2.20	0.82
	(0.77)	(0.88)	(0.89)	(-0.61)	(0.28)
WALKTIME	0.11***	0.39	0.05	0.30	0.31
	(2.71)	(1.59)	(1.15)	(0.69)	(0.59)
CVM Bias Control					
DUMBID	-1.56	-5.59***	5.22*	-5.89***	0.74
	(-1.30)	(-2.59)	(1.91)	(-2.51)	(0.25)
DUMSTRAT	-0.38	1.40	-3.40	-1.03	-1.18
	(-0.32)	(0.65)	(1.21)	(-0.45)	(-0.44)
Heckman Correction[c]					
LAMBDA	-2.04		9.21	-2.13	
	(-0.18)		(0.95)	(-0.14)	
R-Squared	0.182	0.197	0.230	0.328	0.186
Adjusted R-Squared.	0.162	0.144	0.158	0.258	0.132

[a]t-values are in parenthesis.

[b]OLS statistics are reported as less than ten percent of the bids were equal to zero.

[c]Two statistics in addition to the β and t-statistics are [1] the standard error corrected for selection and [2] the squared correlation between the disturbance in the second stage and the selection criterion known as rho-squared.

[1]	14.94	14.53	12.62
[2]	0.019	0.402	0.028

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

TABLE 13

WILLINGNESS TO PAY FOR AN INDIVIDUAL CONNECTION
NO SUBSTITUTIONS ACROSS SOURCES[a]

Econometric Technique: Heckman (second stage)					
Data Set:	Pooled	Banaga[b]	Coral Na Munti	Pakigne	Santol[b]
Number of Observations:	668	197	154	139	196
Mean Value of WTP:	23.47	21.58	21.60	22.07	25.68
Variables					
Intercept & Village Dummies					
INTERCEPT	10.32**	2.29*	-2.23	5.14	22.94**
	(2.22)	(1.91)	(-0.25)	(2.34)	(2.17)
DUMBAN	-0.81				
	(-0.42)				
DUMPAK	-2.55				
	(-0.81)				
DUMST	0.16				
	(0.088)				
Respondent Characteristics					
SEX	-1.20	-0.83	-3.83	0.64	1.80
	(-0.89)	(-0.36)	(-1.46)	(0.23)	(0.60)
AGE	-0.11*	-0.09	0.050	0.0015	-0.34***
	(-1.92)	(-1.06)	(0.48)	(0.016)	(-2.90)
POSITION	0.52	1.83	-3.77	-2.39	1.41
	(0.26)	(0.57)	(-0.76)	(-0.47)	(0.32)
Household Characteristics					
YRSCHO	0.81***	0.44	1.46***	1.51***	-0.004
	(3.97)	(1.15)	(3.64)	(3.33)	(-0.001)
FAMILIAR	1.20	7.59***	-0.69	0.86	0.87
	(0.85)	(2.66)	(-0.26)	(0.34)	(0.33)
MEMHH	0.60**	0.59	1.33***	0.36	-0.21
	(2.37)	(1.21)	(2.57)	(0.72)	(-0.36)
HOME	1.36***	1.04	1.69	0.87	1.74*
	(2.78)	(1.15)	(1.54)	(1.16)	(1.95)
TUTILITY	0.038***	0.02	0.068*	0.055**	0.04***
	(4.68)	(1.25)	(1.89)	(2.43)	(3.90)

TABLE 13
(Continued)

Data Set:	Pooled	Banaga[b]	Coral Na Munti	Pakigne	Santol[b]
Water Source Characteristics					
QUALS1					
WALKTIME					
CVM Bias Control					
DUMBID	-0.81	-5.49***	5.91**	-5.83***	1.48
	(-0.68)	(-2.54)	(2.49)	(-2.60)	(0.54)
DUMSTRAT	-0.56	1.77	-3.67	-0.97	-0.89
	(-0.48)	(0.82)	(-1.47)	(-0.43)	(-0.35)
Heckman Correction[c]					
LAMBDA	6.82		15.74**	7.57	
	(0.68)		(2.06)	(0.89)	
R-Squared	0.171	0.182	0.219	0.325	0.183
Adjusted R-Squared.	0.154	0.138	0.159	0.267	0.139

[a]t-values are in parentheses.

[b]OLS statistics are reported as less than ten percent of the bids were equal to zero.

[c]Two statistics in addition to the β and t-statistics are [1] the standard error corrected for selection and [2] the squared correlation between the disturbance in the second stage and the selection criterion known as rho-squared.

[1]	15.38		15.57	13.50
[2]	0.197		1.00	0.314

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

independent variables.[81] A cursory analysis indicates some similarities in terms of the household and water source characteristics which are statistically significant between the public faucet and individual connection regressions. Furthermore, comparing the coefficients' values for these same variables reveals values of similar magnitude. In light of these congruencies the statistical results for the models are discussed simultaneously, the differences being noted explicitly.

The finding of large intercept terms indicates a strong WTP independent of respondent, household and water source characteristics. The intercept is particularly large for public faucets, evidencing that the other determinants are less important in the valuation decision. The intercept for a public faucet and individual connection represents 70 percent and 39 percent, respectively, of the mean WTP bids.

No respondent characteristic is statistically significant across the two models. However, we observe that SEX, AGE and POSITION have negative signs for the public faucet model. While SEX and AGE retain the negative sign for an individual connection, POSITION is positive. This provides some evidence that the husband/wife may be the primary decision maker.[82]

Household characteristics generally are significant determinants of WTP.

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[81]The results reported in Tables 11 and 13 do not include traditional water source characteristics as independent variables. In terms of the theoretical model presented in Chapter III these equations are more precise. Excepting the village dummy variables, one notes very little difference in the coefficients of common variables in the tables.

[82]Joining a Level III system costs P1000 (for pipes and meter), and that respondents likely realize this type of source is more highly valued by the household. Therefore, the adult respondent other than the husband/wife seems to be a more tentative bidder in such a decision.

First WTP rises with formal years of schooling (YRSCHO), which may reflect a response to higher earning potential but also may evidence greater understanding of the potential for health benefits. Larger households (MEMHH) have greater WTP, as expected, because the demand curve for water is shifted to the right. Higher household income (TUTILITY) increases WTP bids. The coefficients on income are the same in the public faucet and individual connection equations, but wealth (HOME) increases WTP for individual connections. The latter may substantiate the hypothesis that the demand for water from individual connections depends on the ability to pay for the installation charges. Remember that familiarity with existing water systems (FAMILIAR) influences WTJ for Level II, but not WTP for either improved water source. FAMILIAR is significant in the Banaga WTP individual connection equation. This may indicate the presence of hypothetical bias as 81.0 percent of the households were not familiar with existing water systems (see Table 6).

The time savings/convenience factor associated with improved water is important to WTP. WALKTIME is significant in both equations, and as may be expected, the coefficient is nearly twice as large for individual connections. Perception of existing water quality (QUALS1), which was significant for WTJ for public faucets does not statistically influence WTP. The elasticities for statistically significant variables are low in each equation, with values ranging between 0.03 and 0.24.[83]

DUMBID is included to identify bias arising from the bidding game, and DUMSTRAT is to identify strategic behavior. In the public faucet equation

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[83]These point elasticities are calculated by use of the mean value of each relevant variable. See Appendix D, Table D-1.

DUMBID indicates that respondents using the ascending game had WTP values which averaged a statistically significant P2.13 less than the pooled mean of P16.10. This translates into a decline of 13.2 percent from the mean value. No bidding bias was found for the individual connection model; however, the bias was found in several village level equations. It is interesting to note that bidding bias surfaced in Banaga and Pakigne for both the public faucet and individual connection models. Coral Na Munti reports the bias for individual connections and has the unexpected positive sign. The use of smaller increments may have offset these results or at least mitigated the size of the bias. Strategic behavior was not detected in either equation, but in the public faucet equation DUMSTRAT was significant for Banaga.[84]

The pooled regression relative to the village models again proves more consistent. For example, in the public faucet equation we find YRSCHO significant in Pakigne but none of the other barangays, though it does have the expected positive sign across the regressions. The insight gained by centering on the pooled results is that education is relevant to the WTP decision for the rural populations. If the survey were administered only in Banaga this would not be so. A similar argument can be made for HOME and TUTILITY in the individual connection equation.

Using the results in Tables 10, 12 and 14, we can compare the Heckman, tobit and OLS models, first for the public faucet, then for the individual connection. The Heckman and OLS adjusted R^2's are similar for the public

[84]It has the unexpected positive sign so that DUMSTRAT may be capturing other than strategic behavior.

TABLE 14

WILLINGNESS TO PAY FOR AN IMPROVED WATER SOURCE[a]

	Public Faucet		Individual Connection	
Econometric Technique:	Tobit	OLS	Tobit	OLS
Data Set: Pooled				
Number of Observations:	757	757	757	757
Mean Value of WTP:	14.22	14.22	20.71	20.71
Variables				
Intercept & Village Dummies				
INTERCEPT	16.25***	15.15***	8.02*	8.98**
	(4.86)	(5.01)	(1.79)	(2.21)
DUMBAN	-1.58	-1.18	0.81	0.71
	(-0.98)	(-0.81)	(0.37)	(0.35)
DUMPAK	-4.10***	-3.26**	-4.51**	-2.40
	(-2.69)	(-2.35)	(-2.15)	(-1.27)
DUMST	-3.17**	-2.37*	1.40	1.53
	(-2.01)	(-1.67)	(0.66)	(0.79)
Respondent Characteristics				
SEX	-0.71	-0.71	-0.62	-0.81
	(-0.67)	(-0.75)	(-0.43)	(-0.63)
AGE	-0.12***	-0.09***	-0.13**	-0.11**
	(-3.04)	(-2.61)	(-2.47)	(-2.27)
POSITION	0.17	-0.02	0.74	0.69
	(0.10)	(-0.01)	(0.34)	(0.35)
Household Characteristics				
YRSCHO	0.89	0.14	0.79***	0.74***
	(0.55)	(0.98)	(3.63)	(3.76)
FAMILIAR	2.16**	1.82**	2.07	1.73
	(2.11)	(1.96)	(1.48)	(1.37)
MEMHH	0.19	0.22	0.50*	0.48**
	(0.96)	(1.22)	(1.85)	(1.96)
HOME	-0.18	-0.10	1.55***	1.36***
	(-0.54)	(-0.32)	(3.48)	(3.36)
TUTILITY	0.04***	0.04**	0.04***	0.04***
	(6.18)	(6.62)	(5.29)	(5.56)

TABLE 14
(Continued)

Econometric Technique:	Public Faucet Tobit	Public Faucet OLS	Individual Connection Tobit	Individual Connection OLS
Water Source Characteristics				
QUALS1	2.14**	1.29	2.06	1.73
	(2.08)	(1.39)	(1.48)	(1.38)
WALKTIME	0.09***	0.08***	0.07*	0.08**
	(3.06)	(2.96)	(1.76)	(2.07)
CVM Bias Control				
DUMBID	-3.72***	-2.98***	-3.01**	-2.31**
	(-3.90)	(-3.47)	(-2.33)	(-1.98)
DUMSTRAT	2.35**	1.94**	-2.04	-1.48
	(2.49)	(2.27)	(-1.59)	(-1.38)
R-Squared[b]		0.143		0.207
Adjusted R-Squared		0.125		0.191

[a]t-values are in parenthess. Tobit analysis uses z-scores to test the significance of the coefficients. In large samples, z-scores are indistinguishable from corresponding t-values.

[b]Tobit models offer no goodness-of-fit measure since the constrained version of the model (including only a constant) cannot be estimated.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

faucet equations, 0.145 and 0.125 respectively.[85] A careful review of statistically significant variables shows a near perfect match between those for the tobit and the OLS equations,[86] but some notable differences exist between these models and the Heckman regression. Specifically, DUMPAK, DUMST, AGE, FAMILIAR and DUMSTRAT are all statistically significant only for the tobit and OLS equations, and YRSCHO and MEMHH are significant only in the Heckman model. Likewise there are some differences in the coefficient signs. These differences are not wholly unexpected yet the results are curious. The reason is that the Heckman WTP model can be used to estimate the tobit model. Thus, the WTP results between the two are expected to be quite similar. A potential source of this disparity may be the problem of multicollinearity stemming from the use of LAMBDA in the Heckman model. However, neither simple correlations nor dropping LAMBDA from the regression indicated the presence of a high degree of multicollinearity.[87] A comparison of the Heckman, tobit-adjusted[88] and OLS coefficients reveal that when a variable is statistically significant in any of the three models, it is generally the case that the tobit-adjusted coefficients exceed the OLS which has the similar relationship with the Heckman

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[85]As noted in Table 14, the tobit model offers no goodness-of-fit measure.

[86]The one exception is QUALS1 which is significant only for the tobit model.

[87]See Appendix D, Table D-4.

[88]Tobit "'beta'" coefficients are to be interpreted with caution. Specifically, the change in WTP associated with a change in an explanatory variable X_i is given by $\partial E(WTP)/\partial X_i = F(z)\beta_i$ where E(WTP) is the expected value of WTP inclusive of the limiting values, F(z) is the cumulative normal distribution function and β_i is the tobit "'beta'" for X_i (McDonald and Moffitt 1980, p. 318). See Appendix D, Table D-5.

coefficients. This translates into larger changes in WTP for a change in the relevant independent variables for the tobit and OLS model relative to the Heckman model. The correction variable, LAMBDA, is not statistically significant in the Heckman model, suggesting that OLS using the selected sample (WTJ = 1) may be an acceptable technique.[89] When the WTP equation is re-estimated in this manner the generated results are essentially the same as those of the Heckman model (see Appendix D, Table D-4).

As one might expect, similar comparative patterns to those for the public faucet regressions are found for the the private connection equations. The goodness-of-fit values for the Heckman and OLS models are 0.162 and 0.191, respectively. Again there are some differences in statistically significant variables across the three regressions, but the differences are more limited. For example, AGE and DUMBID are both significant only in the tobit and OLS regressions, and DUMPAK is significant only in the tobit regression. The signs across the models are the same, excepting the case where DUMPAK is positive in the Heckman model. There is no discernable pattern in the relative sizes of the coefficients for variables which are statistically significant in each model. The largest discrepancy is for WALKTIME where the Heckman coefficient (0.11) is 83.3 percent larger than the tobit-adjusted coefficient (0.06). The smallest difference is for TUTILITY where the coefficients are equal (0.04) The insignificant LAMBDA may indicate that censoring is not a serious problem. An OLS re-estimation using the selected data set produced results which are essentially the same as the Heckman results (see Appendix D, Table D-4).

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[89]See Heckman (1979) and Edwards and Anderson (1987) on this point.

The tobit and OLS statistics are similar, but the OLS technique fails to consider the censoring issue. Censored data sets require a tobit or Heckman model. Because the tobit model constrains the two behavioral decisions, potentially confounding the relevant explanatory variables and the corresponding magnitudes of the coefficients, we concentrated on the Heckman results.[90]

In conclusion, intuitively one can understand the interdependence of these two decisions. If a household joins the RWSA, it will have a positive WTP, and if it does not join, we observe a WTP value of zero. But what more can be said about these two decisions? Specifically, one might be predisposed to assuming that the choice of water source primarily depends on water source characteristics and WTP on household characteristics. The results given in Tables 7, 8, 10 and 12 present a somewhat more involved explanation.

The public faucet equations give a number of household characteristics as significant in both the WTJ and WTP decisions. However, they are different in the separate behavioral decisions. Familiarity with existing improved water systems (FAMILIAR) and quality of housing (HOME) are significant in the WTJ equation while years of formal schooling (YRSCHO), size of household (MEMHH) and income (TUTILITY) are significant in the WTP regression. Similarly, water source characteristics are pertinent to the two decisions. The quality of the existing major water source (QUALS1) is significant for the WTJ and price (WALKTIME) for WTP. One can argue that

[90]See the discussion on econometric techniques in Chapter III.

households join a public faucet for improved water quality and pay for quantities consumed and convenience.

Turning to the individual connection equations we find that the household characteristics which are statistically significant for both WTJ and WTP are HOME and TUTILITY. In addition, YRSCHO and MEMHH are significant for WTP. What is noteworthy is that neither of the two water source characteristics is significant in the WTJ regression. However, WALKTIME is again significant in the WTP decision. This evidence suggests that households' decisions to join and pay are based on ability to pay and convenience.

Therefore, the hypothesis that WTJ primarily depends on water source characteristics and WTP on household characteristics is not supported by the relevant statistics. In fact for the individual connection decisions the preponderance of evidence suggests that both decisions are based on the ability to pay.

E. Expenditures in a Served Community

The data from San Juan, a barangay with Level III water service, allow us to do an analysis similar to the above unserved household study. However, the contingent behavior is replaced with actual behavior from the served community.[91] Since the price paid per liter of water is the same for all households, we are precluded from estimating a demand curve from which WTP could be determined. In place of a WTP bid we use the actual amount paid by each member of the RWSA. Thus the observed payment understates

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[91]Recall that the other served barangay, Tangil-Tapon, had few households with individual connections. Most were served with Level II (public faucet) so the individual behavior of consumers could not be seen.

the theoretical WTP as it does not reflect the entire area under the demand curve.

Empirical Model

The purpose here is to parallel the models from the contingent valuation research. However, some of the variables from the unserved household models are not used in this analysis. First, SEX, AGE, and POSITION are respondent characteristics and were used to control for influence in the contingent decisions. It is argued here that once the decisions are complete (i.e., we observe actual joining and paying) respondent characteristics are not relevant explanatory variables. Second, because San Juan has Level III service, all households are familiar (FAMILIAR) with an improved water system. Therefore, this household characteristic could not be included. Third, the two water source characteristics, quality (QUALS1) and price (WALKTIME) measure characteristics of the traditional water source. The served households were not asked to evaluate these variables. Finally, the variables which tested for the presence of bidding (DUMBID) and strategic (DUMSTRAT) bias are not relevant to this model. Therefore, the variables used are confined to household characteristics.

Recall that 200 households were survey. Of these 160 households were members of the RWSA and had monthly water expenses. This means we observe actual payment for the 160 households, whereas the remaining 40 have the limiting value of zero. The censored data set requires an econometric technique suited to limited variable analysis. Using the Heckman model we have

(1) JOIN = (YRSCHO, MEMHH, HOME, TUTILITY)

(2) HPAY = (YRSCHO, MEMHH, HOME, TUTILITY, LAMBDA)

The variables have the following definitions.

1. **Dependent Variables**

JOIN:	1 = if the actual payment is greater than zero 0 = otherwise.
HPAY:	monthly household payment for water purchased through household's own connection after any monies received from neighbors are subtracted from the total payment.[92]

2. **Independent Variables**[93]

YRSCHO:	total years of formal schooling.
MEMHH:	household size.
HOME:	description of the home.
TUTILITY:	pesos spent on monthly utilities.
LAMBDA:	inverse of Mill's ratio calculated from the WTJ probit equation.

Empirical Results

The results presented in Table 15 indicate that for San Juan, wealth (HOME) and income (TUTILITY) are statistically significant and positively affect the willingness to be a member of the RWSA for an individual connection. This finding corresponds with the results for the unserved household WTJ for an individual connection (see Table 8) where HOME and TUTILITY are the only significant household characteristics. Thus our hypothesis that joining for an individual connection primarily depends on

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[92]Some households are not members of the RWSA yet they purchase improved water from neighbors having an individual connection. Although we can determine the number of pesos a served household obtains from an unserved household using their private connection, it is not possible to identify the unserved household. Therefore, WTJ based on effective demand (analogous to the CVM analysis) is precluded.

[93]See section B of this chapter for the more precise definitions of YRSCHO, MEMHH, HOME and TUTILITY.

TABLE 15

HOUSEHOLD WILLINGNESS TO JOIN AND PAYMENT
FOR AN INDIVIDUAL CONNECTION[a]

Econometric Technique:	Probit	Heckman (2nd Stage)	Tobit
Data Set: San Juan			
Dependent Variable:	JOIN	HPAY	HPAY
Mean of Dependent Variable:	0.796	72.24	57.49
Number of Observations:	196	156	196
Variables			
INTERCEPT	-1.37***	70.69	-57.86***
	(-2.64)	(1.30)	(-2.52)
YRSCHO	-0.48	0.10	-1.13
	(-1.19)	(0.06)	(-0.73)
MEMHH	0.82	4.73**	7.26***
	(1.54)	(2.25)	(3.57)
HOME	0.27***	-5.09	8.06***
	(4.22)	(-0.95)	(2.83)
TUTILITY	0.005***	0.10*	0.16***
	(2.65)	(1.87)	(3.50)
LAMBDA		-29.02	
		(-0.68)	
Likelihood Ratio Index[b,c]	0.250		
R - Squared		0.125	
Adjusted R - Squared		0.096	

[a] t-values are in parentheses. Tobit analysis uses z-scores to test the significance of coefficients. In large samples, z-scores are indistinguishable from corresponding t-values.

[b] LRI = 1 - $[L(\hat{\Omega}/L(\hat{\omega})]$ where $L(\hat{\Omega})$ is the maximum value of the log-likelihood function and $L(\hat{\omega})$ is the maximum value of this function under the condition that $\beta = 0$. LRI is a measure of the goodness of fit.

[c] Tobit models offer no goodness-of-fit measure since the constrained version of the model (includes only a constant) cannot be estimated.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

wealth and income receives further support from San Juan. Although the intercept term indicates a strong WTJ independent of other characteristics for the unserved household study, for San Juan the opposite is found. This may indicate that in practice there is not a strong WTJ independent of other relevant characteristics.

The Heckman and tobit models report the explanatory results for monthly payments. The common finding is that household size (MEMHH) and income (TUTILITY) are statistically significant and have positive signs. Furthermore, when the tobit coefficients are adjusted (see Appendix E, Table E-1) we see that values are quite similar. Interestingly, the intercepts have opposite signs, and the intercept is statistically significant in the tobit model. Even more curious is the fact that HOME has the unexpected negative sign (though insignificant) in the Heckman model but is positive and significant only in the tobit regression. Nevertheless, it is observed that except for YRSCHO household characteristics do matter, a finding analogous to the WTP study for individual connections (see Table 12).[94]

When comparing the mean contingent valuation WTP values for an individual connection with the actual expenditures of San Juan, we see a major difference. Specifically, the pooled CVM mean is P23.47 while the San Juan mean for HPAY is P72.42.[95] A number of possible explanations for this disparity exist. First, San Juan is a higher income village. Yet, even Santol, a barangay with similar socioeconomic characteristics, has a mean value of only

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[94]San Juan OLS statistics for the total and selected samples are given in Appendix E, Table E-2. The results are essentially the same as those presented in Table 15.

[95]A test for the equality of the two means under the null hypothesis of equal means is rejected at the 5 percent level.

P25.68. Second, the WTP bid may not represent the maximum which unserved households would pay. Third, households which do not have an individual connection may not know their actual demand when the service first is purchased. In particular, the range of water uses and/or amounts used may expand greatly once the water service is obtained. These factors would result in a much lower WTP bid in unserved barangays.

F. RWSA Findings

Empirical Model

The RWSA questionnaire and barangay data form were developed in an effort to facilitate gathering of village-level data which could be used to substantiate the household level results. That is, data pertaining to household and water characteristics at the village level would allow an aggregated (village) analysis comparable to the micro (household) study. However, since sufficient barangay data were not collected, we are partially precluded from undertaking this endeavor. Therefore, we will parallel the household WTP study using data gathered on a sample of RWSAs, though there is no explicit counterpart to a WTP derived from questionnaires or estimated from a demand curve. Instead, as with the San Juan analysis, the dependent variable represents payment for services.

The model is specified as

(1) Payment[96] = (INCOME, WATER, LEVELPCT, OVERALL, PCTHHRWO, QUALITY, ALTSRC1),

where the definitions of these variables are as follows:

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[96]Note there are two measures for payment. These are defined below.

1. Dependent Variables

PAYHH:	the household average monthly payment for services.[97]
BILHH:	the household average monthly bill received from the RWSA for water services.

2. Independent Variables

a. Household Characteristics

INCOME:	the highest monthly salary paid to an RWSA employee.[98]
WATER:	average monthly water consumption.[99]

b. Water Source Characteristics

LEVELPCT:	1 = percentage of water distributed by level III is greater than or equal to 90 percent, 0 = otherwise.[100]
OVERALL:	measure of RWSA's overall reliability; 0 = not reliable, 1 = reliable, 2 = very reliable.
PCTHHRWO:	the percentage of member households regularly without water or receiving reduced supplies.
QUALITY:	measure of water quality.[101]
ALTSRC1:	1 = village's next major water source is a household well, 0 = otherwise.[102]

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[97]This was calculated by determining the average monthly pesos paid to the barangay's RWSA (January - June 1987) divided by the number of households served in the village. Calculation for BILHH is analogous to PAYHH.

[98]This is a proxy for household income.

[99]An instrument was used (predicted values) as there are supply and demand considerations for this variable.

[100]A number of RWSA's are combination Level II-III systems. To account for a household's willingness to pay for the convenience of a private connection this variable is used.

[101]Three qualities were rated (0 = poor, 1 = fair, 2 = good), color, taste and smell. QUALITY represents the sum of the individual ratings.

[102]E.g., lake/river, spring, rainwater.

Looking at the household characteristics, we hypothesize that as income (INCOME) increases so would the amount paid (PAYHH) for the the service. As the quantity of water consumed (WATER) increases, we also posit a higher payment. The water service characteristics are hypothesized to have the following relationships. LEVELPCT is expected to have a positive sign under the assumption that households are willing to pay more for Level III service. A positive correlation is expected between PAYHH and the overall reliability of the system (OVERALL) indicating greater payment for better service. The increase in the percentage of households regularly without water or with reduced supplies (PCTHHRWO) is expected to negatively influence payment. This represents a constraint on the desired level of household water utilization and lowers willingness to pay because of poor quality of service. We predict a positive sign for QUALITY as it is thought that as the water's quality improves so will the amount paid. Finally, all barangays have water source substitutes. It is anticipated that if the major substitute is a household well (ALTSRC1), payment will decrease, as this would be a convenient source with adequate supplies. The difference between BILHH and PAYHH represents the average under- (delinquent) or overpayment of water charges. Under the assumption that the RWSA is not significantly behind or ahead in payments, substituting BILHH for PAYHH is not expected to affect our hypotheses.[103]

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[103]Using the mean values for PAYHH (Table 16) and BILHH (Appendix E, Table E-3) we see that the average household is delinquent by approximately P5 per month, or less than 15 percent of PAYHH.

Empirical Results

Three regressions are reported in Table 16.[104] The first reports the results of the complete model. The second does not use WATER and the third model keeps WATER but suppresses QUALITY and ALTSRC1. This succession of equations is reported in an effort to elucidate the fact that WATER and other variables are collinear and that WATER is never statistically significant.[105] The latter may signify that if a fixed fee for water is charged, there may be no relationship between consumption and payment.

The full model (1) reports that only INCOME is statistically significant and it has the expected positive sign. If we delete WATER, we see that the household and water source characteristics all have the hypothesized signs, and in addition to INCOME two water source characteristics are now statistically significant. Specifically, INCOME is significant at the 1 percent level and OVERALL and PCTHHRWO are significant at the 5 percent level. This result, in terms of categories of characteristics, is similar to the WTP models found in Tables 10 and 12. The final regression further demonstrates the problems that WATER causes. In this model OVERALL and PCTHHRWO become statistically insignificant. LEVELPCT has the unexpected negative sign in all regressions, though it is always statistically insignificant.

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[104]The dependent variable is PAYHH, and three different equations are identified by the numbers 1, 2 and 3. Regressions using BILHH are in Appendix E (Table E-3) and are highly similar to those reported in the text.

[105]The exception is the first regression using BILHH found in Appendix E, Table E-3.

TABLE 16

PAYMENT FOR WATER SERVICES[a]

Econometric Technique: OLS			
Data Set: RWSA	1	2	3
Dependent Variable: PAYHH			
Number of Observations:	34	43	34
Mean of Dependent Variable:	36.62	32.64	36.62
Variables			
Intercept			
INTERCEPT	-6.72	12.24	11.10
	(-0.23)	(0.91)	(1.12)
Household Characteristics			
INCOME	0.027***	0.032***	0.029***
	(3.49)	(5.48)	(4.23)
WATER	0.75		0.45
	(0.81)		(0.62)
Water Source Characteristics			
LEVELPCT	-2.57	-3.04	-1.47
	(-0.39)	(-0.60)	(-0.24)
OVERALL	5.34	8.44**	6.48
	(1.12)	(2.31)	(1.53)
PCTHHRWO	-7.76	-17.93**	-10.56
	(-0.60)	(-2.42)	(-0.98)
QUALITY	2.79	0.51	
	(0.64)	(0.21)	
ALTSRC1	0.16	-2.85	
	(0.02)	(-0.53)	
R-Squared	0.574	0.578	0.550
Adjusted R-Squared	0.438	0.508	0.469

[a]t-values are in parentheses.
***1 percent level of significance.
**5 percent level of significance.
*10 percent level of significance.

In conclusion, a model estimated without WATER yields results akin to those of the CVM study. Again, the dependent variable used here is not a true WTP (i.e., the integral of a demand curve), but an actual amount paid. The mean value (32.64 pesos for 43 observations) is markedly greater that the WTP bids given by unserved households for improved water from an individual connection (23.47 pesos, see Table 12). But, like the San Juan study, we are unable to measure whether it represents an upper bound.

E. Summary

The data utilized for the study were gathered by survey instruments. A description of the questionnaires, villages and institutional context placed this research in its historical setting. Specifically, the socioeconomic descriptions of the villages provided an introduction to the WTJ and WTP findings, and the institutional pattern of households joining an RWSA prior to purchasing its water elucidates the need for analyzing both behavioral decisions.

Following this the theoretical model given by equations (13) and (16) in Chapter III was estimated in an effort to ascertain the determinants of the discrete - continuous choice of selecting a water source and the amount the household will pay for this. The regression results show that household and water source characteristics influence these decisions.

Two household characteristics, FAMILIAR and HOME, and one water source characteristic, QUALS1, influence the WTJ decision for a public faucet. Apparently households do not consider their current water source's characteristics (QUALS1 and WALKTIME) significantly important to the WTJ for an individual connection. Instead the households base their decision on

their ability to pay the one-time fee for a water meter and pipe installation. This is indicated by the significance of HOME and TUTILITY. Payment for both a public faucet and individual connection depends on the current price (WALKTIME) and a number of household characteristics. YRSCHO, MEMHH and TUTILITY are significant variables for both improved sources. Only the individual connection model has HOME as significant to the WTP decision. This emphasizes the importance of the household's ability to pay. Similar results were found in the San Juan and RWSA analyses.

Interestingly, the highest mean CVM bid for an individual connection was P25.68 for the village of Santol. This translates into less than 1 percent of annual income, far below the 3 to 5 percent often assumed to be forthcoming. Recall that Santol has socioeconomic characteristics similar to the served village of San Juan, whose mean payment for water from an individual connection is P72.24 or 2.33 percent of household income. This is a curious finding and may have some bearing on the efficacy of CVM usage. The discrepancy leads us back to the issue of sustainability. Specifically, will P25.68 per month be sufficient to maintain a water system or are monthly payments in the range of San Juan's necessary? The issue of comparing actual costs to WTP is addressed in the following chapter.

CHAPTER V

ACTUAL COST VERSUS WILLINGNESS TO PAY

This study began by informing us of the need to focus on the sustainability of development assistance efforts. Disrepair and/or under-used projects stem from numerous sources including insufficient management skill, tastes/preferences of potential users which differ from the completed service and insufficient financial resources to operate and maintain such projects on a long-term basis.

Locating sources of finance and determining the corresponding available funds are prerequisites for properly setting a sustainable development-assistance effort. One source of finance is the recipients of the good, and contingent valuation is a methodology for ascertaining their WTP for a nonmarket good. This was done here and the results reported in the previous chapter. We now turn to analyzing the actual costs and necessary user fees to permit sustainability. These estimates provide a comparison for the WTP household bids from the CVM study.

A. Cost and User Fee Estimates

Cost estimates for Level III (household connection) and Level II (public faucet) are given based on two different scenarios.[106] First, engineering estimates of the costs to plan, construct, operate and maintain water systems are used to calculate minimum household user fees necessary for providing a

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[106]The engineering and cost estimates in Tables 17 - 20 and in the text were provided by the interdisciplinary team of professionals hired by the Filipino government (Comprehensive Marketing Systems, Inc. 1988).

financially sustainable system. Costs are based on patterns drawn from the sampled RWSAs and engineering analyses. The system (System A) is designed to provide 24 hour/day service and 1180 liters/day (197 liters per person in a six-person household) to each RWSA member household.[107] Second, cost estimates are given using actual costs for the San Juan RWSA (System B).[108] We use San Juan as a model because its system functions well and it is a Level III system. This analysis assumes that people consume 157 liters of water per day[109] and that family size is 5.75.

In each case user fees are based on relevant capital (construction), maintenance (large replacement items) and operation and maintenance costs. No provision is made for delinquent payments. Costs and the associated fees are given separately for an RWSA having membership sizes of 150, 250, 500 and 1000.

Looking at Level III household fees and costs (Tables 17 and 18), we see from line 1 of Table 17 that the household fee for System A with 250 members

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[107]The main, secondary and tertiary piping are 150 millimeters in diameter. Fifty millimeter pipes connect the household's water meter to the tertiary pipes. The household pays for 25, 17 and 13 millimeter lines which run from the meter to the three or more household faucets. System A should be able to continue to accept new customers in the ensuing 10 to 12 years.

[108]System B is assumed to have the same well, pump, motor and pipeline characteristics as the San Juan system, but is unable to take on new households because of pipeline flow limitations.

[109]This is the level in San Juan during the first half of 1987. It is approximately twice the average usage level of the 52 RWSAs in the sample, though it is lower than the highest consuming RWSA. However, consumption is growing in San Juan and likely will be even higher in the future. Thus the 157 liter figure may understate the long-term consumption pattern in an efficiently operating system. Nonetheless, the analysis is based on a constant consumption level, regardless of water fee. This is comparable to assuming a zero price elasticity.

TABLE 17

HOUSEHOLD FEES NECESSARY TO FINANCE LEVEL III WATER SYSTEMS USING DIFFERENT LOAN/GRANT OPTIONS
(In Pesos per Month)

Line	System and Grant	Number of Households			
		150	250	500	1000
1.	System A/No Grant[a]	P 429.96	P 340.04	P 256.84	P 249.97
2.	System A/100 percent Grant for System	167.78	119.80	83.80	70.63
3.	System A/100 percent Grant for System and Maintenance Fund	79.33	60.80	51.80	48.30
4.	System B/No Grant[b]	198.44	151.83	115.37	110.17
5.	System B/25 percent Grant for System	175.45	132.82	100.43	94.70
6.	System B/75 percent Grant for System	129.19	94.81	70.57	63.74
7.	System B/100 percent Grant for System	106.57	75.80	55.63	48.27

[a]System A has two types of grants. A grant for the system is for the capital or construction costs. The grant for the maintenance fund is for the costs associated with the replacement of high cost items such as a pump or motor.

[b]System B has a grant only for the construction costs. Different size grants (a percentage of construction costs) permit a number of user-fee scenarios.

Source: Comprehensive Marketing Systems, Inc. 1988. "Financial Feasibility of Providing Potable Water Services to Rural Areas in the Philippines." Washington, D.C. Report ANE-0401-C00-7025-00.

TABLE 18

COSTS FOR LEVEL III SYSTEMS ASSUMED IN THE FEE ANALYSIS
(Pesos)

	SYSTEM A - LEVEL III			
	Number of Households			
	150	250	500	1000
Operation and Maintenance (Monthly)	P 12,000	P 15,200	P 25,900	P 48,300
Maintenance Fund (10 Years)	1,590,000	1,770,000	1,920,000	2,680,000
Capital Costs (Construction)	2,500,000	3,500,000	5,500,000	11,400,000
	SYSTEM B - LEVEL III			
	Number of Households			
	150	250	500	1000
Operation and Maintenance (Monthly)	P 8,800	P 11,250	P 19,150	P 35,700
Maintenance Fund (10 Years)	862,300	925,350	1,040,000	1,506,700
Capital Costs (Construction)	863,000	1,208,200	1,898,600	3,935,300

Source: Comprehensive Marketing Systems, Inc. 1988. "Financial Feasibility of Providing Potable Water Services to Rural Areas in the Philippines." Washington, D.C. Report ANE-0401-C00-7025-00.

is approximately P340 each month if this fee is to completely finance the water system.[110] Household fees for a larger membership are much lower, but still significantly higher than amounts paid in the past. Construction of the system is expensive and accounts for almost 65 percent of the above fee. Line 2 shows that the fee could be reduced to P120 for the 250-household system if a grant is secured for the system's construction costs. The RWSA would continue to finance, by means of household payments, the operations and maintenance and replacement of major parts with this combination of fees and grant. Finally, line 3 indicates that a further reduction in the monthly fee is possible if a donor would provide in advance (or as needed) sufficient funds for equipment replacement needs which are anticipated during the first 10 years. In each case fees are higher for the system with a smaller number of households. This is especially pronounced when there is no grant for construction.

Lines 4 through 7 give the same type of information, but in this case System B is used for calculating the fees.[111] Construction costs are those expected to replicate the existing San Juan system for a 500-member system. This cost, estimated to be P2,847,758, is reduced by one-third to allow for quantity purchases of materials. This assumption permits capital costs to be less than 35 percent of the costs for System A. Construction costs for the other membership sizes are reduced by the same proportion in the calculations.

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[110]This assumes a 100 percent loan for the system (no grant) at an annualized interest rate of 14.3933, the 1988 interest rate used in the Philippines for government projects. This figure also assumes that consumers begin financing both the capital and depreciation for all parts, with a life equal to or below 10 years.

[111]See Table 18 for the relevant costs.

Replacement parts in the maintenance fund are also assumed to be purchased with the one-third quantity discount, and certain maintenance items are not included.[112] Finally, operations and maintenance expenditures are assumed to be at the level found in San Juan during June 1987.

Using these cost figures line 4 of Table 17 (analogous to line 1, i.e., no grant) illustrates the dramatic reduction in user fees achievable with a less expensive system. For example, the System A household fee with 500 members is P257. This compares to P115 for System B. Lines 5, 6 and 7 indicate the minimum household fee using a 25 percent, 75 percent and 100 percent construction grant. A 100 percent construction grant brings the individual user fee down to P56, a household savings of P59 per month. Comparable calculations are given for Level II service (public faucet) in Tables 19 and 20. Note the household fees are only marginally lower as the only cost difference is due to tertiary piping expenses.[113]

It is evident from Tables 17 and 19 that capital costs account for the greater part of the total system costs and that economies of scale are available. Therefore, securing a grant for the capital costs and having a relatively large RWSA membership are advantageous ways for lowering household water use costs. Furthermore, given that Level II fees do not afford substantial savings over Level III fees, an argument can be made that implementing Level III systems is preferred as individual household metering is possible.

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[112]Specifically, a ditching machine, technical assistance and a small contingency fund.

[113]Recall that piping for individual connections runs to the dwelling whereas piping for the public faucet would be more centrally located to a number of homes. The basic construction features are the same as a Level III system. This is done so that the Level II system can be converted easily to Level III.

TABLE 19

HOUSEHOLD FEES NECESSARY TO FINANCE LEVEL II WATER SYSTEMS USING LOAN/GRANT OPTIONS
(In Pesos per Month)

Line	System and Grant	Number of Households			
		150	250	500	1000
1.	System A/No Grant[a]	P 399.99	P 316.76	P 204.97	P 218.40
2.	System A/100 percent Grant for System	158.78	115.40	82.27	72.10
3.	System A/100 percent Grant for System and Maintenance Fund	84.00	64.40	56.60	51.60
4.	System B/No Grant[b]	185.75	148.74	100.34	103.46
5.	System B/25 percent Grant for System	164.94	130.42	89.18	90.16
6.	System B/75 percent Grant for System	123.30	93.80	66.86	63.55
7.	System B/100 percent Grant for System	102.49	75.48	55.70	50.24

[a]System A has two types of grants. A grant for the system is for the capital or construction costs. The grant for the maintenance fund is for the costs associated with the replacement of high-cost items such as a pump or motor.

[b]System B has a grant only for the construction costs. Different size grants (a percentage of construction costs) permit a number of user-fee scenarios.

Source: Comprehensive Marketing Systems, Inc. 1988. "Financial Feasibility of Providing Potable Water Services to Rural Areas in the Philippines." Washington, D.C. Report ANE-0401-C00-7025-00.

TABLE 20

COSTS FOR LEVEL II SYSTEMS ASSUMED IN THE FEE ANALYSIS
(Pesos)

	SYSTEM A - LEVEL II			
	Number of Households			
	150	250	500	1000
Operation and Maintenance (Monthly)	P 12,600	P 16,100	P 27,300	P 51,600
Maintenance Fund (10 Years)	1,346,000	1,530,000	1,660,000	2,460,000
Capital Costs (Construction)	2,300,000	3,200,000	3,900,000	9,300,000
	SYSTEM B - LEVEL II			
	Number of Households			
	150	250	500	1000
Operation and Maintenance (Monthly)	P 9,350	P 11,900	P 20,200	P 38,150
Maintenance Fund (10 Years)	726,800	836,000	920,000	1,450,100
Capital Costs (Construction)	836,700	1,164,150	1,418,800	3,383,300

Source: Comprehensive Marketing Systems, Inc. 1988. "Financial Feasibility of Providing Potable Water Services to Rural Areas in the Philippines." Washington, D.C. Report ANE-0401-C00-7025-00.

B. The Need for Subsidies

Unserved households indicating their intention of joining an RWSA for an individual connection had a mean WTP value amounting to P23 per month. Clearly this "payment" is dramatically less than the necessary fees to completely finance a Level III even with a membership of 1000.[114] If we use the number of households for each unserved barangay (see Table 2), the differential between the minimum necessary fee and the corresponding WTP is greater. For example, Banaga and Coral Na Munti have 262 and 276 households, respectively. If 250 of these were RWSA members with individual connections, the user fees for the no grant System B case are P152. This compares with WTP bids of P22. Even Santol, with 635 households, falls short of the approximately P115 fee by P90 per month. This elucidates the need for the relevant capital and maintenance fund grants to be secured. If a construction grant is obtained, Level III fees fall to P56 based on 500 members and System B costs. Yet even these fees are more than twice the WTP figures.

It is instructive to recall that the average water payment in San Juan is P72 and that the mean RWSA payment is P55.[115] Both of these values are more than twice the mean unserved WTP for Level III services. This may indicate that unserved village households understated their WTP. As mentioned earlier, the relatively low WTP bid may reflect the fact that unserved households may not know their water demand from an individual connection. This would result in low WTP bids. One way of arguing this claim is to use the empirical WTP equation (Table 12) and the relevant San

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[114]System A fees are P250 per month and System B fees are P110 per month.

[115]This value is not from Table 16 but reflects an average household payment for Level III RWSAs for the month of June, 1987.

Juan data to predict its WTP. This produces a WTP of approximately P28 per month.[116]

Based on the San Juan data, we might expect that the minimum WTP by an unserved barangay would be two-an-a-half times that which the equation predicts. However, even with this assumption the user fee figures of Tables 17 and 19 indicate that subsidies are necessary to attain sustainability. In fact for a 500 member Level III system it becomes necessary to have a 100 percent grant for capital costs for the less expensive System B.[117]

In summary, the cost and fee data generated for public faucets and private connections, whether they are based on System A or B, indicate that capital and possibly maintenance grants will be necessary if newly built systems are to be sustainable. Failure to make provision for this is to condemn a water system to failure and to squander any monies used for such an undertaking.

C. Implications for the Contingent Valuation Methodology

The above mentioned differences between the unserved household WTP (P23) and the actual payments associated with the served households of San Juan (P72) and the RWSAs (P55) is somewhat disconcerting. What is most troubling is the fact that the WTP for Santol (P26), a barangay similar to San Juan, is almost three times less than the actual payments made by San

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[116]To a certain extent this number understates a WTP prior to having water from an individual connection, as the values used for the water characteristics, quality and walking time, reflect the improved source. If these determinants were valued as if households were unserved, we would have a higher predicted WTP.

[117]System A also would require a grant for the maintenance fund.

Juan households. This raises a number of questions. Is CVM of little value in this situation due to the presence of bias, most especially hypothetical bias? Is it appropriate to use San Juan payments and conclude that unserved households have understated their true WTP by a factor of two-and-a-half? Are there other methods for ascertaining WTP which may prove more fruitful? We now turn to these questions.

As stated in Chapter I, many economists are skeptical of CVM analysis because the market (a mental construct) and the payment (values elicited) are hypothetical. Thus the argument is that hypothetical questions elicit hypothetical answers, which may convey no meaningful information. This, we argue, is not the Achilles heel of CVM. What does present a problem is if the respondent does not have a clear understanding of the good being valued. Did the respondents comprehend Level II and III delivery systems, the potential health and time-saving benefits, and the quantity of water they would consume? An understanding of a standpost and an individual connection is considered tenable. Many unserved households were already familiar with RWSA water systems in other barangays, and the enumerators, in addition to their verbal descriptions, used photographs of the systems. However, it is likely that health and time-saving benefits are not accurately known by the respondent. It may be that there is imperfect information. Assuming underestimation in both of these cases, we might rightly conclude that the CVM WTP values are less than expected values corresponding with observed behavior.

The issue of quantity could be addressed by asking WTP for particular water uses and ascertaining the current quantities consumed. For example, the enumerator could state that the respondent is to value the water used for

drinking and cooking. Next the bidding game would be used to value the water used for washing clothes. This permits a more precise analysis of why the water is valued and the current quantities used.[118] If unserved households' WTP reflect current (traditional) consumption patterns which are less than that of served households, it may be that the stated WTP is appropriate. However, even with this insight one needs to make a judgment regarding actual use once the system is used. That is, it is probable that water-use patterns would change with more water being purchased from the RWSA.

It is arguable that barangays with similar socioeconomic characteristics will have similar water consumption patterns. In this case we might expect actual behavior for households in Santol to be that of those in San Juan. Yet extrapolating to the remaining unserved villages, Banaga, Coral Na Munti and Pakigne, may be more tenuous. This is because the socioeconomic characteristics (see Table 3) are markedly different. Thus applying the finding of a two-and-a-half underevaluation to Santol has some basis, but this becomes questionable when applied to the remaining three villages.

Finally, are other methods of determining WTP better suited to this good and therefore able to generate more fruitful insights? Nonmarket goods are of two types. First, goods may have no explicit market (scenic vistas), and second, there may be no market for the good in the relevant geographic region (potable water from delivery systems not available in a village). The methods for ascertaining WTP are hedonic pricing, travel cost and contingent

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[118]Although this may yield insightful information, there is a tension between gaining useful information and fostering boredom in the respondent by taking added time to complete the survey.

valuation. Even if one assumes a housing market where dwelling features are capitalized into the market value, one could estimate the value of an existing individual connection but not the WTP for water consumed. A similar outcome is expected for access to a standpost, excepting the case where a predetermined fee is set regardless of water consumption. The travel cost method also has shortcomings such as judgments in valuing the opportunity cost of time, which may be of little financial value, and there being no occasion for including the valuation of health benefits.

When using CVM a format must be chosen. This should be one with which the respondents feel comfortable. Although the bidding game may be desirable, one might also implement a direct, close-ended questionnaire. In this case the enumerator would inform the respondent of actual payments and water use patterns of served barangays. The respondent would be asked to accept or reject an actual payment value. This format provides additional information helpful in assessing the reliability of the WTP data and could be administered to 100 of the 200 sampled households.

As a tool for eliciting values for nonmarket goods the contingent valuation method is a good source for information. Its strengths and weaknesses properly are assessed in light of those associated with the other methods. On balance it provides a viable method for determining WTP.

D. Summary

Cost estimates based on an engineering design and the San Juan system were given for the purpose of comparing actual costs with unserved household WTP. Tables 17 - 20 clearly indicate that economies of scale are available and that since system costs for Level II and III are not substantially

different, it is prudent to build a system which can provide for individual connections. Furthermore, subsidies are likely to be necessary.

The difference between served household payments and unserved household WTP raises some questions regarding the efficacy of CVM. However, we conclude that extrapolation of actual behavior to barangays with similar characteristics is acceptable but more tenuous for those that are different. Contingent valuation is a viable method and does overcome some of the shortcomings of the hedonic pricing and travel cost methods.

CHAPTER VI

SUMMARY

A. Introduction

The sustainability issue of development assistance projects increasingly is in the fore of relevant literature. The reason for this is the simple fact that many such efforts are observed to fall short of ". . . bringing about lasting changes . . ." (USDA 1987, p. 1). A major reason for this undesirable state of affairs is that the means to attain sustainability, heretofore, have not been properly identified. USDA defines sustainability as the ". . . collective ability to continue a flow of valued benefits or outcomes beyond a given investment period at an acceptable cost" (USDA 1987, p. 3). Therefore the provision of an ongoing stream of benefits is too simplistic a definition.

One facet of sustainability is the identification of various financial sources and mechanisms for meeting recurrent costs. The historical evidence surrounding the Decade's efforts suggests the necessity of identifying these sources and their corresponding amounts prior to the project's implementation.

Determining the amount a purchasing unit will pay requires an appropriate methodology. In the case of public or nonmarket goods, contingent valuation is a viable method. This direct method specifies a hypothetical market for the nonmarket good and queries the potential benefactors regarding their value placed on increments (or decrements) of the good. Although CVM is an acceptable means for ascertaining a WTP, proper use and interpretation of results is required as a number of biases may occur.

CVM was used to learn the determinants of willingness to join and willingness to pay for potable water from an improved source (Level II--public faucet, Level III--individual connection). Household data were collected from unserved and served villages. This allowed a comparison of determinants. Contingent valuation WTP and actual expenditure data permitted comparison and provided a means to analyze WTP juxtaposed with system delivery costs generated from data gathered on well-run RWSA operations and engineering designs.

Since the institutional constraints in the Philippines require a household to join the RWSA as a prerequisite to purchasing improved potable water, a theoretical discrete-continuous model was used to motivate the empirical work on determinants of WTJ and WTP.

The next section will summarize the findings of WTJ and WTP. This is followed by sections on financial viability and the efficacy of CVM for development assistance efforts.

B. Determinants of WTJ and WTP

The household survey gleaned information on socioeconomic characteristics, water use patterns, perception of the need for a potable water system and the desired improvements it should have over the existing sources, willingness to join and willingness to pay. Based on the theoretical model, variables were selected in an effort to understand the determinants of WTJ and WTP.

As noted in Chapter IV, the hypothesis that joining predominantly depends on water source characteristics and paying on household characteristics lacks empirical support. Although WTP determinants are

highly similar for both a public faucet and an individual connection, we do notice that HOME is significant only for the individual connection model. This observation is used to underscore the importance of wealth and income. The common determinants were YRSCHO, MEMHH, TUTILITY, and WALKTIME. In addition, the intercept term was statistically significant. But it accounted for 70 percent of the average WTP value for public faucets versus 39 percent in the individual connection regression. This indicates that the other variables explain more of the variation in the bids for the individual connection equation.

These similarities are not found in the join decision. The evidence strongly suggests that wealth and income determine WTJ for an individual connection. This is not surprising as households incur onetime costs of approximately P1000 for the meter and tertiary piping and their installation. This figure represents a large percentage of household annual income, 2.9 percent in Santol, a relatively wealthy barangay, and 7.0 percent in Coral Na Munti, a relatively poor barangay. For public faucets FAMILIAR, HOME,[119] and QUALS1 are statistically significant.

In conclusion, the determinants for joining are different for Level II and Level III whereas they are virtually the same when it come to WTP. The two additional empirical analyses (San Juan and RWSA), patterned after the CVM study, confirm the behavioral determinants in terms of household and water source characteristics.

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[119]Recall HOME has a negative sign. When interpreted in conjunction with its positive sign in the individual connection equation an argument can be made that a public faucet is considered inferior to an individual connection.

C. Financial Viability and WTP

In addition to highlighting the determinants of WTJ and WTP, within the context of sustainability we compared the actual costs to WTP and elucidated the issue of financial viability of potable water systems. Costs estimated for Level II and Level III systems were given based on data from the well-run San Juan RWSA and data generated by engineers for a superior design.

Both scenarios indicate that the CVM WTP values fall far short of covering construction, major maintenance, and operational costs, even if the RWSA garners significant economies of scale by serving a constituency of 1000 households. The conclusion is that without a grant for capital and, most likely, large maintenance item costs, a system built under the assumption that the benefactors will fully finance the development project is condemned to failure. Furthermore, the 3 to 5 percent of income rule will also result in a waste of capital funds if it is assumed these monies will cover all costs. For example, a 500 member Level III system patterned after San Juan necessitates approximately P1400 per household on an annual basis. Using the average household income for unserved barangays we note that even if 5 percent of income were available for water fees, only Santol yields annual revenues surpassing the P1400 estimate. Annual expenditures for Banaga, Coral Na Munti, and Pakigne fall short of this estimate by P460 to P660. This deficiency corroborates the finding that grants for capital costs are necessary.

D. The Efficacy of CVM for Development Efforts

The contingent valuation methodology is subject to a number of biases which were enumerated in Chapter II. In the sense that no real market is

used to value the good, CVM is inherently hypothetical. Therefore caution is in order. Despite a careful delineation of the two services (public faucet and individual connection) the bias may be evidenced in two ways. FAMILIAR is significant in the public faucet WTJ equation indicating that households familiar with existing RWSA's are more likely to join for a public faucet. However, the statistical significance of FAMILIAR may also indicate that an educational program can attract members to the RWSA. Second, by invoking the ceteris paribus assumption for the served village of San Juan and the unserved village Santol, barangays having similar socioeconomic characteristics, we see that the actual monthly expenditure for San Juan is P72 while contingent WTP is P26 for Santol. This amounts to a differential exceeding two-and-a-half. The disparity may reflect a less than true valuation and/or that factors such as water demand and health benefits from an improved source are not fully known by an unserved household. Arguably it would be helpful for the enumerator to discuss water usage with the respondents. Despite this sobering reality the significance levels and signs of the explanatory variables give strong evidence that the bids do reflect relevant information such as income, round-trip walking time to the major water source and size of household.

Second, there is evidence of bidding game bias in the public faucet equation. Mitigating this effect may be possible by beginning the game with relatively large increments (decrements) to be followed by relatively small changes in suggested bids.

To conclude that contingent valuation is not a reliable method for estimating WTP is to pronounce too harsh a judgment. Insightful and pertinent information is gained by such survey analysis. For example,

ascertaining the determinants of WTP. However, the hypothetical nature of the market and good may require further delineation for the respondent to more properly value the good. This would include designing the valuation process similar to the observed routinized market behavior. Prior to undertaking the survey it should be known whether respondents are comfortable with bidding or prefer stating outright their bid. Likewise helping the respondent understand consumption patterns would be helpful. These precautions will only enhance the efficacy of the specific survey, a method with a useful future.

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APPENDIXES

APPENDIX A

SURVEYED AREAS AND INTERVIEWERS INSTRUCTIONS

SCHEDULE OF SELECTED SURVEY AREAS

I Unserved Households

	Province	Municipality	Barangay
1.	BULACAN	Balagtas	Santol
2.	BATANGAS	Nasugbu	Bilaran
3.	PANGASINAN	Bugallon	Banaga
4.	CEBU	Minglanilla	Pakigne

II Served Households/Part of RWSA Survey

	Province	Municipality	Barangay
1.	BULACAN	Balagtas	San Juan
2.	CEBU	Dumanjug	Tanguil-Tapon

III RWSA Survey (Level II/III combined; Level III)

	Province	Municipality		Barangay
1.	BULACAN	Calumpit	1.	San Marcos
		Guiguinto	2.	Tabe
		Bustos	3.	Tibagan
		Malolos	4.	Bulihan
		San Jose Del Monte	5.	Tungkong Mangga
		Marilao	6.	Tabing-Ilog
		Sta. Maria	7.	San Gabriel
2.	BATANGAS	San Jose	8.	Balagtasin I & II
		Tanauan	9.	Talaga
		Cuenca	10.	Emmanuel
		Padre Garcia	11.	Pansol
		Padre Garcia	12.	Tangob
		Tuy	13.	Lumbangan
		Malvar	14.	San Andres
		San Pascual	15.	Ilat-North & South
		Ibaan	16.	Tulay/Calamias
		Tanauan	17.	Banjo West
3.	PANGASINAN	Asingan	18.	Ariston/Bantog
		Lingayen	19.	Matalawa/Lomboy
		Manaoag	20.	Pao
		Balunggao	21.	San Leon
		Anda	23.	Poblacion
		Mapandan	24.	Luyan/Torres

	Province	Municipality		Barangay
4.	CEBU	Daan Bantayan	25.	Maya
		Medellin	26.	Poblacion
		Dalaguete	27.	Casay
		Santander	28.	Looc-Liloan
		Consolacion	29.	Tayud
		Ronda	30.	Poblacion
5.	AKLAN	Nonancia	31.	Buluang/Kamansi
		Naligusan	32.	Naili/Rizal
		Ibajay	33.	Poblacion
		Ibajay	34.	Maluco/Capilijan
		Batan	35.	Poblacion
6.	ILOILO	Passi	36.	Agdayao
		Leon	37.	Buga
7.	BATAAN	Dinalupihan	38.	Magsaysay/Sn Benito
8.	DAVAO DEL NORTE	Sto. Tomas	39.	Kimamon
		Tagum	40.	Madaum
		Tagum	41.	La Filipina
		Mawab	42.	Andili
		Magatos	43.	Poblacion
		Magnaga	44.	Poblacion
		Maco	45.	Poblacion
		Compostela	46.	Poblacion
		Maragusan	47.	Poblacion
		Corella	48.	Poblacion
		Montevista	49.	Poblacion
9.	CAVITE	Amadeo	50.	Loma
		Silang	51.	Putingkahoy
		Amadeo	52.	Tamakan
10.	PAMPANGA	San Simon	53.	San Miguel
		Sta. Rita	54.	San Isidro
		Macabebe	55.	San Esteban
		Apalit	56.	Sto. Rosario

METHODOLOGY: PRE-SURVEY QUESTIONNAIRE

A. ROLE AND DUTIES OF INTERVIEWERS

The main tool of this research study is the community interview schedule, otherwise known as the pre-survey questionnaire. You, the interviewer, play a crucial role in this research operation. The quality of data gathered depends largely on how you present the questions and are able to elicit accurate and relevant information from your respondents.

In general, your duties include:

1. Locating the appropriate govt/private institutions from which secondary data are to be collected, and filling up corresponding tables in the pre-survey questionnaire.

2. Administering appropriate questions in the community interview schedule to the barangay captain or any knowledgeable barangay leader.

3. Locating the Barangay Health Section and administering the appropriate questions to the midwife or any knowledgeable barangay health officer.

4. Calling back if the subject was not available at the time of the first visit.

5. Maintaining contact with your field supervisor/research team leader.

6. Completing and editing the questionnaire before submitting it to your supervisor.

7. Going back to your respondent and re-interviewing if your supervisor finds errors that can only be rectified by re-interviewing.

B. GENERAL INSTRUCTIONS

1. Before Making Contact

There are four important steps before you make contact with respondents. These are:

a. To review the general interviewing procedures and the question-by-question instructions.

b. To review the questionnaire. Unfamiliarity with the research tool will disrupt the interview and disrupt the respondent as well.

c. To organize your materials. Be sure that you have all the materials you need, and you have them with you when

you go to the field.

d. To be aware of your appearance and behavior. You should be polite, neat and courteous to respondents for a good first impression, since good first impressions pave the way to a better relationship between interviewer and respondent, and may gain the latter's cooperation.

2. Introducing Yourself

It is very important that you briefly introduce yourself. Your identification card should be on hand ready to be presented to the respondent. Nevertheless, you should be able to state in a few words your identification and purpose of the study.

Some respondents might inquire more about the study like what would be the use of information collected, how long the interview would take, etc. You have to answer them in a friendly and reassuring way.

Once the introduction is made and the respondent has agreed to the interview, the next consideration is the setting. You should try to avoid an audience. The presence of others may bias the respondent's answers. Also try to sit across the respondent, not side by side, as the respondent may try to read ahead in the questionnaire.

3. Language of the Interview

The instrument is in English. Depending on the capability of the respondent to understand and comprehend English, you will decide on the language of the interview on a case-to-case basis. For this purpose, you are provided with a translation of the questionnaire in the dialect of the area.

4. Asking Questions

Always bear in mind that your primary goal is to collect accurate information from your respondents. Interviewing is a skill which is learned mostly by practice. However, by knowing the questionnaire and by following standard interviewing practices, even an inexperienced interviewer can do a good job. Here are several rules that should help:

a. Always remain neutral

The respondent's answers should be obtained with as little influence as possible by the interviewer. You must be careful that nothing in your words or manners implies criticism, surprise, approval, or disapproval of neither the questions asked nor the respondent's answers.

When a respondent gives an ambiguous answer, never

assume what the respondent means. Never say things like "Oh. I see. I suppose you mean. . . is that right?" If you do this, the respondent would more often agree with your interpretation, even though it is not correct. The correct procedure is to ask the question again.

b. Ask all questions presented in the questionnaire.

The questions are arranged in logical sequence. Ask the questions in exactly the same order as they are in the questionnaire. Changing the order can affect later responses.

c. Ask all questions exactly as they are worded.

Never change even one small word in the question. If the respondent does not seem to understand the question, simply repeat the whole question without missing a simple word. Each question must be asked in exactly the same way to each respondent in order that information gathered will be standard.

However. if the respondent, after your repeating the question, simply cannot understand the question, you may rephrase it in simpler words. But when doing this, you must be careful not to alter the meaning or intention of this question.

5. Instructions in the Questionnaire

Instructions to the interviewers always appear in CAPITAL LETTERS and are usually enclosed in parentheses. The questions to be asked the respondent are always in regular print and never enclosed in parentheses.

6. Entering Answers in the Questionnaire

a. If no instruction is given for entering responses

If there is no instruction given for entering responses to a question, this means checking the appropriate response if there are pre-coded responses given.

b. Pre-coded response alternatives

For most questions, an attempt has been made to divide the possible responses into response categories, which are referred to here as "pre-coded response alternatives." Whenever possible, the interviewer should try to determine which of the alternative best fits the answer given by the respondent and check the line next to that alternative. as in the following example, where the answer is "No."

1 _____ Yes
2 _____ No

In some cases, the interviewer may not be sure which alternative should be checked or encircled; in such cases, none should be checked. Instead, the interviewer should write out the answer in full, using the exact words of the respondent as much as possible. If the answer originally given by the respondent is inadequate for classification into one of the pre-coded alternatives, or an additional category, the interviewer should probe to elicit whatever additional information is needed. Unless instructed otherwise, check only one of the pre-coded responses.

c. Responses in a Table Form

In several questions, the answers will be entered in a table form. Whenever this is the case, you will be given specific instructions immediately before the first question relating to the table. Be sure to enter the answer in the correct row and column of the table. For the questions with pre-coded categories, enter the codes or number of the category into the correct cell of the table.

7. Probing

Probing is a tool in interviewing to obtain a full, complete and relevant answer from the respondent. An answer is probed whenever it does not adequately answer the question.

Do not immediately settle for an "I don't know" reply. If you feel the respondent is trying to fill the silence while she is thinking, be silent and wait. Later, you may use the following probes: "Well, what do you think?"

If you think the respondent says "don't know" because she is afraid of giving a wrong answer, you should say that there is no wrong or right answer, and that you just want the respondent's answer or opinion. However, if the respondent feels the question is too personal, reassure her that the survey information is confidential.

Always probe an "I don't know" reply at least before accepting it as final, but be careful not to antagonize the respondent or force him/her to give an answer. Remember, you do not want your respondent to give up the whole interview altogether.

8. Materials Required for the Interview

The following are the materials you need to carry out your job as an interviewer, you should bring these materials with you everytime you go out on field.

a. Questionnaires for the day's interview
b. Your ID
c. A map of your assigned territory
d. Sharpened pencils and eraser
e. Envelopes for completed questionnaires
f. Translation of the questionnaire

9. Ending the Interview

It is very important that you leave respondents with the idea that you are grateful for their cooperation. So, when you have finished asking all the questions, be sure that you thank the respondents and mention that her cooperation has been most helpful in providing information for the study.

10. Editing the Questionnaire Before Submission to the Field Supervisor

The process of reading and checking through the questionnaire is called "editing" and it is an important part of your job as an interviewer. You should read through the schedule at least once, to check for accuracy, completeness, and legibility as soon as possible after leaving the respondent. This would give you the opportunity to return to the respondent easily to ask questions which were omitted by mistake.

APPENDIX B

HOUSEHOLD QUESTIONNAIRE

RURAL WATER SUPPLY AND SANITATION PROJECT

HOUSEHOLD QUESTIONNAIRE

Name of Barangay: _____

Household No.: _____

Household Classification:

_____ Unserved Household, Unserved Barangay
_____ Unserved Household, Served Barangay
_____ Served

Water Service Classification:

_____ Level I
_____ Level II
_____ Level III
_____ Level II and III combination
_____ Other combinations

Date of Interview: _____
Time Started: _____ Time Ended: _____
Name of Interviewer: _____

[NOTE TO SURVEYOR: This study focuses on determining willingness to pay and the relationship of price and quantity for rural water systems. This information will be used in conjunction with data on the cost of alternative water systems to establish the conditions under which rural water systems can become financially sustainable. The household questionnaire is the most important element in this research project. From it we will be able to ascertain household need and willingness to pay for water while paying careful attention to the influence of non-economic factors. Thank you for your help. Good luck!]

VERSION A B C D

INTRODUCTORY STATEMENTS

A. Unserved Barangays

We are working on a water supply study in cooperation with the Department of Local Government. We would like to ask you some questions about your household's water use. Your answers will help us understand how to best supply potable water in barangays such as yours. Your answers will not be used for any other purpose.

B. Served Barangays

We are working on a water supply study in cooperation with the Department of Local Government. We would like to ask you some questions about your household's water use. Your answers will help us understand how much water people need. Your responses will greatly help us to design new water supply systems and for no other purpose.

I. HOUSEHOLD CHARACTERISTICS

1. Name of Respondent: _____

   Age: _____ Sex: _____ Male
   _____ Female

   Position in HH: _____ Husband
   _____ Wife
   _____ Other adult earning member of HH

   Highest Educ. Attainment: _____
   (or _____ yrs. of formal schooling)

2. How many people live in your house? _____

3. I would like to ask a few more questions about the other members of the household. Can you tell me their names?

	3a. Name of HH Member	3b. Sex	3c. Age	3d. Highest Educ. Attainment (put yrs. of school in parenthesis)	3e. Whether member is still in school
1.					
2.					
3.					
4.					
5.					

	3a. Name of HH Member	3b. Sex	3c. Age	3d. Highest Educ. attainment (put yrs. of school in parenthesis)	3e. Whether member is still in school
6.					
7.					
8.					
9.					
10.					

II. EMPLOYMENT AND INCOME

4. Who among the members of your household have worked in the last 12 months?

Name of HH Member	What is her/ his job or work	How many months in the last year has he /she been working as	For the mos. that he/she was working: How much did he/she earn in cash	How much did he/she earn in kind2	Total Peso Earned for the last year for each job
1. _____	_____( )1	_____	P_____	P_____	P_____
	_____( )	_____	_____	_____	_____
2. _____	_____( )	_____	_____	_____	_____
	_____( )	_____	_____	_____	_____
3. _____	_____( )	_____	_____	_____	_____
	_____( )	_____	_____	_____	_____

Special Instructions for the Interviewer:

1 Enter occupational code for given job.

2 For household members engaged in farming and fishing, determine annual income by first establishing the value of their (share of) harvest/catch per cropping/ fishing season the number of times they harvested during the year

For HH members in non-farm jobs with no fixed monthly wages or salaries, ask for average earnings in a month and multiply by the number of months worked.

5. Other than the above earnings of family members, does your household have other regular source of income as from rentals perhaps, or remittances, or sale of livestock or cashcrops grown by your household, other businesses, etc.?

_____ No, HH has no other source of income
_____ With income from rentals P_____per Year
_____ With income from remittance P_____per Year
_____ With income from crop sale P_____per Year
_____ With income from other business P_____per Year
_____ With income from other sources P_____per Year

III. HOUSEHOLD WATER SOURCES

5. FOR SERVED COMMUNITIES ONLY: Is your household a member of any local water association? (Note to interviewer: check "No" for Unserved communities)

_____ No
_____ Yes

6a. What is the name of your association?

_____

6b. What year did you join the association?

_____

7. Where has your household been getting its water the past week? (List sources from most to least used.)

(first source) a._____ e._____
b._____ f._____
c._____ g._____
d._____

8. During the past week, where did your household get water for:

	1st source	2nd source	3rd source	4th source	5th source	6th source
o Drinking	_____	_____	_____	_____	_____	_____
o Cooking	_____	_____	_____	_____	_____	_____
o Adult bathing	_____	_____	_____	_____	_____	_____
o Child bathing	_____	_____	_____	_____	_____	_____
o Washing	_____	_____	_____	_____	_____	_____
o Animal Upkeep	_____	_____	_____	_____	_____	_____
o Plant/ vegetable watering	_____	_____	_____	_____	_____	_____
o Other commercial activity(specify)	_____	_____	_____	_____	_____	_____
o Other uses(specify)	_____	_____	_____	_____	_____	_____

[Note to Interviewer: The possible sources of water include the ff:]

Rainwater
Spring
Lake/river
Irrigation canal
Water vendor
Public faucet
Public well
Neighbor s well
Own well
Neighbor connected to BWP system
Own connection
Another barangay (specify type of source)

9. During the dry season, do your sources of water change?

_____No
_____Yes

9.a What sources do you use in the dry season?

a._____ e._____
b._____ f._____
c._____ g._____
d._____ h._____

9.b In the dry season what sources do you use for:

	1st source	2nd source	3rd source	4th source	5th source	6th source
o Drinking	_____	_____	_____	_____	_____	_____
o Cooking	_____	_____	_____	_____	_____	_____
o Adult bathing	_____	_____	_____	_____	_____	_____
o Child bathing	_____	_____	_____	_____	_____	_____
o Washing	_____	_____	_____	_____	_____	_____
o Animal Upkeep	_____	_____	_____	_____	_____	_____
o Plant/ vegetable watering	_____	_____	_____	_____	_____	_____
o Other commercial activity(specify)	_____	_____	_____	_____	_____	
o Other uses(specify)	_____	_____	_____	_____	_____	_____

10. FOR HH USING RAINWATER

a. What do you use for rainwater storage? (Describe the material and location of source.)

_____

_____

b. How large is your rainwater storage?(get measurements and shape of storage and estimate capacity in liters.)

_____

_____

c. How often is this filled up during the rainy season?____ during the dry season? _____

d. How much rainwater do you use in a day in the rainy season? _____ in the dry season? _____

11. FOR HH USING SPRING, RIVER/LAKE, IRRIGATION CANAL, PUBLIC FAUCETS, PUBLIC WELLS, AND NEIGHBOR'S OR OWN WELL, ASK:

	SOURCES					
	1st	2nd	3rd	4th	5th	6th
a. How far is this source from your house?						
b. How long does it take you to walk from this source to your house?						
c. If you were to rate the water that comes from (NAME OF SOURCE) as good, fair or bad, how would you rate it in terms of the following:						
i) Color						
ii) Taste						
iii) Smell						
iv) Adequacy (plenty of water)						
v) Reliability (available all the time)						
vi) Distance/Convenience						
vii) Too crowded						
viii) Overall opinion						
d. Do HH members carry/collect some water from the (source), or do you do all your bathing/washing/etc. activities at the (source)?						
Carries						
Does all activities at source						

e. When you want to obtain good quality water for drinking or cooking, do you often pass by a nearby source but go to a farther source to obtain the better quality water?

_____ Yes

_____ No

12. If HH carries water from a given source back to their house, ask the following:

Who among the members of your HH perform the task of carrying water?

Name of carrier	Source where member get water	Number of times in a day he/she collects water	Time it takes for him/her to go fill up, and return 1/	Type & capacity of container used	Number of containers filled in a day	Time of the day he/she collects
1._____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
2._____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
3._____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
4._____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
5._____	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____	_____

1/ Includes travel time, queueing time and filling time.

13. FOR HH BUYING WATER FROM VENDORS

a. What containers do you use when you buy water? (Get measurements and shape of container.)

_____

_____

b. How many such containers do you buy in a day? _____

c. How much do you pay per container?_____

14. FOR HH USING PUBLIC FAUCETS, OR PUBLIC WELLS, ASK THE FF:

a. Is the public faucet or public well that you are using a part of an RWSA system?

_____ No

_____ Yes, public faucet that the HH uses is part of RWSA system

_____ Yes, public well that HH uses is part of RWSA system

b. Do you pay for use of this public faucet or well?

_____ No

_____ Yes, pays for public faucet. ₱_____ per/mo.

_____ Yes, pays for public well. ₱_____ per/mo.

15. FOR HH WITH OWN WELL

a. What kind of well do you have?

_____ open well

_____ closed well

b. How much did it cost you to construct your system? ₱_____

c. Where is this located? _____

d. How deep is your well? _____

16. FOR HH CONNECTED TO A NEIGHBOR'S SYSTEM

a. How much water do you get from your neighbor's system in in a day?_____

b. Do you pay your neighbor for drawing water from his/her system?

_____ No

_____ Yes 16.b.1 How much do you pay?_____

c. Is your neighbor's water system part of an RWSA?

_____ Yes _____ No

17. FOR HH WITH THEIR OWN CONNECTIONS

a. How much do you pay for water each month?

Rate/m^3 _____

_____

_____

Total paid: _____

b. How much water do you get for this amount? _____

c. Do you have neighbors who get or buy water from your connection?

_____ No (Go to 17.e)

_____ Yes

d. If yes to (c), what arrangements do you have with your neighbor/s regarding this?(Indicate prices charged or if arrangement is for free.)

_____

_____

e. How satisfied are you with the quality of your water service?

_____ Satisfied
_____ Unsatisfied (explain): _____
_____
_____

V. PERCEIVED NEED FOR WATER SYSTEM

18. [TO BE ASKED OF UNSERVED HOUSEHOLDS ONLY.] If a water system were to be constructed for the community, what improvements would you like to see in your HH's water sources and supply?

_____ cleaner/better quality of water

_____ adequate/reliable supply

_____ closer/more convenient source

_____ cheaper water

_____ none, satisfied with current source and supply

19. [FOR UNSERVED HOUSEHOLDS ONLY.] Between paying a regular (monthly) fee for a water system for your household and setting aside and saving money for your HH's emergency, medical or educational needs, would you rather

_____ pay for water system

_____ build HH savings for other needs

20. [FOR UNSERVED HOUSEHOLDS ONLY.] Between paying a regular (monthly) fee for a water system for your household and buying food for the family, would you rather

_____ pay for water system

_____ buy more food for the family

21. [FOR HH WITH NO ELECTRICAL CONNECTION]: Between paying a regular (monthly) fee for a water system and having your house connected to electricity, would you rather

_____ pay for water system
_____ have house connected to electricity

22. [ASK ALL HOUSEHOLDS] Let me read to you a list of possible projects that may be undertaken in your community. Which do you think is most needed, 2nd most needed, etc.,

Rank

_____ Roads

_____ Water Supply

_____ Electricity

_____ Health Service

_____ Livelihood Projects

_____ Toilet facilities

_____ Barangay Hall

_____ Irrigation

_____ Schools

_____ Others, specify:

_____
_____
_____

VI-1. WILLINGNESS TO PAY: UNSERVED HOUSEHOLDS/ UNSERVED BARANGAY

OPENING STATEMENT A: Show pictures, describe systems, and read statement.

If a water system were to be constructed in your community, the residents of the community would have to pay regular fees to ensure the operation of the system so that you and the others will have good quality water and an adequate and reliable supply. The water system will be managed and operated by a local water association in which residents will have to join to make use of the service. Membership in the association will cost ₱10 .

I am going to ask you some questions to find out if and how much your household would be willing to pay for such a system. The amount you say will not determine how much you actually pay if the system is actually built. The actual water charges would of course be decided on by the local water association. There are no right or wrong answers to my next questions. Your answers will not affect whether or not a system is built in your community. I would appreciate your answering these questions as candidly as you can.

BIDDING GAME A1: PUBLIC FAUCETS (ASCENDING)

[NOTE TO THE INTERVIEWER: When maximum is reached, go to Q. 26]

23. If public faucets of this kind (show picture) were to be constructed in the barangay such that 6 to 8 households will have use of one faucet (no more than 10 minutes away from your house), would your household be willing to pay ₱10 per month for such a service?

_____ Yes

_____ No

_____ DK

24. If the local water association decides to charge households ₱15 each per month, would your household be willing to pay for this amount?

_____ Yes

_____ No

_____ DK

25. If the decision is to charge each household ₱20 per month, would your household be willing to pay for this amount?

_____ Yes

_____ No

_____ DK

Use the following table to ask same question as above but with succeedingly higher amounts as indicated

Amount	Yes	No	DK
P25	_____	____	_____
P30	_____	____	_____
P35	_____	____	_____
P40	_____	____	_____
P45	_____	____	_____
P50	_____	____	_____
P55	_____	____	_____

26. If you think about it again, what is the largest amount that your household is willing to pay for a public faucet in your neighborhood?

_____ P _____

_____ DK

BIDDING GAME A2: HOUSEHOLD CONNECTIONS (ASCENDING)

[NOTE TO THE INTERVIEWER: When maximum is reached, go to 0.28.]

27. Suppose that the water system in your barangay will allow households to have individual piped connections into their houses, such as those shown in the pictures. For a private connection, you would have to pay a one time installation charge. This one-time charge may reach P1000 and is in addition to the P10 membership charge. Assuming good water is already available from nearby public faucets, would you be willing to pay P20 per month for an individual house connection?

_____ Yes

_____ No

_____ DK

Use the following table to ask the same question as above but with succeedingly higher amounts as indicated.

Amount	Yes	No	DK
P25	_____	____	____
P30	_____	____	____
P35	_____	____	____
P40	_____	____	____
P45	_____	____	____

Amount	Yes	No	DK
P50	_____	____	____
P55	_____	____	____
P60	_____	____	____

28. If you were to think about it again, what do you think is the largest amount per month that your household would be willing to pay for an individual connection?

P_____

29. FOR HOUSEHOLDS BUYING OR PAYING FOR WATER, ask:
Do you find the present rates that you pay for water

_____ Reasonable

_____ Expensive

_____ Inexpensive

VII. WILLINGNESS TO JOIN A LOCAL WATER ASSOCIATION

[TO BE ASKED ONLY IN UNSERVED COMMUNITIES OR TO UNSERVED HOUSEHOLDS IN SERVED COMMUNITIES.]

30. In order to receive water from an improved water system (i.e. faucets/house connections), it will be necessary to join the local barangay water association.

a. Would you be willing to join such an association in order to have a public faucet near your house for a one time membership fee of ₱10?

_____ Yes

_____ No

b. Would you be willing to join such an association to have an individual water connection in your house for a one time membership fee of ₱10?

_____ Yes

_____ No

c. What do you think of this one-time membership charge. Is this
_____ Just right
_____ Too low
_____ Too high

d. How financially manageable are connection and installation charges of up to ₱1,000 for individual connections for your own household?

_____ Easily manageable
_____ Manageable, with some difficulty
_____ Not manageable

VIII. AWARENESS OF WATER SYSTEMS IN OTHER BARANGAYS

31. Are you familiar with improved water systems in other barangays?

_____ Yes, specify name of barangay: _____

_____ No

32. If yes, are you aware of the prices charged to households for water in other barangays?

_____ No

_____ Yes. If so what are these prices?

1. ₱_____, for public faucets

2. ₱_____, for individual household connection

IX. HOUSING CONDITIONS

33. Do you own or rent your house?

_____ Own
_____ Rent
_____ Occupied rent-free

34. What does your household use for lighting?

_____ kerosene lamp Amount spent ₱/month_____

_____ petromax Amount spent ₱/month_____

_____ electricity

a. How many electrical bulbs?
_____

b. How much do you pay for electricity per month?

₱_____ /month

35. What type of fuel do you use for cooking?

_____ wood/charcoal Amount spent per month: ₱_____

_____ LPG Amount spent per month: ₱_____

_____ kerosene Amount spent per month: ₱_____

_____ electricity

36. What facilities do you have in your house for storing water?

	Type	Size (estimate storage capacity)
a.	_____	_____
b.	_____	_____
c.	_____	_____

37. a. Do you boil water brought into the house?

_____ No

_____ Yes, boils water. Specify _____
_____

b. Do you add anything to the water brought into the house?

_____ No

_____ Yes; specify _____

38. a. What type of toilet facilities do you have?

_____ Flush/ water sealed with septic tank

_____ Flush/water sealed without septic tank

_____ Antipolo/closed pit

_____ Open pit

_____ Public toilet

_____ None

_____ Others, specify: _____

b. What other sanitary facilities do you have? (e.g. shower, kitchen sink, etc.)

_____

_____

_____

39. Description of R's house

a. _____ squatter type; roof and walls of salvaged materials; no flooring

b. _____ semi-squatter; improved or semi-permanent roof and walls; no flooring

c. _____ native structure; bamboo or sawali walls; raised floor; one room

d. _____ same as (c) but multi-room

e. _____ non-native materials; wood walls; multi-room or unfinished hollowblock; single storey

f. _____ multi-storey, non-architectural; usually concrete lower floors and walls; wooden upper storey walls

g. _____ small, less than 30 sq. m., decorated or architectural treated; either wood or concrete

h. _____ medium, 30-60 sq. m., same as item (g)

i. _____ large, 60-100 sq. km., same as item (g)

j. _____ very large; over 100 sq. m., same as item (g) or any commercial structure; sari-sari stores in residences are not considered commercial

40. Where does your household go to market?

_____ buy from vendors in the neighborhood

_____ barangay market

_____ town market

_____ city market

_____ provincial capital town market

41. How often does your household go to these markets? _____

X. AVERTING (ATTAINING) BEHAVIOR

42. If you felt that by improving your water supply, your family's health would improve, would you be willing to pay more (extra)?

_____ No
_____ Yes How much more? _____/month

43. If you felt that an improved water supply would lead to more jobs in your barangay, would you be willing to pay more (extra)?

_____ No
_____ Yes How much more? _____/month

XI. COMPARATIVE VALUE

44. [FOR HOUSEHOLDS WITHOUT INDIVIDUAL CONNECTIONS, ASK:] You currently carry water to your house in a _____ which holds approximately _____. What are some things that you currently purchase or use which you consider of equal value to one container, if you had to barter for water

_____
_____

45. Is your household currently receiving income from abroad?

_____ No
_____ Yes

XII. 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?

   _____ Excellent
   _____ Good
   _____ Fair
   _____ Mediocre
   _____ Bad

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

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

For Served Households in Served Barangays, Complete Section XIII.

APPENDIX C

RWSA QUESTIONNAIRE

RURAL WATER SUPPLY AND SANITATION PROJECT

RWSA QUESTIONNAIRE

Name of RWSA: _____

Location: _____
(Municipality, Province)

RWSA No. _____

Water Service Classification

___ Level I
___ Level II
___ Level III
___ combination of Levels II and III
___ other combinations

No. of Barangays Served by the RWSA: _____

1. _____
2. _____
3. _____

Name of Respondent/s	Position in the RWSA
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

[NOTE TO SURVEYOR: This study focuses on determining willingness to pay and the relationship of price to quantity for rural water systems. Information is being collected on RWSA operations and performance in several barangays. The purpose of this questionnaire is to provide data on the price-quantity relationship of water consumption and to provide the project engineers information on water system costs and performance. Thanks for your help. Good Luck.]

I. RWSA ORGANIZATION

1. When was your RWSA formed or organized?

Month/year organized: _____

Month/year when water system was turned over to RWSA: _____

2. Does your RWSA follow the standard organizational structure for RWSA's, with a Board of Directors, and _____ _____, and _____, and _____ Committees?

___ Yes
___ No

2.a. If so, what is the organization of your RWSA like?

_____
_____
_____
_____

3.a. What other positions do the officers or board members of your RWSA hold in the community?

	Positions Held in Community	Time in Position
President	_____	_____
V-President	_____	_____
Secretary	_____	_____
Treasurer	_____	_____
Other Board Member	_____	_____

3.b. If something goes wrong with your water system, is it relatively easy for any one of your officers or board members to get assistance from the provincial engineer's office or from the provincial government?

_____
_____
_____

4. Does your RWSA employ any of the following personnel:

Position	Part-time / Full-time	Salary/Honorarium paid per month	No pay/ serves as volunteer	Time in Position
Systems superintendent				
Operator				
Collector				
Bookkeeper				
Others, specify				

5. With regard to officers and staff:

   a. How many people have held these positions since the beginning of RWSA?

   b. What specific management and staff problems has the RWSA experienced?

II. RWSA MEMBERSHIP AND RATE STRUCTURE

6. Obtain from the RWSA data on the following:

	Total # of HHs in the Bgy./s Served by the RWSA			Total # of HHs in RWSA Service Area in Bgy./s			Total # of HHs joining RWSA in served Bgy./s		
	1	2	3	1	2	3	1	2	3
At beginning									
End of Year 1									
End of Year 2									
End of Year 3									
End of Year 4									
End of Year 5									
End of Year 6									
End of Year 7									
End of Year 8									
End of Year 9									
Currently									

6.a. Obtain from the RWSA the following data on levels of service (Divide by Measer/Non-Measer if necessary):

	# of HHs served by a Level I System	# of common faucets in Level II System	# of HHs served by Level II faucets		# of HH connections in Level III	# of HH connected to Level III HH	
			M	NM		M	NM
At beginning							
At present							

7. What is the rate structure of your RWSA water charges for:

	At beginning	At present
a. Level II households		
1. Structure of minimum flat rates		
2. Structure of rates above the minimum flat rate		
3. Other ways of computing water charges		
b. Level III households		
1. Structure of minimum flat rates		
2. Structure of rates above the minimum flat rate		
3. Other ways of computing water charges		
c. Business use (using water for one's orchards, poultry, piggery or other business)		
1. Structure of minimum flat rates		
2. Structure of rates above the minimum flat rate		
3. Other ways of computing water charges		
d. Other situations		
1. Provision of free water (Why?)		
2. Special rates (Purpose)		
3. Other		

5

8. What dues, fees or other expenses must the household pay for or incur to join a

	Member-ship	Equity	Own Meter	Own Pipes	Instal-lation Fees	Others
Level II system						
Level III system						
Other (e.g. Combinations)						

9.a. What expenses would a household have to shoulder, if it were to join a Level II system?

_____

9.b. What expenses would a household have to shoulder, if it were to convert from Level II to Level III?

_____

10. Do you have non-member households getting water from your RWSA Level II faucets?

___ None
___ Yes 10.a. How many? _____

10.b. What policies do you have regarding these extra connections?

_____

_____

11. Do you have non-member households connecting to your Level III connections?

___ None
___ Yes 11.a. How many? _____

11.b. What policies do you have regarding these extra connections?

_____

_____

12. How often does your RWSA governing body meet?

_____

13. What is the average attendance at these meetings?

_____

III. RWSA OPERATIONS AND FINANCING

14. Estimate the percent distribution of water use:

Type		%
Household		___
Business		___
Other:	_____	___
	_____	___

15. What is the design capacity of your systems and how has it changed over time?

	Maximum number of HH serviceable	Maximum cubic meter of water deliverable
At Beginning		
End of Year 1		
End of Year 2		
End of Year 3		
End of Year 4		
End of Year 5		

End of Year 6 _____

End of Year 7 _____

End of Year 8 _____

End of Year 9 _____

Currently _____

16. Please describe the reliability of your system.

_____

_____

_____

16.a. For example, can you recall the approximate number of days of lost service?

Year of operation	Days lost
Year 1	_____
Year 2	_____
Year 3	_____
Year 4	_____
Year 5	_____
Year 6	_____
Year 7	_____
Year 8	_____
Year 9	_____
Current year	_____

17. Can you discuss the adequacy (sufficiency) of your system. Can you provide sufficient water to all sewer households?

_____

_____

_____

_____

17.a. For example, how many households would you say regularly are without water or received only reduced supplies?

Year of operation	No. of HH
Year 1	
Year 2	
Year 3	
Year 4	
Year 5	
Year 6	
Year 7	
Year 8	
Year 9	
Current year	

18. How would you describe the quality of your water with regard to:

	Good	Fair	Poor
Color			
Taste			
Other (Specify)			

19. Since the RWSA began operations, what other sources of water are in use in the barangay? Please indicate number.

Year	Springs	Rivers/ streams	Irrig. canals	Private wells	HHs collecting rainfall (est.)	Other (specify)
1						
2						
3						
4						
5						
6						
7						
8						
9						
Current						

20. In what years have you made significant improvements to your system?

Year	Type of improvement	Amount spent

21. What was the total cost of your system?

Total cost ₱_____

GOP part ₱_____
Provincial part ₱_____
Loan ₱_____

Date of loan _____
Interest rate _____
Loan term _____
Amount due/month ₱_____

22. How have collections/delinquencies changed over time?

Year	# of delinquent HHs
1	
2	
3	
4	
5	
6	
7	
8	
9	
Current	

17. RWSA SYSTEM CHARACTERISTICS

23. Well

a. Type _____
Diameter, depth, drilling or dug

b. Casing used: _____ Yes
_____ No

c. Well screen type: _____ cut and slotted
_____ actual well screen

d. Screen feet in well: _____ Yes
_____ No

e. Gravel pack: _____ Yes
_____ No

f. Cost for well drilling and development:

P_____ in 19___

g. Well rehabilitated: _____ Never
_____ In 19___
_____ In 19___
_____ In 19___

h. Well problems:

_____
_____
_____
_____

24. Well pump/motor assembly

a. Type: _____

b. Motor horsepower: _____

c. Pump stages: _____

d. Motor design voltage: _____

e. Electrical phase: _____

f. Pump brand/model: _____

g. Pump rating: lps at _____ TDH at _____ rpm

h. Pump rating: gpm at _____ TDH at _____ rpm

i. Pump characteristics:

_____

_____

j. Total well depth to water table: _____ feet

k. Pump depth setting in well: _____ feet

l. Feet of water in well above pump: _____ feet _____ gallon
_____ cu. meter

m. Total depth of well: _____ feet

n. Depth of well to pump: _____ feet

o. Unused well volume: _____ feet _____ gallon
_____ cu. meter

p. Cost of pump/motor: ₱_____ in 19___

q. No. of motor repairs since original installation: _____

Year/month/cost ₱ of repairs: #1 _____
#2 _____
#3 _____
#4 _____
#5 _____
#6 _____
#7 _____
#8 _____

r. No. of pump repairs since original installation: _____

Year/month/cost ₱ of repairs: #1 _____
#2 _____
#3 _____
#4 _____
#5 _____
#6 _____
#7 _____
#8 _____

s. Is pump/motor assembly routinely pulled out of hole for regular inspections and maintenance?

_____ Yes
_____ No At what frequency? _____

t. Where does RWSA take pump or motor for repair?

_____ Provincial city
_____ Within barangay
_____ Municipality
_____ Metro Manila

u. Does RWSA have a spare pump for well?

_____ Yes
_____ No

v. Does RWSA have a spare motor for well?

_____ Yes
_____ No

w. Does RWSA have a spare pump/motor for well?

_____ Yes
_____ No

25. Well screen assembly

a. Type: _____

b. Brand: _____

c. Model: _____

d. Screen length: _____ feet

e. Open area: _____ feet
_____ %

f. Screen diameter: _____

g. Recharge estimate (maximum): _____ gal/sq.ft./min
_____ liters/sq.m./sec

h. Recharge estimate (minimum): _____ gal/sq.ft./min
_____ liters/sq.m./sec

i. Screen problems:

_____
_____
_____

j. Number of times well screen has to be cleaned/pulled over life of RWSA system: _____ times since 19___

k. Frequency of screen pull: _____ 19___
_____ 19___
_____ 19___
_____ 19___

2a. Electric motor controls at RWSA (Buswork)

a. Type of buswork: _____

b. Brand: _____

c. Buswork components:

_____
_____
_____
_____
_____

d. Does buswork have voltage regulator?

_____ Yes
_____ No

If yes, Brand: _____

Type, model: _____

Voltage protection range: _____ volts
(specify other units if protection is identified in other units)

Has this ever been replaced?

_____ Yes
_____ No

e. Does buswork have shutdown fuses?

_____ Yes
_____ No

If yes. Brand: _____

Type, model: _____

Number of fuses: _____

Ampere range for shutdown: _____ amps

Have these fuses had to be changed?

_____ Yes
_____ No

If yes, when? _____

f. Does buswork have circuit breaker?

_____ Yes
_____ No

If yes, Brand: _____

Type, model: _____

Voltage and ampere shutdown range: _____ volts
_____ amps

Has this circuit breaker had to be changed?

_____ Yes
_____ No

If yes, when? _____ 19__
_____ 19__
_____ 19__

g. Who performs work on RWSA busworks system?

_____ electrical contractor
_____ PES
_____ RWSA operator
_____ other

h. Is busworx repairman certified or licensed in any way?

_____ Yes
_____ No

i. Has busworks problems caused any long outages of RWSA system?

_____ Yes
_____ No

If yes, when? 19___ for _____ days
19___ for _____ days
19___ for _____ days

27. Storage tank

a. Is storage tank on frame?

_____ Yes
_____ No

b. Dimensions of tank: Diameter _____ feet _____ meters

Length of tank _____ feet _____ meters

c. Shape of tank:

_____ sphere
_____ square
_____ cylinder

d. Total storage volume in tank(s): _____ liters
_____ cu. meters
_____ gallons

e. Effective storage volume in tank(s) due to current hydraulic grade line:

_____ liters
_____ cu. meters
_____ gallons

f. Has leaks in the storage tank caused any RWSA system shutdowns since installed?

_____ Yes
_____ No

If yes, when? 19___ for _____ days
19___ for _____ days
19___ for _____ days
19___ for _____ days

g. Type of tank support:

Earth bern surrounded by concrete wall: _____ Yes
_____ No

Conical ring type support: _____ Yes
_____ No

Other

h. Any tank support problems? _____ Yes
_____ No

29. Piping

a. Size of pipes and lengths for original system

_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe
_____ feet of _____ inch diameter PVC/GI pipe

b. Pipe type: _____

c. Pipe brand(s):

_____
_____
_____

d. Pipe specifications:

_____
_____
_____

e. Does RWSA have extra piping stocked at each of the sites in its system?

_____ Yes
_____ No

If yes, specify: _____ ft. of _____ dia.
_____ ft. of _____ dia.
_____ ft. of _____ dia.
_____ ft. of _____ dia.
_____ ft. of _____ dia.
_____ ft. of _____ dia.
_____ ft. of _____ dia.
_____ ft. of _____ dia.

f. Where does RWSA get piping for breaks?

_____ PSS
_____ commercial supplier in municipality
_____ commercial supplier in province
_____ other (specify _____)

_____
_____ _____

g. Do pipeline problems exist now?

_____ Yes
_____ No

If yes, specify

_____
_____
_____

h. What pipeline problems have the RWSA had over system life?

_____
_____
_____

i. Is system currently able to fully serve consumer demand of population served on a 24 hours basis?

_____ Yes
_____ No

29. Faucets

a. Type: _____

b. Brand/model: _____

c. Size: _____ dia. inches

d. Material: _____ brass
_____ GI
_____ steel
_____ aluminum

e. Automatic shutdown type: _____ Yes
_____ No

f. Does RWSA own faucets?

_____ Yes
_____ No

g. Does RWSA repair faucets?

_____ Yes
_____ No

h. Does RWSA stock repair seals or gaskets for sale to HH for repair of leaky faucets?

_____ Yes
_____ No

i. If faucet is broken or leaks significantly, does RWSA cut water off at valve before house connection?

_____ Yes
_____ No

j. How often does system operator check for leaky faucets?

_____ daily
_____ weekly
_____ monthly

k. Do other people check for leaks?

_____ Yes
_____ No

D. Meters

a. Type/material: _____

b. Brand: _____

c. Diameter: _____

d. Does RWSA own system meters?

_____ Yes
_____ No

If yes, how many? _____

e. Does RWSA maintain a supply of spare meters?

_____ Yes
_____ No

f. When meter goes out at HH connection, what does RWSA do about service to HH?

_____
_____
_____
_____

g. Where are meters repaired and recalibrated?

_____ at PES
_____ at private shop
_____ at LWUA facility in province
_____ at RWSA
_____ at other places (specify _____)

h. Do meters go for long periods without maintenance?

_____ Yes
_____ No

i. How often does system operator check meters in system to determine if they are operating or not?

_____

j. Are meters sometimes bypassed in this RWSA by the HH?

_____ Yes
_____ No

If yes, what does RWSA do?

_____
_____
_____

k. Are meters purposely broken by HHs?

_____ Yes
_____ No

If yes, what does RWSA do?

_____
_____
_____

l. What major problems are occurring with meters in community HHs?

_____
_____
_____
_____

30. Interviewer's own ratings:

a. How would you rate the management and operations of this RWSA?

1 Excellent
2 Good
3 Fair
4 Poor

b. How would you rate the records and record-keeping practices of this RWSA?

1 Excellent
2 Good
3 Fair
4 Poor

[NOTE TO SURVEYOR: Go to Q. 31, Monthly Data Summaries.]

APPENDIX D

ALTERNATIVE ESTIMATIONS AND RELEVANT STATISTICS FOR HOUSEHOLD WTJ AND WTP

TABLE D-1

SELECTED ELASTICITIES[a]

Data Set: Pooled Water Source: Household Behavior:	Public Faucet WTJ[b]	 WTP[c]	Individual Connection WTJ[b]	 WTP[c]
Variables				
Respondent Characteristics				
AGE	-0.13		-0.09	
Household Characteristics				
YRSCHO		0.16		0.23
MEMHH		0.15		0.14
HOME	-0.06		0.07	0.24
TUTILITY		0.12	0.04	0.09
Water Source Characteristics				
WALKTIME		0.03		0.04

[a]Elasticities are given only for continuous variables that are statistically significant. These are derived from the first stage (probit) and second stage Heckman model.

[b]WTJ elasticities are given by $E_i = f(z)\beta_i[X_i/WTJ]$, where $\partial P(WTJ)/\partial X_i = f(z)\beta_i$ and $f(z)$ is the value of the standard normal density function. The mean value for each relevant variable is used.

[c]WTP elasticities are given by $E_i = \beta_i[X_i/WTP]$. The mean value for each relevant variable is used.

TABLE D-2

WILLINGNESS TO JOIN FOR AN IMPROVED WATER SOURCE
WEIGHTED LEAST SQUARES[a]

	Public Faucet	Indivividual Connection
Econometric Technique: WLS		
Data Set: Pooled		
Number of Observations:	667	696
Mean Value of WTJ[b]:	3.65	3.98
Variables		
Weight & Village Dummies		
WEIGHT[c]	1.13***	1.02***
	(21.62)	(18.41)
DUMBAN	-0.07***	0.006
	(-2.63)	(0.23)
DUMPAK	-0.15***	-0.21***
	(-5.25)	(-5.53)
DUMST	-0.13***	-0.02
	(-4.94)	(-0.71)
Respondent Characteristics		
SEX	-0.0005	0.008
	(-0.03)	(0.48)
AGE	-0.002***	-0.004***
	(-3.54)	(-4.90)
POSITION	0.01	-0.02
	(0.44)	(-0.73)
Household Characteristics		
YRSCHO	-0.004	-0.007***
	(-1.38)	(-2.90)
FAMILIAR	0.05***	0.04**
	(2.94)	(2.56)
MEMHH	-0.006*	0.005*
	(-1.69)	(1.73)
HOME	-0.02***	0.01**
	(-3.24)	(2.06)
TUTILITY	0.0001	0.0005***
	(0.73)	(3.53)

TABLE D-2
(Continued)

	Public Faucet	Individual Connection
Water Source Characteristics		
QUALS1	0.12***	0.02
	(6.29)	(1.21)
WALKTIME	0.0008*	-0.0008
	(1.87)	(-1.05)
R-Squared	0.981	0.975
Adjusted R-Squared	0.981	0.974

[a]t-values are in parentheses.

[b]This is the mean of the weighted WTJ. The weight is given by $w_i = [\hat{Y}_i(1 - \hat{Y}_i]^{1/2}$.

[c]The model is estimated without an intercept as the original intercept becomes α / w_i.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

TABLE D-3

WILLINGNESS TO JOIN FOR AN IMPROVED WATER SOURCE
SCALE-ADJUSTED COEFFICIENTS[a]

	Public Faucet		**Individual Connection**	
Data Set: Pooled				
Econometric Technique:	Probit	Logit	Probit	Logit
Variables:				
Intercept & Villages Dummies				
INTERCEPT	1.59***	1.72***	1.04***	1.03**
DUMBAN	-0.19	-0.25	0.06	0.08
DUMPAK	-0.32***	-0.40***	-0.34***	-0.39***
DUMST	-0.31***	-0.39***	0.01	0.01
Respondent Characteristics				
SEX	-0.004	-0.01	0.02	0.02
AGE	-0.008***	-0.008***	-0.004*	-0.005*
POSITION	0.06	0.09	-0.05	-0.03
Household Characteristics				
YRSCHO	-0.01	-0.02	0.002	0.005
FAMILIAR	0.12*	0.13*	0.08	0.08
MEMHH	-0.01	-0.01	-0.004	-0.008
HOME	-0.03*	-0.04*	0.04*	0.05*
TUTILITY	0.0002	0.0002	0.002***	0.002**
Water Source Characteristics				
QUALS1	0.32***	0.38***	0.06	0.05
WALKTIME	0.008	0.01	-0.002	-0.002

[a] The coefficients are adjusted as follows: (1) $\hat{\alpha}_{OLS} \cong 0.4\hat{\alpha}_P + 0.5 \cong 0.25\hat{\alpha}_L + 0.5$, and (2) $\hat{\beta}_{OLS} \cong 0.4\hat{\beta}_P \cong 0.25\hat{\beta}_L$ where the ordinary least squares model is subscripted by OLS, probit by P and logit by L.

***1 percent level of significance.

**5 percent level of significance.

*10 percent level of significance.

TABLE D-4

WILLINGNESS TO PAY FOR AN IMPROVED WATER SOURCE
ABOVE THE LIMIT VALUES[a]

	Public Faucet	Individual Connection
Econometric Technique: OLS		
Data Set: Pooled		
Number of Observations:	669	668
Mean Value of WTP:	16.10	23.47
Variables:		
Intercept & Villages Dummies		
INTERCEPT	12.41***	8.67**
	(4.12)	(2.08)
DUMBAN	-0.89	0.69
	(-0.61)	(0.34)
DUMPAK	-1.67	1.65
	(-1.21)	(0.81)
DUMST	-1.22	2.06
	(-0.86)	(1.05)
Respondent Characteristics		
SEX	-0.96	-1.08
	(-0.99)	(-0.80)
AGE	-0.06	-0.09*
	(-1.62)	(-1.82)
POSITION	-0.58	0.69
	(-0.38)	(0.34)
Household Characteristics		
YRSCHO	0.34**	0.80***
	(2.22)	(3.95)
FAMILIAR	1.26	1.12
	(1.34)	(0.86)
MEMHH	0.39**	0.58**
	(2.09)	(2.28)
HOME	0.31	1.26***
	(1.03)	(3.03)
TUTILITY	0.04***	0.04***
	(6.95	(4.85)

TABLE D-4
(Continued)

	Public Faucet	Individual Connection
Water Source Characteristics		
QUALS1	-0.52	1.12
	(-0.56)	(0.86)
WALKTIME	0.06**	0.11***
	(2.45)	(2.83)
CVM Bias Control		
DUMBID	-1.95**	-1.56
	(-2.22)	(-1.28)
DUMSTRAT	0.92	-0.38
	(1.06)	(-0.32)
R - Squared	0.165	0.182
Adjusted R - Squared	0.146	0.163

[a] t-values are in parentheses.
***1 percent level of significance.
**5 percent level of significance.
*10 percent level of significance.

TABLE D-5

WILLINGNESS TO PAY FOR AN IMPROVED WATER SOURCE
ADJUSTED COEFFICIENTS

	Public Faucet		Individual Connection	
Data Set: Pooled Econometric Technique: Tobit				
Adjusted Coefficients:	$\frac{\partial E(WTP)^a}{\partial X_i}$	$\frac{\partial E(WTP^*)^b}{\partial X_i}$	$\frac{\partial E(WTP)^a}{\partial X_i}$	$\frac{\partial E(WTP^*)^b}{\partial X_i}$
Variables:				
Intercept & Villages Dummies				
INTERCEPT	15.16***	12.55***	7.02*	6.14*
DUMBAN	-1.47	-1.22	0.71	0.62
DUMPAK	-3.83***	-3.16***	-3.94**	-3.45**
DUMST	-2.96	-2.45	1.22	1.07
Respondent Characteristics				
SEX	-0.66	-0.55	-0.54	-0.47
AGE	-0.11***	-0.09***	-0.11**	-0.10**
POSITION	0.16	0.13	0.65	0.57
Household Characteristics				
YRSCHO	0.83	0.69	0.69***	0.60***
FAMILIAR	2.02**	1.67**	1.81	1.58
MEMHH	0.18	0.15	0.44*	0.38*
HOME	-0.17	-0.14	1.36***	1.19***
TUTILITY	0.04***	0.03***	0.04***	0.03***
Water Source Characteristics				
QUALS1	2.00**	1.65**	1.80	1.58
WALKTIME	0.08***	0.07***	0.06*	0.05*
CVM Bias Control				
DUMBID	-3.47***	-2.87***	-2.63**	-2.30**
DUMSTRAT	2.19**	1.81**	-1.78	-1.56

[a] The change in WTP (inclusive of limiting values) corresponding with a change in X_i is given by $\partial E(WTP)/\partial X_i = F(z)\beta i$, where F(z) is the cumulative normal distribution function and $z = X\beta/\sigma$ evaluated at the mean values for X.

[b] The change in WTP* (exclusive of limiting values) corresponding with a change in X_i is given by $\partial E(WTP^*)/\partial X_i = \beta_i[1 - zf(z)/F(z) - f(z)^2/F(z)^2]$, where f(z) is the unit normal density function, F(z) is the cumulative normal distribution function, $z = X\beta/\sigma$ and z is evaluated at the mean values for X.

***1 percent level of significance.

**5 percent level of significance.

APPENDIX E

ALTERNATIVE ESTIMATIONS AND RELEVANT STATISTICS FOR SAN JUAN AND RWSA

TABLE E-1

HOUSEHOLD PAYMENT FOR AN IMPROVED WATER SOURCE
ADJUSTED COEFFICIENTS

Data Set: San Juan

Econometric Technique: Tobit
Water Source: Individual Connection

Adjusted Coefficients:	$\frac{\partial E(WTP)^a}{\partial X_i}$	$\frac{\partial E(WTP^*)^b}{\partial X_i}$
Variables:		
INTERCEPT	-44.40**	-31.86**
YRSCHO	-0.87	-0.62
MEMHH	5.57***	4.00***
HOME	6.18***	4.44***
TUTILITY	0.12***	0.09***

[a] The change in WTP (inclusive of limiting values) corresponding with a change in X_i is given by $\partial E(WTP)/\partial X_i = F(z)\beta i$, where F(z) is the cumulative normal distribution function and $z = X\beta/\sigma$ evaluated at the mean values for X.

[b] The change in WTP* (exclusive of limiting values) corresponding with a change in X_i is given by $\partial E(WTP^*)/\partial X_i = \beta_i[1 - zf(z)/F(z) - f(z)^2/F(z)^2]$, where f(z) is the unit normal density function, F(z) is the cumulative normal distribution function, $z = X\beta/\sigma$ and z is evaluated at the mean values for X.

***1 percent level of significance.
**5 percent level of significance.
*10 percent level of significance.

TABLE E-2

HOUSEHOLD PAYMENT FOR AN INDIVIDUAL CONNECTION
SAN JUAN[a]

Econometric Technique: OLS		
Data Set:	Selected (WTP>0)	Total (WTP≥0)
Number of Observations:	156	196
Dependent Variable: HPAY		
Mean Value of WTP:	72.24	57.49
Variables		
INTERCEPT	38.08	-13.48
	(1.54)	(-0.74)
Household Characteristics		
YRSCHO	-0.26	-0.67
	(-0.18)	(-0.51)
MEMHH	5.44***	6.14***
	(2.91)	(3.63)
HOME	-2.19	3.43
	(-0.68)	(1.57)
TUTILITY	0.12***	0.14***
	(2.95)	(3.70)
R-Squared	0.122	0.185
Adjusted R-Squared.	0.099	0.168

[a]t-values are in parentheses.
***1 percent level of significance.
**5 percent level of significance.
*10 percent level of significance.

TABLE E-3

PAYMENT FOR WATER SERVICES[a]

Econometric Technique: OLS			
Data Set: RWSA	1	2	3
Dependent Variable: BILHH			
Number of Observations:	34	42	34
Mean of Dependent Variable:	41.07	37.27	41.07
Variables			
Intercept and Control			
INTERCEPT	-17.30	15.3	17.99**
	(-0.74)	(1.41)	(2.21)
Household Characteristics			
INCOME	0.020***	0.026***	0.022***
	(3.33)	(5.26)	(4.13)
WATER	1.20*		0.49
	(1.73)		(0.83)
Water Source Characteristics			
LEVELPCT	-2.48	-2.35	-0.42
	(-0.48)	(-0.50)	(-0.08)
OVERALL	4.16	7.48**	7.05**
	(1.14)	(2.36)	(2.14)
PCTHHRWO	-3.87	-17.85***	-12.10
	(-0.40)	(-2.79)	(-1.44)
QUALITY	5.26	1.35	
	(1.55)	(0.65)	
ALTSRC1	-4.29	-4.91	
	(-0.75)	(-1.03)	
R-Squared	0.615	0.585	0.570
Adjusted R-Squared	0.512	0.514	0.493

[a]t-values are in parentheses.
***1 percent level of significance.
**5 percent level of significance.
*10 percent level of significance.

VITA

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