University of Alberta

Demand for Water in Queretaro, Mexico: A Study of the Preferences for Water Supply Improvements

by

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Abstract

This thesis investigates the demand for water supply improvements in Queretaro, Mexico. Queretaro currently lacks of adequate water supply services and it is of interest to know if residents would be willing to finance improvements to the water supply system.

The data for this work were collected with two in-person surveys of Queretaro's households. The first survey was administered to a stratified random sample of 629 homes with piped water services. The second survey was conducted with a semi-random sample of 207 households in informal settlements that do not have private water services.

This thesis is one of the first studies in Mexico that demonstrates that residents are willing to pay a significant amount of money for water supply improvements. This study also provides some of the first evidence from Latin America that residents from informal settlements are willing to pay a considerable proportion of their income for water service improvements.

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I also want to thank to Nicole Carter because she introduced me to the study of the economic value of water assets while we worked together at my old school, the CIDE.

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And finally but not least in importance, thanks to every person that opened their houses and participated in this study.

¡Muchas Gracias a todos!

Dedication

To all the people of Queretaro and Mexico, especially to those that do not have enough water and economic opportunities.

A toda la gente de Querétaro y México, especialmente a los que no tienen suficiente agua y oportunidades económicas.

Preface

My interest to study the demand for and the economic value of water originated when I was working at my old school, *Centro de Investigacion y Docencia Economicas* (Center of Research and Teaching in Economics, CIDE). In this research center, Dr. Nicole Carter and I worked on research projects that studied the water resources of the Rio Bravo and Lerma-Chapala Basins. Through these projects I learned about water scarcity problems in Mexico and just how complex they can be. Mexico and all of Latin America face a significant research gap in water economics analysis. As a Mexican citizen I understand the urgency for data and research that helps identify and design solutions to our country's water problems.

I came to Canada motivated to obtain my Masters degree at the University of Alberta. At the Department of Rural Economy of the U of A, I was able to obtain a kit of tools and methodologies to study the economics of natural resources such as water. After completing my graduate courses and having in mind Mexico's need for research, I decided to undertake a Master's project that aimed at studying the economic value of water in Mexico.

I chose Queretaro as the case study because this city is my hometown and I have first hand knowledge of the city's water problems. The goal of this research is to contribute to Mexico's body of information and to encourage discussions on possible solutions to water problems in Mexico and other developing countries.

Queretaro is a medium size city with important history related to water resources. In the early 1700's, the city built its first major water supply system, the Aqueduct. The Aqueduct is a system of 74 arches made of stone and cement with an average height of 23 meters and a length of about 1.3 kilometers that took water across the Valley of Queretaro (Gobierno del Estado de Queretaro, 2006). This system transported water from the springs of *La Cañada* (east of the city) to Queretaro's downtown. In those days, water was very abundant and it was possible for the residents to obtain it from public fountains or to receive it in the residential yards.

Nowadays, the Aqueduct still rises in the middle of the valley but only as a major tourist attraction. The Aqueduct no longer transports water to the city's downtown core because the springs in *La Cañada* are dry. With the drying of *La Cañada* and other sources, water in the capital city has now become a scarce resource. Many people in Queretaro do not have an adequate water supply service and the aquifer that provides water to the city is being depleted.

In collaboration with Dr. Sean Cash and Dr. Vic Adamowicz, I designed and implemented the research found in this thesis. Throughout the spring and the summer of 2005 I traveled to Queretaro, Mexico to pilot test our survey and to collect the data. With a group of 13 enumerators we conducted a survey and knocked on more than 2,000 doors. The experience was very motivating and has allowed us to learn a lot about Queretaro and its residents. It was also very rewarding to see that many participants were very interested in this study.

I hope that the results of this thesis help to provide better water supply services to Queretaro's people and support the water availability for future generations.

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Chapter 1
Overview

According to the United Nations World Water Development Report, currently about 1.1 billion people in the world lack access to adequate water supply services and 2.4 billion people do not have adequate sewage systems (United Nations Educational, Scientific and Cultural Organization, 2003). In Latin America, approximately 20% of the population of the major cities lives without water taps in their houses or their yards. About 40% of the world's population lives in arid and semi-arid regions and they share only 2% of the available water runoff. If water consumption trends continue, by 2025, 48% of the world's population will live in water stressed-areas (Revenga, 2000).

Queretaro is one of the many communities facing significant challenges in guaranteeing its water availability for the future. The City of Queretaro is located in the central high plains of Mexico. This city has approximately 900,000 residents and it is currently one of the most developed cities in Mexico. Queretaro's success is due to significant economic growth during the last decade in its industry and services sectors. In the last 10 years, the State of Queretaro has had an average annual GDP growth of 5% compared to a national average of 2.9%. The state's prosperity is attracting new residents from other parts of Mexico pushing the current population growth rate to 2.58% (Consejo Nacional de Poblacion, 2006a).

Despite the promising economic development in Queretaro, the city currently has several problems related to water availability, water quality and water resource exploitation. More than 12,000 residents of Queretaro live in neighbourhoods without access to piped water (Instituto Nacional de Geografia, Estadistica e Informatica, 2006a). Instead, these residents have to hire trucks that carry water to their houses or share public taps. In addition, the city currently lacks a water supply service that guarantees water 24 hours a day supply for all its residents and most of the people do not drink water from the water supply service because of health concerns.

The Government of the city and the State of Queretaro have already proposed and budgeted some infrastructure projects and programs to improve the water supply system. However, some of those projects might not be feasible to undertake because of insufficient funding. Therefore, it is important to know if the residents would be willing to finance partially or totally the necessary programs or investments to have an adequate water supply system.

This thesis explores the demand for water supply improvements in the city of Queretaro, Mexico. The analysis presents estimates of the benefits generated from providing Queretaro's residents with a 24 hour water service and water that is safe to drink from the tap. The individual willingness to pay (WTP) for water supply improvements is an appropriate measure of the person's economic benefits derived from better water services. Once the individual WTP is estimated, it is possible to calculate the total economic benefits or WTP for the whole population of Queretaro. Additionally, this thesis studies how the characteristics from Queretaro's households affect the willingness to pay for water supply improvements and the demand for water.

The analysis is divided into two cases of study: residents with piped water and residents without piped water. Residents with piped water services live in houses located in regular neighbourhoods. The houses without piped water services are located in irregular or informal settlements.[1] The analysis presented in this thesis tested the following hypotheses:

1. Residents with piped water services are willing to pay a significant amount of money for having a 24 hour water supply service and being able to drink water straight from the tap. This hypothesis is important to test since residents living in houses connected to the water supply system already spend a considerable amount of money in water storage containers and cisterns to avoid any variation in the water supply. These residents also spend a substantial amount of money on bottled water to provide drinking water for their households.
2. Residents living in the informal settlements are also willing to pay a considerable amount of money for having a private water connection in their houses and water supply improvements. It is relevant to test this hypothesis because the people in informal settlements have very low levels of income and they might be considered as residents that cannot or are not willing to pay for investments in infrastructure for their neighbourhoods.
3. Residents living in the informal settlements are willing to pay a higher proportion of their income than people from regular neighbourhoods for water supply improvements.

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[1] Houses with piped water services are usually referred in this thesis as "connected houses" or houses in regular neighbourhoods. The houses without piped water services are referred as "non-connected houses" or houses in the informal settlements.

Some of the most relevant works that analyzed the WTP for water supply improvements, such as Whittington, Briscoe and Mu (1990), have found that people in developing countries are willing to pay to have an improved water supply system. These studies estimated the economic benefits of water using the Contingent Valuation (CV) method and focused on water supply for both rural and urban areas. The main motivation for these works was to determine the benefits to people from public policies and projects related to water assets.

The CV method investigates directly the monetary value that people would assign to a specified good or service change. The discrete choice question is one of the most frequently used type of questions to analyze the individual's WTP. In this kind of question the person is asked if he/she would be willing to pay a specified amount of money for the good or service offered. The individual usually only has the option to answer yes or no. The discrete choice questions can be analyzed using a utility difference model with a random component of the preferences. To determine the effect of an individual's characteristics on the WTP estimate, the response to the dichotomous choice question can be modeled as a logit or probit where the index function is the utility difference between the options available to the respondent.

The data for this thesis were obtained from two household surveys conducted in Queretaro through in-person interviews. The first survey was administered to 629 households with piped water services. The second survey was conducted with 202 houses that were not connected to the piped water service. Both surveys gathered information about residents' socio-demographic characteristics, water consumption and preferences for water supply improvements. The survey for connected households was administered using a stratified random sample, i.e. city neighbourhoods were first grouped by income strata and then participants were randomly selected within each stratum. The survey for households without piped water was administered using a semi-random sample of all the neighbourhoods without water connections.

The chapters in this thesis present the methodology employed to conduct the analysis, the results from the surveys administered and the analysis of the WTP questions in the two case studies. Chapter 2 presents some general characteristics of the city of Queretaro and the current water supply services. This chapter also presents the literature review on the tools and methods used for conducting the CV analysis. Chapter 3 presents the results of the WTP for water supply improvements to houses that are connected to the city's water supply system. This chapter also describes the data and the methods utilized to conduct the analysis of this case. Chapter 4 examines the results from the WTP question for water supply improvements in the informal settlements. This chapter includes a detailed description of the current situation in Queretaro's informal settlements and the results of the survey conducted in these neighbourhoods. Chapter 5 presents a comparison of the two cases of study, the final conclusions and some further discussions. Appendices A and B include some tables and figures that complement the information presented in Chapters 3 and 4 respectively. In appendices C and D the reader will find a copy of the two surveys used in this study. Appendix E presents some pictures of the conditions of the houses in the informal settlements and their water supply services.

The aim of this work is to support policies and projects that are in accordance with people's preferences and the estimated economic benefits derived from an improved water supply service. Since Queretaro is facing water supply shortages it is important to identify solutions that provide the highest possible benefit to people at the lowest feasible cost and that also guarantee an adequate distribution of the benefits obtained from water.

Chapter 2
Background and literature review

1. Introduction

Queretaro is one of the cities in central Mexico with significant problems related to water. Despite a promising economic development, the city's supply of water is lower than the current demand. Therefore, there is a need for effective policies and programs to assure the water availability in the city. However, little research has been done to study the economic benefits that these projects could generate to Queretaro's residents.

Other cities and communities of the world have also found it necessary to estimate the economic benefits derived from significant investments in hydraulic infrastructure and projects to improve water services. One of the limitations in estimating the benefits derived from an improved water supply service is the non-existence of conventional markets where water is traded. If residential water supply services were traded in common markets (as many other goods or services), it would be possible to establish the prices and the quantities of water traded in these markets and the estimation of the benefits derived from increases in the houses' water supply would be relatively straightforward.

One of the frequently used methodologies to estimate the economic benefits derived from water assets and services that are not commonly traded in markets is the CV method. In this approach, individuals are asked questions that attempt to find their WTP for an improvement or change in a specific good or service. The individual WTP is an appropriate measure of the person's economic benefits derived from the proposed change in the good. Once the individual WTP is estimated, it is possible to calculate the total economic benefits or WTP for the group of people being studied.

This chapter presents some general information about the socio-economic characteristics of the city of Queretaro and the conditions of its water supply services. The chapter also provides a summary of the methodology used to conduct CV studies and some of the most relevant examples of the utility of the CV approach to estimate the economic benefits from possible water supply improvements.

2. The City of Queretaro: socio-economic aspects and water supply services

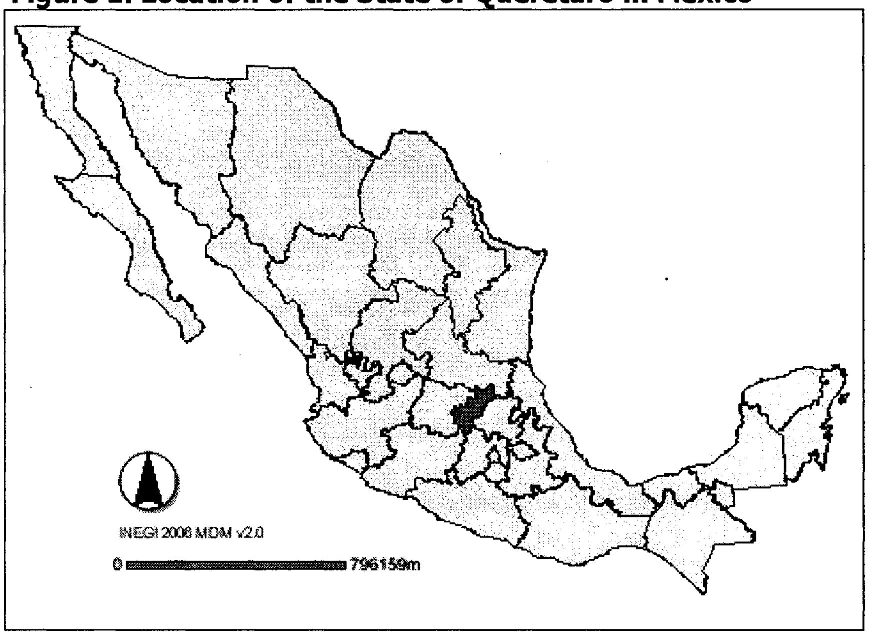
2.1 Socio-economic aspects of the City of Queretaro

The City of Santiago de Queretaro, commonly known as Queretaro, is the capital of the State of Queretaro de Arteaga (Figure 1). The State of Queretaro is located in central Mexico, between the states of Mexico, Guanajuato, Michoacán, Hidalgo and San Luis Potosi (See Figure 2). The city of Queretaro is located in the southwest side of the state and is approximately 205 kilometres north of Mexico City (See Figure 2). Queretaro and its metropolitan area are spread in three municipalities: Corregidora, Queretaro and El Marques.

Queretaro has experienced rapid population growth of the population in the last 50 years. Between 1950 and 2006, the population of the city and its metropolitan area increased from 104,500 habitants to 918,100 habitants (Comision Nacional del Agua and Comite Tecnico de Aguas Subterraneas del

Acuifero de Queretaro, 2002; Instituto Nacional de Geografia, Estadistica e Informatica, 2006a). This makes Queretaro the eleventh largest city in Mexico.

Figure 1. Location of the State of Queretaro in Mexico

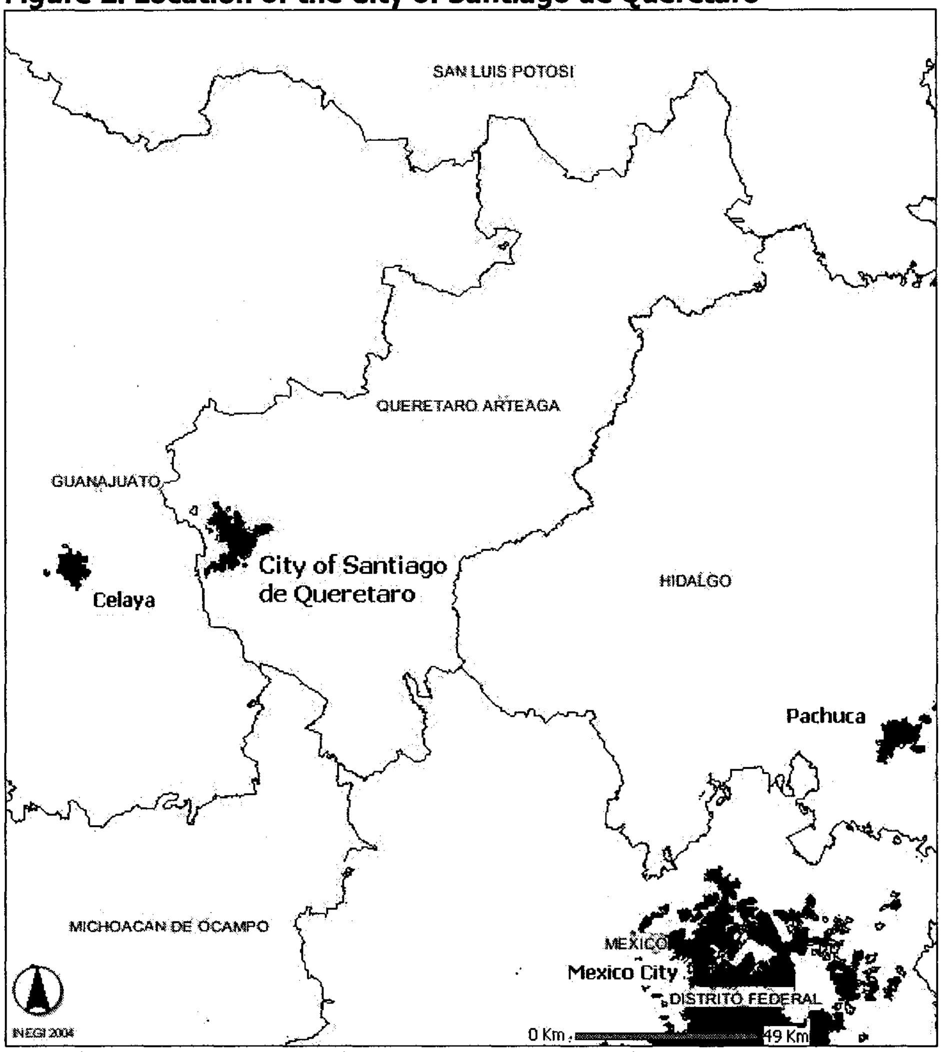


Adapted from *Instituto Nacional de Geografia, Estadistica e Informatica* (INEGI), Digital Maps, 2006 in http://www.inegi.gob.mx

The current average density in the municipality of Queretaro is 3,180 habitants per square kilometre (Municipio de Queretaro, 2005). The *Consejo Nacional de Poblacion* (National Council of Population, CONAPO) has estimated that the city of Queretaro and its metropolitan area will have more than one million habitants by 2010 and by 2030 there will be almost 1.4 million residents in the city (Consejo Nacional de Poblacion, 2006c).

One of the main reasons for the city's population growth is the significant number of people that had moved to live to Queretaro in the last three decades. For example, from 2000 to 2005 approximately 63,428 people migrated from other states of Mexico to the city of Queretaro (Consejo Nacional de Poblacion, 2006a).

Figure 2. Location of the City of Santiago de Queretaro



Adapted from *Instituto Nacional de Geografia, Estadistica e Informatica* (INEGI), Digital Maps, 2006 in http://www.inegi.gob.mx

The migration of people to Queretaro is related to the city's strong economic growth. Between 1993 and 2004, the average rate of growth of Mexico's GDP was approximately 2.9% while the State of Queretaro achieved a

GDP growth of 5.05% during the same period (Instituto Nacional de Geografia, Estadistica e Informatica, 2006c).

This significant growth of the state's GDP is attributed to the development of the manufacturing, services, transportation and communications sectors in the City of Queretaro. The manufacturing sector is showing the strongest performance and represents a third of the state's GDP (Instituto Nacional de Geografia, Estadistica e Informatica, 2006c). This sector is mainly focused in the following branches:

1. Metal products, machinery and equipment.
2. Food, beverages and tobacco.
3. Chemicals, rubbers and plastics (Municipio de Queretaro, 2005, p.105).

The improved economic situation has made Queretaro one of the most attractive cities to live in Mexico. However this accelerated growth has not been accompanied by adequate infrastructure improvements of the water supply system.

2.2 Water supply services: Current and future water problems

Quearetaro's water supply and sewage services are administered and regulated by the *Comision Estatal de Aguas Queretaro* (Water Commission of the State of Queretaro, CEA). The CEA currently provides a total of 2,105 litres per second to

169,631 water connections[2] in Queretaro and its metropolitan area (Comision Estatal de Aguas, 2006).

The city's infrastructure for water supply and sewage services consists of 1,857 km of water pipes, 1,692 km of sewage pipes, 108 water tanks, 6 water treatment plants (Comision Estatal de Aguas, 2006a) and 126 wells (Briseño, 2004, p. 134). Currently all of the water supplied to Queretaro's households comes from underground water sources.

The CEA has an organized monitoring system for the consumption of water in Queretaro's households. Most of the homes with piped water services have a water meter that the CEA uses to monitor and charge every house for its monthly water consumption.

According to the CEA, 70% of the population connected to the city's water supply system has water service running between 17 and 24 hours a day (Ramirez, 2005). The *Instituto Nacional de Geografia, Estadistica e Informatica* (National Institute of Geography, Statistics Informatics, INEGI) reports that 94% of the inhabited homes in Queretaro and its metropolitan area (204,169 houses) have their own private piped water connection (Instituto Nacional de Geografia, Estadistica e Informatica, 2006a)

The demand for water for domestic use in Queretaro poses important challenges to the city's water supply system. In 1999, the CEA published the *Plan Hidraulico del Estado de Queretaro,* a report on the water resources situation and the improvements necessary to guarantee the water supply of the city for

[2]Most of the water connections correspond to inhabited houses. However, the number of houses with piped water service might differ from the number of water connections because of the existence of lots or terrains without a house but with a water connection.

the next 26 years. According to this report, there is a gap between the demand and the supply of water. For example, in 1999, while the city's demand for water was 2,600 litres per second (for an estimated population of 700,000 habitants), the supply capacity of the system was only 2,083 litres per second (Comision Estatal de Aguas, 1999). The deficit of water availability means that water is not available 24 hours per day and in the worst cases some neighbourhoods have only water three hours a day. Currently, the deficit of the water supply in the city is estimated to be at least 533 litres per second (Diario de Queretaro, 2005).

The shortage of water in Queretaro is mainly a result of the reduction of the water available in the Aquifer of the Valley of Queretaro. This aquifer is the main source of water for the city. However, since 1992, the city has been importing water from the Aquifer Valley of Chichimequillas-Amazcala about 20 km away from the city (Comision Estatal de Aguas, 1999). In the 1980s, the city was extracting water from the wells of Queretaro at a maximum depth of 45 meters. In the 1990s, the maximum depth of the wells increased to 90 meters. Since 2000, the maximum depth of the wells has been greater than 150 meters (Universidad Autonoma de Queretaro and Comision Estatal de Aguas, 2002, p. 5.19-5.36; Negrete, 2000). It is projected that in 2020, it will not be possible to get water from wells less than 200 meters deep (Negrete, 2000; Perrusquia, 2003, p. 18).

The increase in the depth of the wells in Queretaro is caused by the negative balance of the amount of water infiltrated and extracted. For example, in 1999, the balance of water (infiltrations minus extractions) was -61.97 million cubic meters per year. This negative balance has intensified mainly because of increases in the extractions from wells that provide water to the city (Briseño, 2004, pp. 134-144). Between 1985 and 2003, the wells of the aquifer Valley of Queretaro, have extracted an average of 99 million cubic meters per year. In the same period, 52% of the water extractions were used to supply Queretaro's houses, 31% were used for agriculture, 9.8% supplied the city's industry sector and the rest of the extractions were water without any specific use (Briseño, 2004).

According to the CEA's 1999 report, the *Universidad Autonoma de Queretaro* and CEA's joint report (2002) and Briseño's thesis (2004), if the water extractions from the aquifer Valley of Queretaro continue at the same rate most of the wells of the city will either have to be closed or the depth necessary to extract water will be considerably higher in the future.

In addition to reduced water availability issues, the water supply system has large problems with leakages that reduce the supply capacity of the system. Because the system cannot provide a 24-hour service, the water pipes suffer significant variations in water pressure. This causes serious leakages and between 37% and 53% of the water running in the distribution system is lost (Comision Estatal de Aguas, 1999, p. 89; Comision Nacional de Agua and Comite Tecnico de Aguas Subterraneas del Acuifero de Queretaro, 2002).

The future of the water supply situation will be impacted further by the city's rapidly increasing population. In 2010, there will be at least 989,000 inhabitants and the city will need a water supply of 3,292.46 litres per second (Comision Nacional de Agua and Comite Tecnico de Aguas Subterraneas del Acuifero de Queretaro, 2002, p. 68). In 2025, the population will reach at least

1,249 million people and the demand of water will exceed 4952.95 litres per second.

Besides the current and potential future problems of water availability, Queretaro is also facing reduced water quality in the city wells. According to the *Universidad Autonoma de Queretaro* and CEA's joint report (2002) and Perrusquia (2003), some wells of the aquifer Valley of Queretaro have total coliforms, fecal coliforms, fluorine, nitrates, total solids and pH above the levels safe for humans. For example, the well called "El Menchaca" tested for a fluorine level of 18.72 mg/litre, however, the maximum level recommended is only 4.0 mg/litre (Universidad Autonoma de Queretaro and Comision Estatal de Aguas, 2002, p. 6.11). This well had to be closed but there are still some wells open with levels of fluorine above the recommended level.

The CEA (1999) has insisted that the water from the supply system is adequate to drink straight from the tap. According to the CEA, 99% of the water running in the supply system is treated using sodium hypochlorite and chlorine gas. However, the results of the survey indicate that most of the people in the city do not drink water straight from the tap and a significant proportion of residents have concerns about the quality of the water from the supply system.

In May 2006, the Government of the State of Queretaro, the municipal government of the City of Queretaro and the CEA have supported the creation of a new water supply system that will bring water from the springs "*El Infiernillo*" in the *Rio Moctezuma* basin (Campero, 2006).[3] The estimated cost of this system

[3]The Rio Moctezuma basin is located in the northeast of the State of Queretaro in the municipality of Cadereyta.

is 2,000 million Mexican pesos ($238 million CDN)[4] and it will supply 1,584.38 litres of water per second. The government of the State of Queretaro currently charges a payroll tax of 2% to Queretaro's companies with more than four employees. The funds collected through this tax will pay for new hydraulic and transportation infrastructure. Approximately 60% of the cost of "El Infiernillo" project will be obtained from the payroll tax. The rest of the costs will be covered by funds from the CEA, the municipal government and the State's government (Gonzalez, 2004).

Despite the significant investment that "*El Infiernillo*" project represents, it will not be capable of meeting the estimated increase of 2,100 litres per second in the demand for water.[5] Therefore, the city of Queretaro needs more investments in infrastructure and programs to guarantee the current and future water availability and quality. The *Plan Hidraulico 1999* (Comision Estatal de Aguas, 1999) is one of CEA's reports that established the importance of complementing the creation of new sources of water with programs and projects to make better use of the water available in the system such as the reduction of leakages, the building of waste water treatment plants, households' water savings programs, etc.

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[4] The exchange rate used in this thesis is $8.4 Mexican pesos per Canadian dollar (CDN). This is the average exchange rate (at a cash rate) in the months of June and July 2005 when the surveys were conducted (Bank of Canada, 2006). The final amounts in Canadian dollars may differ due to rounding.

[5] Considering that the city currently consumes 2,870 litres of water per second (Diario de Queretaro, 2005) and the future demand for water in 2025 is 4,952.95 litres per second (Comision Nacional de Agua and Comite Tecnico de Aguas Subterraneas del Acuifero de Queretaro, 2002, p. 68).

In order to improve the water supply system, it is important to know the residents' economic benefits derived from adequate water availability and quality. This kind of information is crucial in identifying and selecting the options that will have the highest benefit possible at the lowest feasible cost. In addition, estimates of the price that people might be willing to pay for an improved water supply system will help to design future pricing policies.

2.3 The informal settlements in Queretaro

The informal settlements in Queretaro are neighbourhoods in the suburbia of the city usually located in lands that were part of the *ejidos* or agricultural areas. These neighbourhoods are not legally entitled to develop dwellings so most of these settlements do not have public services such as piped water, drainage systems, paved streets, garbage collection and in some cases electricity. The informal settlements are one of the few options for residents who cannot afford to pay a mortgage or do not have a job that qualifies them for housing offered by the Federal Government Agencies.

The informal settlements in urban areas of Mexico have been in existence since the 1940s. According to the *Comision para la Regularizacion de la Tenencia de la Tierra* (Federal Commission for the Regularization of Land Tenure, CORETT), the high rate of migration from the rural areas to the cities and the lack of sufficient housing caused many people to invade or occupy land in several Mexican suburbs (Comision para la Regularizacion de la Tierra, 2006). According to Siembieda and Lopez (1997), urban settlements are defined as "illegal" or "irregular" depending on at least one of the following conditions: the land and house lack legal status, the settlement lacks appropriate zoning and building permits from the government authorities or the house is not built to appropriate standards.

The land used for informal settlements can be ejido, government, private or communal lands. The most common type is the ejido land and at least 65% of the lands of informal settlements in Mexico used to be ejido lands (Siembieda and Lopez, 1997). The ejido "is a legally defined system of land tenure and land use for the community of peasants that reside on the land. It is a corporate holding system in which the defined users (ejidatarios) have shareholder rights" (Siembieda and Lopez, 1997, p. 651). Before the reforms of 1992 the ejido shareholders were not able to sell or modify their shareholder rights,[6] but after the reforms shareholders were allowed to rent or sell their lands (as collateral) for the development of agriculture infrastructure (Thompson and Wilson, 1994; Siembieda and Lopez, 1997.)

There are two kinds of sale processes that occur in the selling of ejido lands for the establishment of informal settlements: internal and external subdivisions (Siembieda and Lopez, 1997, p. 658). In the first case, the ejido members sell plots of land to any interested buyer. In the second case, external sub-dividers buy land from the ejido members and they sell it to buyers without having permits or approval from the government authorities. The buyer only

[6] In January 1992, article 27 of the Constitution of Mexico was reformed to support the facilitation of agriculture infrastructure. The new law prohibits the redistribution of land through expropriation and allows that parcelized communal lands can be rented and sold to other farmers or investors. Thompson and Wilson (1994) present a good summary of the historical context of the ejido and analyze the possible outcomes from the privatization of ejido lands.

receives a deed-type document indicating the characteristics of the lot, location and price. The external sub-dividers provide loans to the buyers to accelerate the sale of these lands. The faster the land sells the faster the sub-dividers can buy more land from the ejido members. Sub-dividers may be making their business in more than one ejido within a city and political practices such as affiliation with political parties allowed them to keep doing these illegal activities (Siembieda and Lopez, 1997, p. 658). The external sub-dividers often tell buyers that the lands are in process of regularization and the government has promised to provide public services to the informal settlement.

Ward and Jimenez (1993) found that in Queretaro, between 1970 and 1990, the prices of land from ejidos were very low compared to the rest of Mexico. This happened because the ejido members were politically weak compared to groups such as the *Confederacion de Nacional de Organizaciones Populares* (National Confederation of Popular Organizations, CNOP) that aimed to establish settlements in the ejido lands. In the same period, the *Partido Revolucionario Institucional* (PRI), the party in power in the municipal and the State's governments, enjoyed a conflict free relation with the ejido members and groups such as the CNOP. This allowed that many informal settlements in Queretaro were regularized and provided with public services (Ward and Jimenez, 1993.)

Currently, there is a very active and heated discussion about the legality and the feasibility of regularizing these neighbourhoods in Queretaro. The government of the State of Queretaro, the Congress of the State and the municipal government of the city are analyzing and discussing how to address the problem of informal settlements in Queretaro. However, there is a lack of consensus between these different levels of government on how to solve the problem. This disagreement has delayed the development of an institutional and legal framework that aims to solve the problem of informal settlements.

The problem of the informal settlements in Queretaro is complex. The settlements have problems of inadequate urban planning and an institutional and property rights framework that does not guarantee an ordered growth of the city. The settlements have largely developed due to poverty in Mexican rural and urban areas. Although there might be some people that live in informal settlements to avoid paying taxes and the cost of the public services, most of the residents of these neighbourhoods cannot afford a dwelling in regular neighbourhoods. The lack of services in the informal settlements provokes a vicious cycle because without services such as water, schools, police, etc. the families living in these neighbourhoods have lower probabilities of increasing their wealth or levels of income than families in regular neighbourhoods.

Piped water is one of the services most needed in informal settlements. Therefore, besides the analysis conducted in connected households, it was important to know which would be the benefits derived from an improved water supply service in informal settlements. With this information, it would be possible to asses the feasibility of water supply improvements that would provide water to all of Queretaro's residents.

The analysis in this thesis does not attempt to solve the discussion about the legal framework of the informal settlements. The situation of the property rights in these neighbourhoods hampers the support of water supply service improvements. Therefore more research has to be conducted on how to create a stable and reliable property rights framework in the informal settlements. This thesis focuses on measuring the benefits that the residents of these neighborhoods would obtain if they were provided with these improved water supply services. Although the feasibility of providing improved water services might be low the objective is to know if it could be possible to support these projects considering the potential welfare gains that residents might have.

3. Literature review

3.1 The contingent valuation method and discrete choice WTP questions

The contingent valuation method "involves asking people directly what they would be willing to pay contingent on some hypothetical change in the future state of the world." (Young, 2004, p. 135.) Grafton *et al.* (2004, p. 251) mentioned that the CV approach involves a careful design of a scenario where the individual is offered a good or service and is asked whether he/she would be willing to trade off some amount of money in exchange for the good or service.

In order to conduct a reliable CV, it is essential to define a target population, the product that is going to be described to the respondents of the survey, the payment vehicle and the kind of willingness to pay (WTP) question (Young, 1996). There are three general types of questions to conduct a CV study (Young, 1996 and Freeman, 2003): open ended questions, bidding games and discrete choice questions.[7] However, discrete choice questions might have some advantages over the other kind of questions. In discrete choice WTP questions, the respondent is asked if he would be willing to pay a certain amount X for a specified good (Freeman, 2003, p. 166). If the answer is yes, the individual has indicated a WTP that could be higher or equal than the specified amount. If the response is no, then the specified amount can be taken as a non-binding upper bound of the WTP. This places individuals in a context very similar to private market transactions where goods are exchanged on a "take-it-or-leave-it basis", i.e. the individual only has to decide if he/she purchases the good or not at the offered price. If the question presents a tax as the payment vehicle, then the question becomes a simulated referendum where each person must decide if everybody gets the good or service and pays the tax offered.

Since the discrete choice question only asks the individual to answer yes or no to the supply of the good (Freeman, 2003), this reduces the levels of no response answers and refusal to participate. In addition, under the following conditions the single discrete choice question is incentive compatible and the individual will answer truthfully:

1. Consequentiality: The policy issue of the WTP question has to matter to the individual and he/she has to believe that his response will affect the outcome.

[7] Young (1996, p. 47-48) and Freeman (2003, p. 161-167) present a detailed description of the kinds of WTP questions existent to conduct CV studies. The authors also discuss some the advantages and disadvantages of using each of these types of WTP questions. Young's work is focused on the measurement of economic benefits derived from water assets.

2. The individual has to believe that the agent (in many cases the government) providing the good is able to "compel payment of some amount" (Freeman, 2003, p.180).

Another advantage of the discrete choice questions is the information gains derived from using a survey to gather the individual characteristics of the respondent and his answer to the WTP question (Freeman, 2003). This kind of information may not be available when observing common real markets or people's discrete choices. In the case of the water supply service in Queretaro, although there is information on the consumption of water and tariffs charged to every household, there is not enough accurate data on the characteristics of each of Queretaro's households or the individual characteristics of the household heads. A CV survey with a WTP discrete choice question aims to obtain an estimate of the price that the household is willing to pay for water supply improvements and to gather information on the characteristics of each of the households being surveyed. In addition, with a discrete choice setting it is possible to set different randomly selected subsamples of respondents and present different prices to the participants. This allows the researcher to analyze how the respondents' households' characteristics relate to the WTP for a specified set of prices.

One possible drawback of the discrete choice questions is that the respondents might bias their answers to agree with the interviewer, i.e. they might just answer yes to please the interviewer (Freeman, 2003). Follow-up questions can be used to understand the nature of the responses to the discrete choice question and identify possible biases in the response to the WTP question.

Another concern about this elicitation method is that the estimation of WTP requires a large sample because the responses do not show the individual's maximum WTP.

Despite the disadvantages of the discrete choice questions, there is a general consensus among CV practitioners that discrete choice questions work better than bidding games or open ended questions (Freeman, 2003, p. 179). Therefore, this is the elicitation method used in the surveys to analyze the WTP for water supply improvements in connected and non-connected houses.

The next section will present some of the general guidelines to conduct CV studies. This information is needed to understand some of the procedures that were used in administering and designing the survey.

3.2 Guidelines to conduct reliable contingent valuation studies

The experience on the application of the contingent valuation technique has shown that studies have to be carefully designed and administered otherwise the estimated benefits will not be consistent with the preferences of the surveyed population.

According to Whittington *et al.* (1990) and Briscoe *et al.* (1990), there are 3 main biases that CV studies can present in their estimates of WTP:

1. Strategic biases: The individuals might think that they can influence the value at which the good or service is going to be charged once it is provided. This kind of bias can be avoided by developing an exhaustive research about people's perceptions about the survey and their behaviour before, during and after the questionnaire.

2. Hypothetical biases: The respondent might not understand the scenario or the good being described in the WTP question. Another source of hypothetical bias is that the individuals may just not take the survey seriously and might be answering yes to all the questions and stating unreal preferences. To avoid this kind of bias it is necessary to provide individuals with enough information about the good or service, the survey and the purposes of the study. It is recommended to use materials such as pictures or videos that will aim to explain the hypothetical good or service to individuals.
3. Starting-point bias: The estimates of the WTP might be biased by the original bid offered to the respondents. To avoid this problem it is necessary to create sub-samples with randomly selected starting bids and test for any bias towards any of the proposed initial bids.

Freeman (2003) points to four types of validity approaches that CV studies should accomplish to obtain reliable estimates of the WTP. The first approach is the criterion validity which involves comparing the estimates of WTP through stated preference methods with "...some alternative measure that can be taken as the criterion for assessment" (Freeman, 2003, p. 164). This author's recommendation is to compare the estimated WTP with true values of the change in the good or service. However, true values of non-marketed goods cannot be estimated, but they can be simulated at least. For example, a simulated market to recycle burned oil from cars can be used to obtain the values of the environmental amenity (which can be clean aquifers). These results can be used to asses the estimates obtained from a stated preference method.

The second approach is convergent validity which is the comparison of the values obtained from stated preference methods with a revealed preference technique. One revealed preference technique is the hedonic property value method which estimates the value of one attribute from "a complicated multi-attribute good or service (usually farm land or residences) by separating the contributions of the various attributes using data from market transactions on a selected good or service" (Young, 2004, p. 47 and p. 331). For example, the CV estimates of the WTP for water supply improvements could be compared with estimates of how much the value of a house increases in the real estate market when the neighbourhood where the house is located has an improved water supply service.

The third criterion is construct validity, this approach requires that the results of the CV study are consistent to what economic theory suggests. For example, if clean water is considered a normal good then the WTP for this good should increase when income rises.

The last approach is the content validity which means that "...the design and implementation of the survey conform to the generally recognized best practices..." (Freeman, 2003, p. 179). Guidelines and criteria such as those stated in the U.S. National Oceanic and Atmospheric Administration (NOAA) panel report[8] or recognized academic publications could be the basis to construct a reliable CV study.

[8] The U.S. National Oceanic and Atmospheric Administration (NOAA) formed a panel of economic experts and asked them to analyze the viability of using the contingent valuation method for measuring the benefits or damages from a change in an environmental amenity (Arrow *et al.*, 1993).

Regardless of the criticisms of the CV method, there are several successful examples of the use of the CV approach to know the value or economic benefits derived from goods and services related to water. When a CV study follows most of the guidelines mentioned in this section, it is possible to obtain trustworthy estimates of the economic benefits that people will have from important policies or projects. The next section will present a summary of the review of the most relevant works on the valuation of water supply service improvements using the CV method.

3.3 The CV method and the valuation of water supply services improvements

Several studies have been conducted using the CV method to estimate the value of several goods and services in different places around the world. In the case of the measurement of the benefits from residential water supply services, the CV method has been frequently used to analyze people's WTP for water supply services that provide a higher level of water quality and/or availability.

One of the first CV studies to estimate water economic benefits in developing countries is Whittington, Briscoe and Mu's study in Laurent, Haiti (Whittington, *et al.*, 1990). The authors conducted a survey to estimate the WTP for water supply services and improved quality of water in rural areas. More specifically, the authors built two hypothetical scenarios where they offered either public standposts or private connections to a community that did not have a piped water supply system. Two kinds of questions were used to collect information on the WTP: open ended questions and discrete choice questions including a "don't know" answer. The authors found from the results and their estimations that households from Laurent are willing to pay 1.7% of their income for public standposts and 2.1% for private connections. The main conclusion of this paper was that it is possible to conduct a contingent valuation study and obtain reliable estimates of the WTP for water supply services even if the residents are illiterate and very poor. The authors conducted tests to identify possible hypothetical and starting point bias but did not find evidence for these biases in their WTP estimates. Briscoe *et al.* (1990) also supported the idea that carefully designed CV surveys in developing countries can provide reliable WTP estimates for water supply improvements.

Whittington, Lauria and Mu's (1991) study in Onitsha, Nigeria is another study that used a contingent valuation survey to inform the state water agency about how much to charge its customers and know what was going on at the household level in terms of water supply services. Most of the people in this city did not have private water connections and obtained their water from different kinds of water vendors (water trucks, public supply system, small wells, etc.) The water agency needed information on how much to charge to people to obtain the necessary revenues to finance a new water supply service and guarantee that most of the residents would connect to the system. The survey found that poor residents in Onitsha, Nigeria were paying the most for water. Households in the lowest income brackets were paying about 25% of their income for water from tanker trucks. The authors contended that although it has been assumed that households can only pay between 3-5% of their income levels, there are several cases where poor people in urban areas pay over 5% of their income levels for water supply services. The expenditures in water of Onitsha's residents could have financed more than twice the operation and maintenance costs of a new piped distribution system. The authors found that in 1987 people were willing to pay between $34.4 USD and $43 USD per 1000 gallons of water through piped private water connections. With this kind of charges, the water agency could have raised its revenues considerably.

Altaf *et al.* (1993) also used CV surveys to show that it is possible to have full cost recovery from people's WTP for a project to provide better water supply services. The results of this study showed that residents from rural areas of the Punjab, Pakistan were willing to pay more than double what they were currently spending on water for the household in exchange of improved water reliability.

Not only is it important to know how much people are willing to pay but it is also important to know what determines their WTP. Raje *et al.* (2002) analyzed how the people's satisfaction level with the supply service, their beliefs in the water management system and the affordability of the water utility bill affect the WTP for municipal water supply improvements. Their study was conducted in Mumbai, one of the most populated cities in India. Their findings suggest that in Mumbai the satisfaction level with the supply service and the belief in the water management system do not affect the WTP for water supply improvements. However, they also found that the people's perception about the affordability of increases in the water utility bill has a significant effect on the WTP.

Another recent work focused on estimating the WTP for water supply service improvements is Whittington *et al.* (2002). This study was conducted in

South Asia in the Kathmandu Valley, Nepal. The survey collected information on households' WTP for a 24-hour service, water that is safe to drink from the tap and for having a private operator that would provide accurate billing on the water consumption. In the Kathmandu Valley live approximately 1 million people and 70% of the households have private connections. However, the water supply service varies significantly and residents with private water connections do not have 24-hour running service. The people that do not have private connections in their house have to get water from tanker trucks, close neighbours, public taps or from shallow wells. In addition, there is a fall in the groundwater table of the aquifer that provides water to the valley. This is due to the continuous extractions from private wells. Therefore, the residents of the valley require a significant improvement in the water supply service that makes an adequate use of the aquifer's water. The results from the analysis show that 70% of the people in Kathmandu are willing to pay five times their current utility bill and have a private water service supplier. The authors estimated that the connected households' mean monthly WTP for 500 litres of water from an improved water supply service is equal to $14.31 USD. On the other hand, non-connected households are willing to pay $11.31 USD for 500 litres of water from a private connection with an improved water supply service.

One study of the WTP for water supply improvements that focused on the case of informal settlements in urban areas is Goldblatt (1998). The author conducted a CV survey that analyzes the WTP for improved levels of water supply in two informal settlements of Johannesburg, South Africa. The survey found that the residents WTP for the water supply improvements is not enough to cover the costs of the improved service. However, Goldblatt supports the use of CV surveys to provide valuable information on the economic benefits that water services enhancements might have on the habitants of informal settlements.

Although the CV approach has limitations such as those mentioned in sections 3.1 and 3.2 of this chapter, it has been useful in valuing improvements to residential water supply services. Given the lack of data on the demand for water in developing countries, the CV method may provide a reliable point of reference of the benefits derived from water supply improvements.

4. Conclusions

Queretaro is a city in central Mexico with a fast pace of economic growth. However, given the growth of the city in the last 3 decades, there has been an exponential increase in the demand for water.

Currently there is a gap between the demand and supply of water because of the reduction in the water available from the aquifer Valley of Queretaro. In addition to this, the water supply system presents problems such as leakages in the piped distribution system that result in between 37% and 53% of the water being wasted. Therefore, significant improvements are needed in the water supply system to guarantee the water availability for Queretaro's residents.

About 8% of Queretaro's households are located in the informal settlements without piped water services. These households live in extreme poverty conditions and require improvements to the water supply system in order to provide them with a 24 hour service and water that is safe to drink from the tap. Several studies around the world have found that poor people in developing countries are willing to pay a significant amount of money for water supply improvements. Therefore, it might be feasible to provide Queretaro's informal settlements with an improved water service. However, it is necessary to gather data on how much the water agency may able to collect from these neighbourhoods to finance a water supply improvement.

The contingent valuation method is an approach that allows estimating the economic benefits derived from a change in a good or a service that is not traded in common markets. This information is useful in the case of residential water supply services to conduct cost-benefit analyses of improvements to these services and to have an idea on people's preferences from those improvements.

There is a vast literature on the methodology to conduct CV studies and the application of this approach in estimating the value of water quality and supply improvements in developing countries. Many relevant studies have shown that the CV method can provide reliable estimates of people's WTP for water and on the amount of money that a water agency may collect to finance a project of residential water supply services.

Chapter 3
Willingness to pay for water supply improvements in Queretaro, Mexico: The case of houses connected to the water supply system

1. Introduction

Chapter 2 described how the city of Queretaro does not have an adequate water supply service and that improvements are needed to guarantee water availability for the future. If Queretaro enhances its water supply services there could be a significant improvement in residents' welfare. Moreover, with information that helps to determine the tariff or price that people would be willing to pay every month for the water supply improvements, it may be possible to finance partially or completely the projects and public works required for an adequate water supply service.

This chapter shows the results of the survey that was conducted with residents of Queretaro who live in homes with private piped water connections. The survey collected the necessary information to analyze and estimate the residents' WTP for water supply service improvements. Therefore, this chapter presents Queretaro's residents estimated WTP for a water utility service that brings water to their homes 24 hours a day and that allows them to drink water straight from the tap. These estimated WTP values were calculated using the responses to questions designed with the methodology to conduct CV surveys (presented in Chapter 2).

The survey also collected data on the households' socio-economic characteristics and people's opinions about the water supply service. With all this information in hand, it was possible to know current resident's perceptions about the water supply service and the factors that determine their willingness to pay for improvements in this utility service.

2. Survey design and administration

2.1 Focus groups and pilot tests

An in-person household survey was conducted to collect data from the neighbourhoods connected to the water supply system. The survey was designed and pre-tested by conducting three focus groups and 91 pilot surveys.

The first focus group was undertaken in January, 2005, at the University of Alberta, with eleven Mexican students from this institution. This focus group helped to enhance the language and writing of the questionnaire. The other two focus groups were conducted in the City of Queretaro, in February of 2005. These focus groups were done with members of the executive boards of two neighbourhood associations. The executive committees meet regularly to address the problems and concerns that their neighbourhoods face in terms of public services, community and social development. Moreover, they are one of the links between government officials and common residents. Therefore, with these focus groups it was possible to know the opinion of residents that are very aware about the situation of their neighbourhoods' water services.

A total of five residents participated in the first focus group in the City of Queretaro. In this focus group it was possible to do the first pre-tests of the questionnaire and to know some of the main concerns about the water supply service. Some participants declared that they do not have any problem with water availability. Other participants argued that they lack of sufficient water supply especially in the warm months (April, May and June) and that usually they are only able to fill their water tanks during the nights because daytime pressure is too low. Moreover, there was a rich discussion about the water quality. Some participants argued that most people in Queretaro buy bottled water, but that this was the result of a very good marketing strategy from bottled water companies. Some other participants declared that they drink bottled water to avoid any risk from drinking tap water and there are some households in the neighbourhood that receive tap water that smells bad. Another comment in this focus group was that the current water supply system has a lot of inefficiencies since a considerable amount of water is wasted in leaks. The group was divided between the election of private companies or public agencies to operate and manage the water supply system. Some participants mentioned that corruption has become a problem with the water agencies in Mexico and that this generates inadequate management of water assets. Other participants argued that a pricing policy that constrains water consumption is needed, i.e. to charge people accordingly to their levels of water use.

In the second focus group a total of five participants attended. This focus group also helped pre-test the survey and identify how participants were interpreting the questionnaire. In this focus group, the residents stated that they do not have any problem with the water supply service. However they showed strong disagreement in the way the water agency is managing Queretaro's water resources. One of the participants mentioned that the excessive growth of the city in the last 20 years has created a shortage of water and that the solution to the water problems lies in controlling the city's population growth. All participants agreed that is difficult to manage water assets because neither the government nor private companies will make a proper use of the resources available.

These three focus groups gave a preliminary insight of the issues and concerns related to the water supply service. Moreover, they helped to clarify and revise the survey tool. A larger pre-test of the questionnaire was done through pilot surveys administered directly to 91 households of Queretaro.

The pilot surveys were conducted in five rounds of pre-testing and were administered in neighbourhoods of low, middle and high income levels across the whole city of Queretaro. In each round, several ranges of bid levels were tested to set the lower and upper bounds of the prices offered to the respondents in the WTP question. The pilot surveys also helped to further analyze residents' interpretation of the questionnaire and to finish the training of the enumerators (see section 2.3). The researcher and the enumerators usually met after conducting the pilot surveys to discuss the respondents' perceptions about the questionnaire and any problem related to the administration of the survey. Special care was taken to make sure that the enumerators were conducting the survey based on the specified guidelines and that the questions of the survey were clearly understood by the respondents.

2.2 Questionnaire design

The questionnaire of the survey for water supply improvements is divided in seven sections (See Appendix C). The first section contains questions about sources of water and expenditures in the water utility service and bottled water.

The second section analyzes the water availability for the household. The third section of the survey collects information on people's perceptions about the quality of and health concerns about tap water. The fourth section contains questions about the participant's satisfaction levels with the current water supply service. The fifth section presents the WTP question for water supply improvements and some follow-up questions to participant's response to this WTP question. The sixth section deals with a WTP question for water resources conservation and some follow-up questions to the participant's response. Finally, the seventh section gathers information on socio-economic characteristics from the participant and her/his household. This chapter will present a summary of the results of sections 1, 2, 3, 4, 5 and 7. The analysis and results of section 6 are left for future research.

The WTP question for water supply improvements is a dichotomous choice question that has a detailed explanation of the scenario of water supply improvements (see Appendix C). This question starts by explaining to the participant that Queretaro needs improvements in the water supply service to guarantee an adequate level of water availability and quality. Moreover, it includes an explanation of the WTP question and a request to answer the question as if he or she were going to pay in reality for the water supply improvements. This part of the WTP question is usually called "cheap talk" (Cummings and Taylor, 1999) and is included in contingent valuation questionnaires to reduce the bias in the answer to the WTP question and to motivate an answer that is closer to respondent's reality. The WTP question then explains that if necessary projects and public works were undertaken it could be possible to supply water to the participant's household 24 hours a day and that water would be good enough to drink straight from the tap. During the explanation of this question a coloured table with recognizable icons was used to illustrate the scenario to participants (See Appendix C).

The information obtained from the WTP question for water supply improvements and the other sections of the survey will be discussed in sections 3 and 4 of this chapter. Before this, sections 2.3 and 2.4 will describe the administration of the survey and how the sample was built.

2.3 Survey application and sample design

The survey of homes connected to the water supply system was administered to a sample of 629 households during the months of June and July, 2005. This was achieved by hiring and training a team of thirteen enumerators. The hiring and training of the enumerators followed Whittington's recommendations to conduct contingent valuation surveys in developing countries (Whittington, 2002).

The enumerators were university students in their second year. Since most of them had limited or no experience conducting household surveys, extensive training was required. During the training, enumerators were carefully explained the characteristics of a contingent valuation study and the utility of conducting this kind of analysis. Moreover, there were active discussions on how a household survey should be conducted and on how to request participation.

The training also required that enumerators had to rehearse the interview procedure in front of the enumeration team. Careful attention was given to the WTP question and enumerators were instructed to read the text the way it was written in the questionnaire. Each of the enumerators practiced the administration of the survey by conducting one rehearsal survey with a real resident from Queretaro. This practice survey was supervised and each enumerator received comments and suggestions on how to improve the administration of the surveys. In addition, most of the enumerators were able to conduct pilot surveys and gain enough experience before conducting real surveys. Finally, to maintain the quality of the surveys the enumerators were monitored regularly while they conducted the survey.

The administration of the survey was done mostly during daylight times from 9 a.m. to 8:30 p.m., Monday to Friday. During Saturdays, the surveys were conducted from 9 a.m. to 2 p.m. The enumerators were divided into two shifts (morning and afternoon). The enumerators usually met in the research office and were transported to the neighbourhoods that were going to be surveyed. They usually worked in pairs and were distributed in different streets of the neighbourhood being surveyed. Each enumerator carried a script designed to request participation and a sheet to record the households that were visited, surveyed or refused to participate. When the enumerator knocked on the door of a house, she or he had to request to talk with the household head and request his or her participation. If the household head gave verbal approval to participate, the enumerator provided the survey information sheet and helped the participant complete the written consent form.[9] Finally, the enumerator proceeded to read the survey and show the illustrations for the WTP questions.

[9] The information sheets and consent forms were a requirement of the Ethics Committee Board of the Faculty of Agriculture, Forestry and Home Economics at the University of Alberta.

The script of the enumerator, the information sheets and consent forms can be seen in Appendix C.

Surprise supervising was another method used to ensure the quality of the surveys that were conducted. The supervisor met the enumerators by surprise while they were working in the field and requested to be shown the completed surveys. Then the supervisor randomly selected one of the surveys and he made a return visit to the household. In the second visit to the household, the supervisor asked the participant different questions to determine if the respondent understood the explanation given by the enumerator. The supervisor asked the participant some questions from the survey to verify the recorded information. This method helped to improve the quality of the surveys and to detect any problems in the filling of the questionnaire such as enumerators faking responses. All the enumerators were supervised and reviewed while they conducted their surveys. The use of cell phones allowed the supervisor to locate and communicate with the enumerators in the field.

About 2,500 households were visited and from these households 629 participated and 554 refused to answer the questionnaire. The rest of the households that did not participate consisted of household heads that were not at home. Each survey took on average 19 minutes to be completed. In total, the enumeration team visited 61 neighbourhoods in the City of Queretaro and its metropolitan area (See Appendix A, section 1). The neighbourhoods that participated in the survey were chosen to create a representative sample of the city. The procedure used to build the sample is described in the next section.

2.4 Sample of the survey for connected households

The survey for connected households was administered to a stratified random sample of Queretaro's residents. A stratified random sample, according to Champ *et al.* (2003, p. 66), is built using some available measure to divide the study population into "...non-overlapping subpopulations (strata)." In the case of Queretaro's households, stratified sampling was used because there are substantial differences in the income levels of Queretaro's population. As in other areas of Mexico, Queretaro has a significant amount of people living in poverty while a reduced proportion of the population earns ten times or more the income of the average resident.

Table 1. Minimum wages in Queretaro.

	Daily minimum wage	One monthly minimum wage	Two times the monthly minimum wage	Three times the monthly minimum Wage	Five times the monthly minimum Wage	Ten times the monthly minimum Wage
Minimum wage wages in $Mexican Pesos (MXN)	$44	$1,322	$2,643	$3,965	$6,608	$13,215
Minimum wage in $Canadian Dollars (CDN)	$5	$157	$315	$472	$787	$1,573

Source: Comision Nacional de Salarios Minimos, *"Salarios Minimos y Profesionales,"* 2005, in http://www.conasami.gob.mx.

Table 1 shows the amounts of the individual minimum wages in Mexico and their multiples in Canadian dollars. Table 2 shows the percentage of Queretaro's occupied population that earns different levels of income (wages).

Table 2. Percentage of Queretaro's workers earning different proportions of the minimum wage.

	0 to half the minimum wage	Half to less than one minimum wage	1 to 2 to times the minimum wage	2 to 3 times the minimum wage
Percentage of workers	4.3%	3.2%	22.3%	20%
	3 to 5 times the minimum wage	5 to 10 times the minimum wage	More than 10 ten times the minimum wage	Do not specify income level
Percentage of workers	21.3%	13.6%	8.9%	6.5%

Source: Instituto Nacional de Geografia, Estadistica e Informatica, "XII Censo de Población y vivienda," 2000, in http://www.inegi.gob.mx.

There is substantial variability in Queretaro's residents' income levels. According to Tables 1 and 2, almost 50% of workers in Queretaro are earning less than $472 CDN per month. However, only about 9% of Queretaro's residents are earning more than ten times the monthly minimum wage. This variability in income affects the levels of water expenditures, water consumption and the estimates of WTP for water supply improvements.[10] Therefore, residents' income levels might be a useful variable to build a sample of subpopulations.

The sample of study was created with data obtained from the *Sistema de Consulta para la Informacion Censal por colonias* (Consultation System for the Census Information by neighbourhoods, SCINCE, Instituto Nacional de Geografia, Estadistica e Informatica, 2001). This source gives useful information on geographic and demographic data about Queretaro and contains information on residents' income levels by neighbourhood.

[10] In sections 3 and 4, it will be shown how the level of income affects the household's water expenditures and the WTP estimates.

To create the sample it was necessary to build a table of the income strata in Queretaro using the SCINCE data. Table 3 shows the income strata for workers in Queretaro obtained from the SCINCE. Notice that the last stratum of income only accounts for people earning more than five times the minimum wage. The table could not be completed for more strata because of lack of information. However, the SCINCE data base identifies the income levels of every worker living in Queretaro's neighbourhoods. With this information, it was possible to build a list of neighbourhoods to survey and to find the number of surveys per stratum that replicates the proportions of Table 3.

Table 3. Percentage of Queretaro's workers earning different proportions of the minimum wage (from the *Sistema de Consulta para la Informacion Censal por Colonias,* SCINCE)

	Proportion of the monthly minimum wage brackets			
	0 to 1 times the minimum wage	1 to 2 times the minimum wage	2 to 5 times the minimum wage	More than 5 times the minimum wage
Percentage of workers	6.4%	20.8%	41.7%	24.9%

Source: Instituto Nacional de Geografia, Estadistica e Informatica, *Sistema de Consulta para la Informacion Censal por colonias por colonias Santiago de Queretaro,* 2001.

During the survey administration, the enumerators were spread out across the assigned neighbourhoods and usually no more than three enumerators worked on the same street. Within each neighbourhood, the households to be surveyed were randomly selected to maximize heterogeneity.

Table 4 shows the final proportion of surveys conducted for each income stratum. The levels of income considered in the survey correspond to the participant's average range of monthly individual income.

Table 4. Sampling results of the survey for connected houses (percentage of surveys in each income stratum)

	Proportion of the monthly minimum wage			
	0 to 1 minimum wage	1 to 2 times the minimum wage	2 to 5 times the minimum wage	More than 5 times the minimum wage
Percentage of surveys conducted in each stratum	14.94%	20.99%	36.72%	27.34%

Note that most of the percentages of survey participants in each income stratum of Table 4 are similar or close to the percentages shown in Table 3. However, for the first stratum the percentage of surveys conducted is quite different from the percentage of people of the population under this stratum. This could be due in part to the 6.5% of the occupied population that does not report their income levels (Table 3) and because the survey participants that do not generate any income at all (unemployed or not economically active) are classified in the first income stratum of Table 4.

One limitation of the sampling procedure used to conduct the surveys is that it does not take into account all of the employed household members. The household's income is generated by all of those members that are working. However, the sampling procedure only takes into account one of the household's heads. The household's income might be higher than the participant's if there were other members working to earn money. The implication of this is that the income levels used to identify the households might not be completely accurate. However, the participant's income level was considered as a reasonable proxy of the household's income since he or she is in most cases a household head that generates a significant proportion of the household's income.

The reader will note through the analyses conducted and presented in the following chapters that the participant's income is used to compare different statistics such as water expenditures, water availability, etc. It is expected that the participant's income level produces a reasonable ranking of the household in terms of income levels. However, the use of more accurate approaches such as the estimation of wealth indexes is left for future research.

3. Descriptive statistics

This section will show the main results from the data collected in the survey for connected houses. Although this section presents only a summary of the results of the survey, the reader can find more descriptive statistics and tables derived from the answers to the survey in Appendix A.

3.1 Socio-economic characteristics of respondents

3.1.1 Individual characteristics

The majority of the respondents were household heads or residents that knew about the expenses of the household. The average age of the participants was 41 years and most of participants were women (61.29%). The fact that the sample was formed with a majority of women was due to random events and the willingness of people to participate in the survey. During the survey administration, the female household heads were sometimes requested by other household members to answer the questionnaire. This happened because the female household head was referred as the person that knew and made decisions about the household's expenditures and the water supply service. The analysis conducted in this thesis intends to analyze the households' WTP for water supply improvements. Therefore, since most of participants were household heads the sample represents significantly the population that has the highest influence in any household decision related to the water supply service.

The survey also found that about 73% of the respondents were married or living with a partner and the rest were single or living without a partner. About 21% of participants completed only elementary school, 24% completed only junior high school and about 25% completed high school, a commercial career or a technical degree. Approximately 19% of the respondents had a graduate or undergraduate degree. It is important to note that 8.74% of the participants did not complete any level of education.

Participants also responded to questions about their occupation and the nature of their employment. Table 5 shows the participants' distribution of occupations. Note in Table 5 that about 43% of participants declared to be occupied in household duties and about the same proportion stated they were employed (self-employed, wage earner, labourer, employer and others). In the employed category, the highest proportion consisted of wage earners, labourers and employees (23% of employed residents). On average, the people currently working have one job, however, 10% of the respondents have two or more jobs.

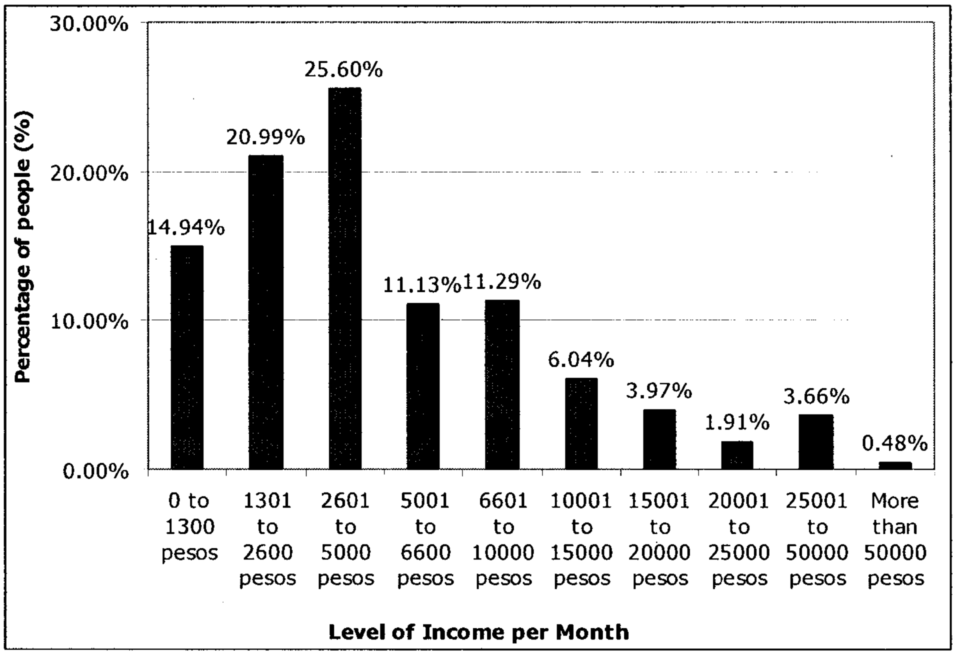
Table 5. Main occupations of participants living in regular neighbourhoods

Main Occupation	Percentage of respondents
Household duties	42.93%
Self-employed without workers	18.92%
Wage earner	17.49%
Retired	6.84%
Labourer or employee	5.41%
Student	4.93%
Employer	1.43%
Unemployed	1.27%
Others	0.18%

Section 2.4 compared the official statistics of the income levels in Queretaro with the income levels of the survey sample. Figure 1 shows a detailed description of the income distribution in the sample. In Queretaro, there are significant inequalities in the distribution of income. About 15% of the respondents live on less than $1,300 Mexican pesos per month (about $155 CDN). However the richest 0.48% percent of the sample earns more than 38 times the income level of the poorest group. About 61% of the population lives on less than five times the minimum wage or $6,600 Mexican pesos per month ($786 CDN).

The data in Figure 1 can also be used to measure the inequality of the individual income in most of Queretaro's population. The Gini coefficient is commonly used to measure the inequality of income levels in a group of people or at the macro level to measure the distribution of income of a whole nation. The Gini coefficient is measured in a scale of zero to one. A Gini coefficient of zero corresponds for perfect equality and a measure of one would be for perfect inequality. Canada has a national Gini coefficient of 0.33 according to the last Human Development Report from the United Nations while Mexico has a Gini coefficient of 0.541 (United Nations Development Programme, 2005). The Gini coefficient for the sample of Queretaro's connected houses is 0.54 (at the income median levels).

Figure 1. Individual monthly income distribution of participants living in regular neighbourhoods.



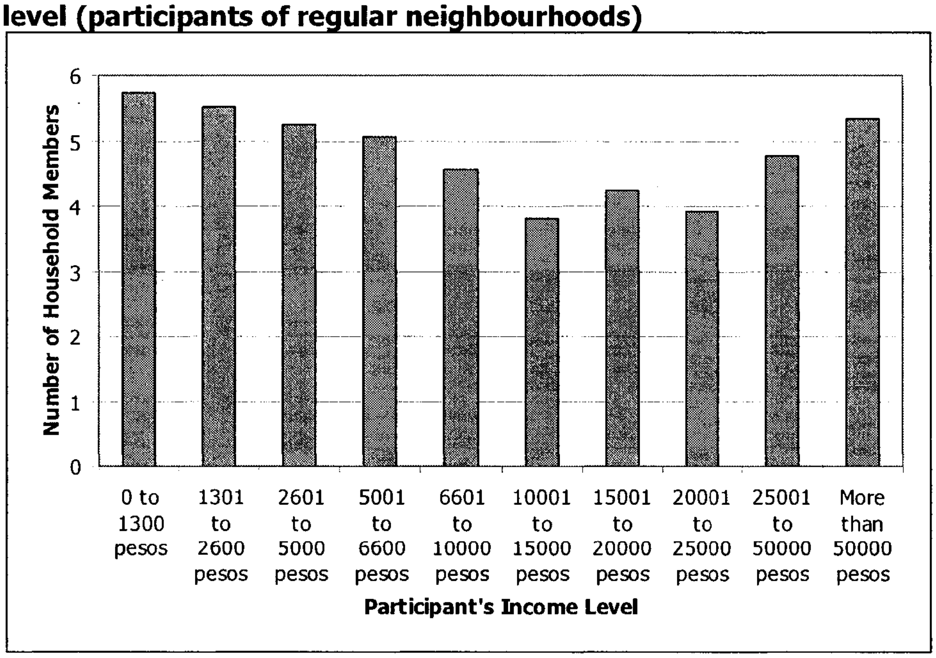
3.1.2 Household characteristics

During the survey several kinds of households were visited. The houses that Queretaro's residents inhabit have varied sizes and physical characteristics. This section will present the results of the questions that gathered information about household characteristics. These characteristics are relevant to distinguish the contrast among households of different income and wealth levels.

As in other cities of Mexico, Queretaro's households have several compositions. In addition to the nuclear family there is usually some other people living in the house (relatives, tenants, etc.) The survey found that on average there are five people living in Queretaro's residences and four belong to the nuclear family. Most households have two or more children. Therefore, an average household from Queretaro is comprised of two adults (usually the family heads), at least two children and one person that is not part of the nuclear family.

The survey also found that the number of household members may vary across the income levels of the household heads. Figure 2 shows the average number of household members across the level of income of the household head or survey participant.

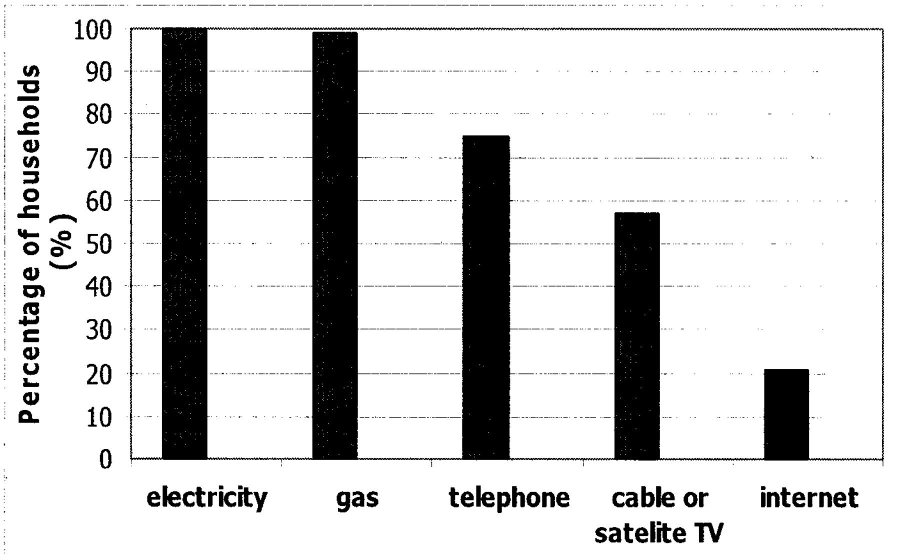
Figure 2. Average number of household members in each income level (participants of regular neighbourhoods)



Note in Figure 2 that households with low income levels usually have the highest number of people living in the household. In the poorest income strata (0 to 1,300 pesos per month), a participant reported that 20 people were living in his/her dwelling.

Besides water, all the households surveyed have electricity service (Figure 3). In addition, almost all the households that participated in the survey have gas too (in tanks or piped gas), however the percentages of households with telephone, cable and internet are considerably lower (Figure 3). Cable and internet services are used by people with medium to high income levels. For example, 91% of the people earning more than $8,300 pesos ($988 CDN) per month have cable. In the case of the telephone about 86% of the people earning less than $3,800 pesos ($452 CDN) per month do not have this service.

Figure 3. Percentage of households with other utility services besides piped water in regular neighbourhoods.



The survey found that, on average, the participants' houses have 6 rooms including the kitchen, bathrooms, bedrooms and others. However, about 2% of the participants declared they live in a place with only one room. The participant with the biggest house declared a total of 26 rooms. Table 6 shows the materials that were used to build the houses that were surveyed and the percentage of houses using each material.

Most of the houses in Queretaro have their ceilings and walls made of concrete, cement or bricks while the floors are made of ceramics, wood or other kind of parquet. The households with low income levels usually have floors made of cement or dirt. This kind of household represents about 44% of the sample.

Table 6. Materials of the houses with piped water services

Material of the walls	Percentage of households	Material of the ceilings	Percentage of households	Material of the floors	Percentage of households
Concrete, cement or bricks	97.62%	Concrete, cement or bricks	91.26%	Wood, ceramics or other kind of parquet	55.96%
Asbestos or metal sheets	0.48%	Asbestos or metal sheets	7.31%	Cement	43.08%
Adobes	1.75%	Cardboard sheets	0.16%	Dirt	0.95%
Other materials	0.16%	Other materials	0.48%		
		Cement and asbestos or metal sheets	0.79%		

Another question on the household characteristics was type of ownership. Respondents were asked to declare if their house was self-owned, rented or lent by some other person. The results from the survey show that about 74.4% of the participants own their house and have no mortgage. On the other hand, 11.76% are renting and 8.11% are paying a mortgage or other financing plan. Finally, about 5% have borrowed their house from somebody else (usually a relative).

In order to gather more information on the household's wealth level, the survey also collected data about the vehicles (automobiles) available for transportation in each household. The results show that only 33% of the households have at least one car available for household members. The remainder of the participants and their household's members use buses or other ways of transportation.

3.2 Households water supply service characteristics

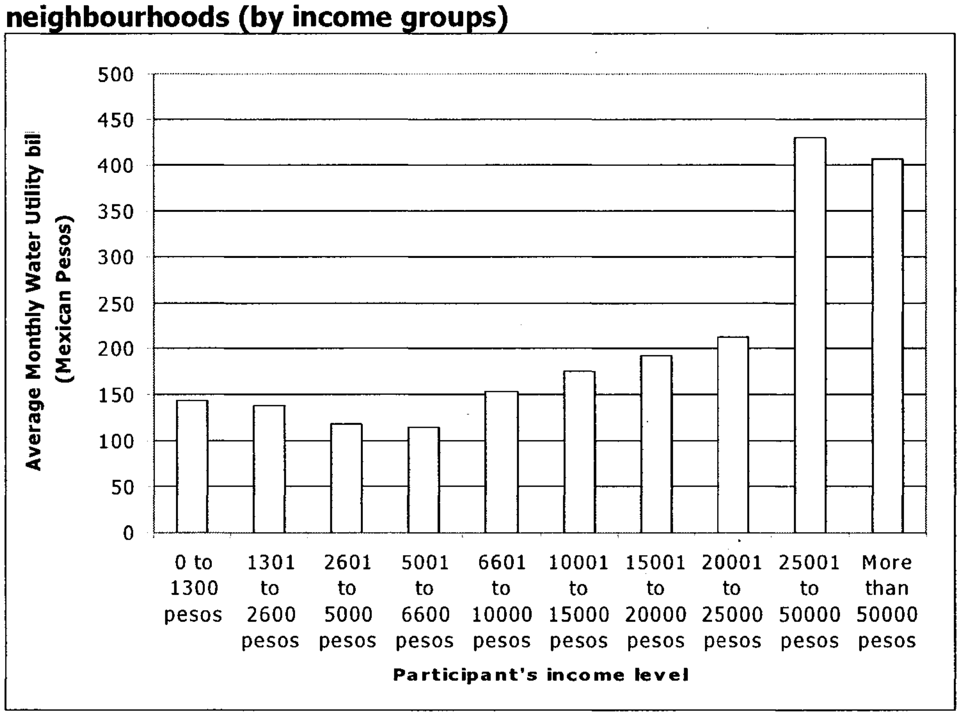
3.2.1 Water expenditures

In the survey of households with piped water service, all of the participants confirmed that they are connected to the CEA water supply system and almost of all them stated that they pay for the service directly to this water agency. On average, respondents pay $151.17 Mexican pesos (approximately $18 CDN) per month on their water utility bill. However, there are significant differences in the monthly expenditures on water depending on the participant's level of income (Figure 4).

Figure 4 shows that for participants with low income levels, the average expenditure on the water utility bill is around $150 pesos per month. On the other hand, for medium income levels the average expenditure on water is between $150 to $200 pesos. Finally, for high income levels the average water expenditure is around $400 pesos per month.

The household's water expenditures vary depending on two main factors: the tariffs from the water agency and water consumption. In Queretaro, the CEA uses a scheme of water tariffs that is approved by the State's Congress. Currently, the CEA charges three different tariffs depending on the income level of the neighbourhood where the house is located: low, medium or high income neighbourhood. The tariffs follow an increasing block tariff structure[11] where the price for every cubic meter of water is set depending in the household's level of water consumption (Comision Estatal de Aguas, 2002).

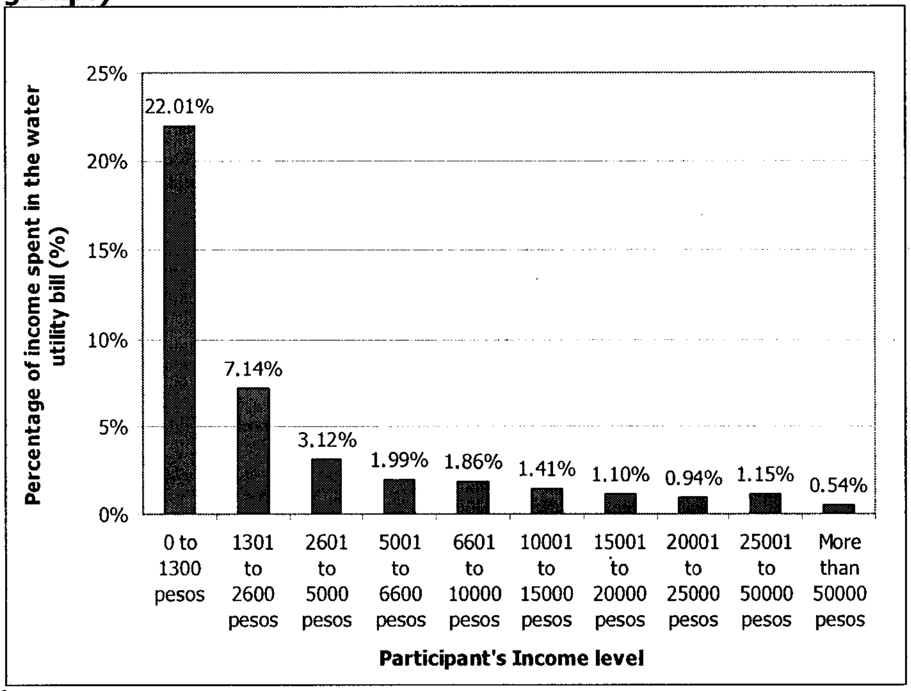
Figure 4. Average monthly expenditure on water utility bill in regular neighbourhoods (by income groups)



[11] Increasing block tariffs "set two or more prices for water, with each price applying to consumption within a defined block. Prices rise in each successive block." Boland and Whittington, 2000.

Figure 4 shows that people with higher income levels pay more than residents of low income levels. Figure 5 presents the average water expenditure as a proportion of income (at the medians of the income ranges). This graph reveals that for participants in the lowest income bracket, the monthly water utility bill represents about 22% of their income. On the other hand, for people with a monthly income level of more than 15,000 pesos per month, the monthly water utility represents on average less than 1% of their income.

Figure 5. Average monthly expenditure on water utility bill as a percentage of income in regular neighbourhoods (by income groups)[a]

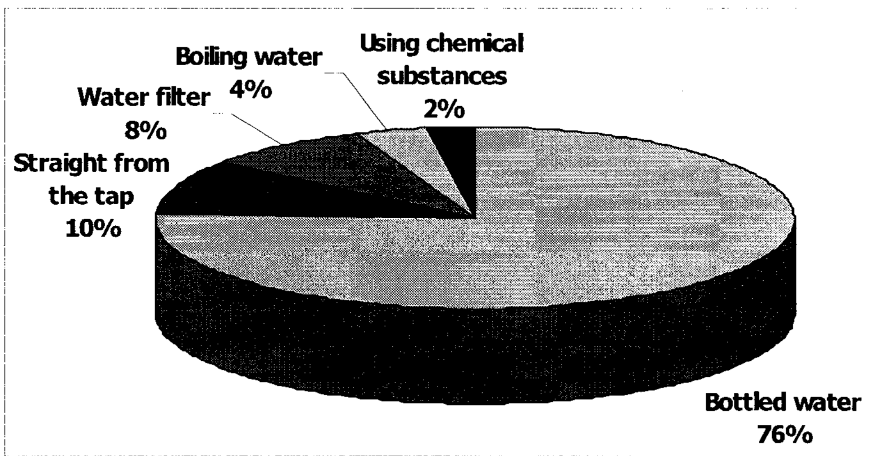


[a] Percentages of income at the medians of the ranges of income.

By comparing the results of Figure 5 with the data on the percentage of participants in each income bracket (Figure 1), it becomes clear that about 15% of the participants have to spend almost a quarter of their monthly earnings to pay for the water bill. For almost 40% of the participants (people earning more than $5,001 pesos per month), the water utility bill represents less than 2 percent of their individual income levels.

Another source of expenditure on water is the amount of money that Queretaro residents spend for drinking water. The survey asked participants about their main source of drinking water in their households. The results of this question are shown in Figure 6. About 76% of participants answered that their main source of drinking water is bottled water. Only 10% of the respondents declared they drink water straight from the tap. Moreover, 8% of the participants mentioned that they get drinking water through a water filter. About 4% boil water for drinking and 2% use chemical substances, such as iodine, to clean the water from the tap.

Figure 6. Sources of drinking water in houses with piped water services

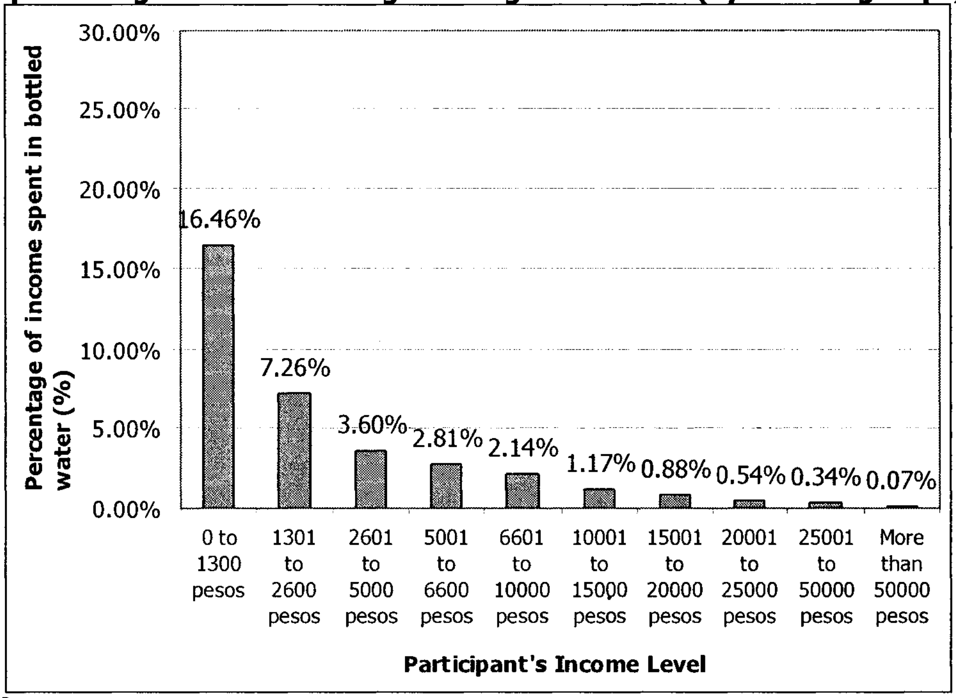


It is also important to note, that there are differences in the sources of drinking water depending on income levels. For the higher income strata (people with income over $25,001 pesos per month) people appear to substitute the consumption of bottled water by buying water filtration systems (See Appendix B, section 3-ii). On the other hand, more than 20% of the participants earning less than $1,300 pesos per month drink water straight from the tap. This constitutes the highest proportion of people in all the income strata drinking water from the tap. For middle income strata ($6,601 to $20,000 pesos per month), over 80% of the participants declared that they buy bottled water.

Since bottled water is the main source of drinking water for most of Queretaro's residents, the survey collected information on the households' expenditure on bottled water every month. On average, the participants of the survey are buying two *garrafones* (20 litre bottles of water) every week at a price of $17.03 Mexican pesos ($2 CDN) per bottle of water. Therefore, for all the participants from the sample (including those who do not buy bottled water) the average expenditure in bottled water is $141.13 Mexican pesos (about $17 CDN) per month.

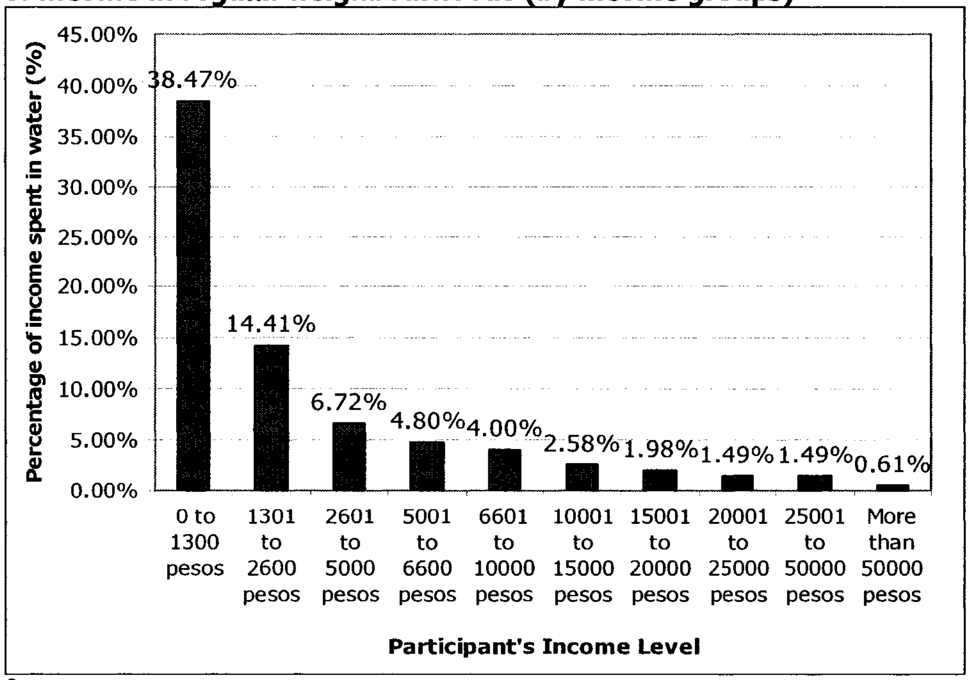
Queretaro's residents with low levels of income are spending a considerable amount of money on bottled water. For residents in the lowest income stratum, spending on bottled water represents, on average, approximately 16.5% of the income of one of the household heads (Figure 7). Moreover, for residents in the second lowest income stratum, the expenditures in bottled water represent about 7.3% of the participant's monthly income level. Note that for income groups where the participant earns more than $2,601 per month, the expenditure in bottled water represents less than 5% of their income levels. For income groups earning more than $15,000 pesos per month, the cost of buying bottled water represents less than 1% of their monthly incomes.

Figure 7. Average monthly expenditure on bottled water as a percentage of income in regular neighbourhoods (by income groups)[a]



[a] Percentages of income at the medians of the ranges of income.

Figure 8. Average total monthly expenditure in water as a percentage of income in regular neighbourhoods (by income groups)[a]



[a] Percentages of income at the medians of the ranges of income.

Figure 8 uses the data from Figures 5 and 7 to show the average total water expenditure as a percentage of income levels. Note in Figure 8, that participants in the first income brackets are paying more for water relative to their income levels. For a participant whose income level is less than $1,300 pesos per month, the total expenditure in water represents 38.5% of his/her income. For people with incomes between $1,301 and $5,000 pesos water expenditures represent more than 5% of their monthly earnings. Therefore, Figure 8 shows that for household heads with low income levels paying for water for their households represents a significant proportion of their monthly income.

3.2.2 Water availability

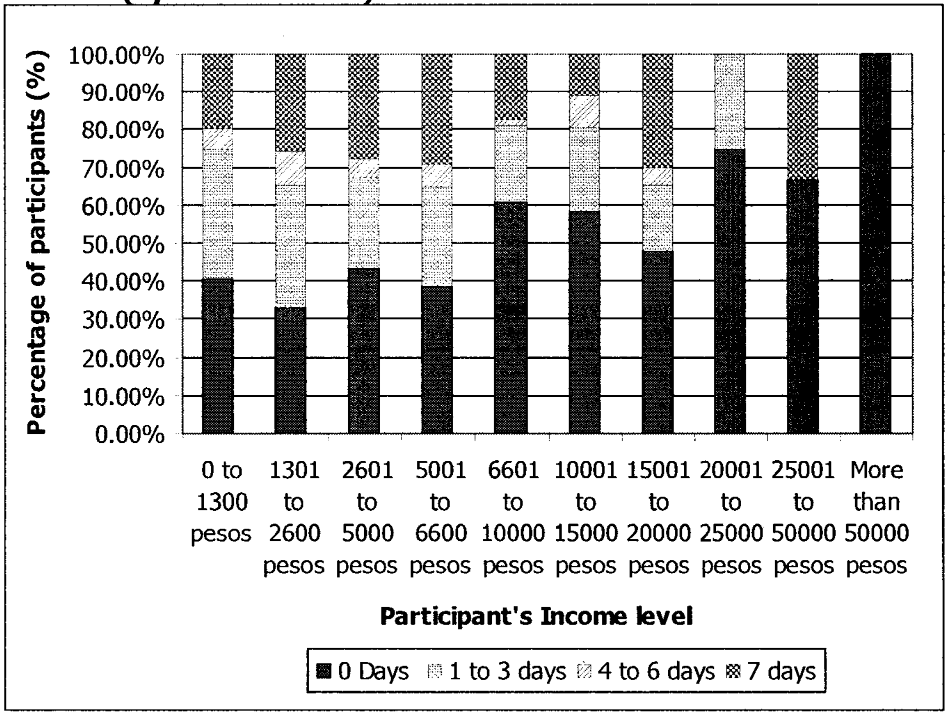
In central Mexico, the local water agencies tend to supply water to neighbourhoods in the cities by shifts or schedules. Therefore, the water supply service is not running 24 hours a day. Residents usually avoid the variation in water availability by storing water in tanks and other kinds of containers. This section will present the information that the survey collected about water availability by analyzing people's perceptions about the occurrence of water cut-offs and the kind of water containers that they have.

From the total of respondents, approximately 95% know about the occurrence of water cut-offs. A water cut-off was described to participants as having no water at all coming from the water supply system or low pressure that is not adequate to satisfy the household's demand. From the total of participants that knew about the occurrence of the water cut-offs, 45% stated that they do not have water cut-offs in a regular week (see Appendix A, section 4-i).

However, approximately 25% of the respondents declared having water cut-offs between one and three days a week. On the other hand, about 5% reported having between four and six days a week with water cut-offs. About 24% of the participants that have perceived water cut-offs declared that this happens all the days in a regular week.

Most of the participants that could state the exact time of the day when water cut-offs occur noted day-light times as more frequent, specifically, mornings. Moreover, some respondents were also able to give some information about the number of hours that the water cut-offs usually last. On average, the water cut-offs last almost 12 hours. However, 32 participants declared that when they have water cut-offs they usually last the whole day (24 hours).

Figure 9. Number of days in regular neighbourhoods with water cut-offs (by income levels).



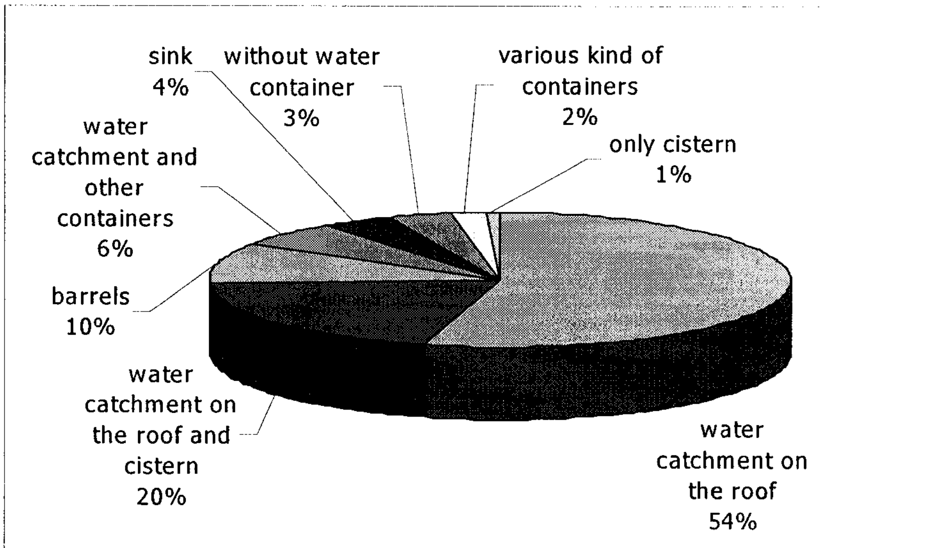
Note in Figure 9 that the percentage of participants with water cut-offs (1 to 3 days, 4 to 6 days and 7 days) decreases when the income level increases. For example, above income levels of $6,601 Mexican Pesos ($786 CDN), an average of 68% of participants declared having no water cut-offs at all. Therefore, most of residents in Queretaro from medium and high income levels do not have problems with the availability of the water supply service.

In central Mexico, it is very common that households usually have a water tank or catchment to store water (usually located on the roof of the house). However, some households have a cistern and a pump that is used when there are water cut-offs. When there is enough water the household fills the water catchment and the cistern. When there is a water cut-off the residents pump water from the cistern to the water catchment (on the roof).

In the sample from Queretaro's residents connected to the water supply system, approximately 54% of the participants have a water catchment on their roofs and about 20% have a catchment plus a cistern (Figure 10). This kind of water storage minimizes the risk of having water shortages in the house because the cistern usually can store significant amounts of water. The residents only have to pump the water from the cistern to the water catchment to have water in the pipe system of their households. Of the people that have cisterns, approximately 88% of them use electric pumps to take the water from the cisterns to the house piped system.

The households most affected by variability in water supply service are those that do not have adequate water storage containers or do not have the cistern-water catchment installations. In the survey, 19% of participants are exposed to water supply service variability because they either have barrels, sinks, various kinds of small containers (pails, tubs, etc.) or none of these (Figure 10). Moreover, the lack of adequate water storage containers reduces considerably the quality of the water used in the households. Even if water arrives clean to the households if it is stored in rusty old metal barrels or pails without a cover, water may get polluted with different chemicals or pathogen organisms.

Figure 10. Percentage of participants from regular neighbourhoods using different types of water containers



The availability of adequate water storage containers is related with income levels too. The survey found that above individual monthly income levels of $10,000 pesos ($1,191 CDN) per month all residents reported having either a water catchment on the ceiling or a water catchment and a cistern with a pumping system. In the lowest income bracket (people earning less than $1,300 pesos [$155 CDN] per month), less than 10% of the participants reported having water catchments and cisterns. Moreover, the highest proportions of residents using barrels, sinks, various kinds of containers or no container at all are among people whose monthly individual income level is less than $6,600 pesos ($786 CDN) per month.

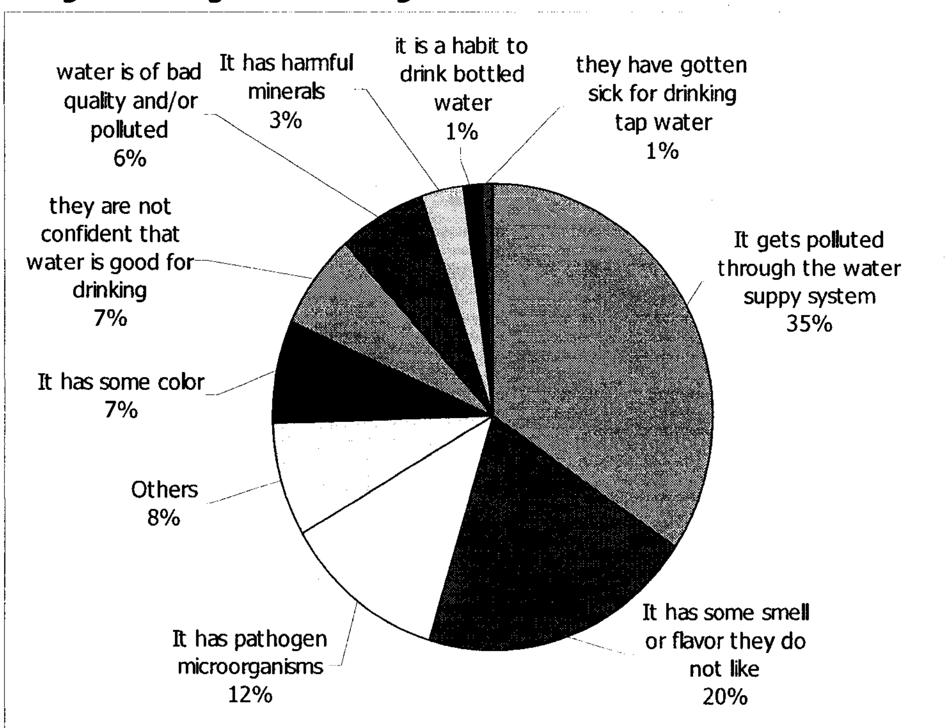
3.2.3 Water quality

Section 3.2.1 showed that the residents in Queretaro spend a considerable amount of money on bottled water. One of the reasons behind people's decisions to buy bottled water is the quality of the water from the city's supply system. In the survey, participants were asked to state if they think that water straight from the tap is good for drinking. Approximately 76% of participants stated that they believe that water straight from the tap is not good for drinking. Only 23% stated that they think that it is good enough to drink (the rest of participants answered "don't know or not sure").

The most frequent reason given for not drinking water straight from the tap was that water gets polluted through the water supply system (35% of participants stated this reason, Figure 11). Another argument that received several mentions was that water from the tap has some smell or taste that they do not like and many people declared that water smells or tastes excessively of chlorine (20% of participants, Figure 11). About 12% stated that the water has pathogen organisms. The rest of the people mentioned several different reasons such as color presence in water, lack of confidence in the water quality, pollution of wells, etc (Figure 11).

Participants were also asked if they or some household member has ever been sick because of drinking water straight from the tap. Most of participants (98% of the sample) declared that nobody has ever gotten sick by drinking tap water. However, the people that have been sick because of drinking tap water mentioned the following diseases: stomach infections (78%), typhoid (10%), amoebic dysentery (4%), skin rash (4%), cholera (2%) and blacking teeth (2%).

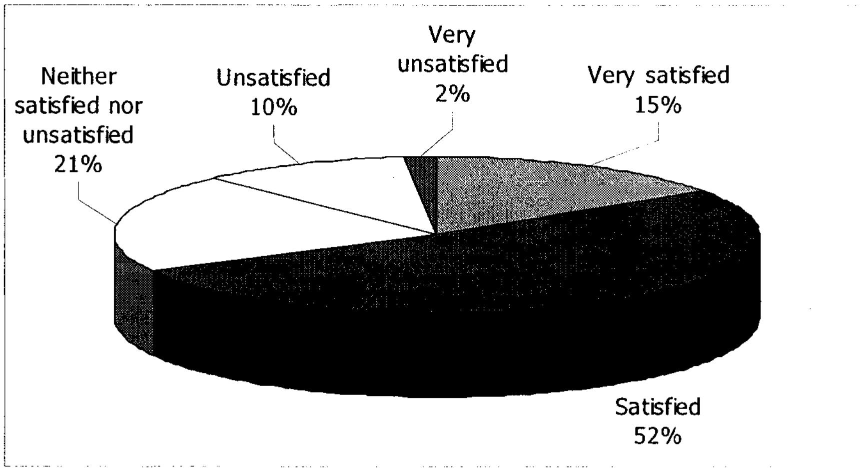
Figure 11. Percentage of participants from regular neighbourhoods and their responses to why do they think that water from the tap is not good enough for drinking?



3.2.4 Satisfaction levels from the water supply service

The survey also contained a section that asked participants to state their satisfaction levels with the current water supply system. Figure 12 shows their responses. Most participants (67%) stated that they felt satisfied or very satisfied with the current water supply service. However, about 12% said that they felt unsatisfied or very unsatisfied with the current water supply service. Moreover, approximately 21% of participants declared that they do not feel satisfied or unsatisfied with the service.

Figure 12. Percentage of participants and their satisfaction levels with the water supply service



Respondents mentioned different reasons for their satisfaction levels with the current water supply service. The responses can be divided into two groups: opinions approving of the water supply system and opinions not approving the current system. In the first group, about 63% of participants declared either that the water supply system ensures water availability or the service is good or that the water quality is acceptable (see Appendix A, section 6). In the second group, people with opinions disapproving of the water supply system, about 37% of participants mentioned one or several of the following reasons: they need more water, water is not clean, water quality is not acceptable and the service needs numerous improvements. Therefore, although some participants declared to be neither satisfied nor unsatisfied, they stated that the service needs several improvements.

Residents' satisfaction levels with the current water supply system show that most of the survey participants approve of the current water service. This demonstrates that there could be a very good level of acceptance of the work conducted by the CEA. However, a significant number of residents think that there are several improvements that the CEA needs to do to guarantee an adequate water supply service.

4. Results from the WTP question for water supply improvements

In the descriptive statistics of the data from the survey, it was shown that there are significant concerns about the water supply service. These concerns are related to the lack of a reliable water supply service that provides adequate water availability and quality to Queretaro's households. Therefore, residents might have significant welfare gains if the water supply system is improved.

The survey presented to participants a scenario that proposed improvements to the systems of water extraction, purification, treatment and distribution, in such a way, that Queretaro's households may be able to have water 24 hours a day and drink water straight from the tap (without any concerns about its quality). This scenario was presented in section 5 of the questionnaire (See Appendix C). With the use of graphics, enumerators read the script of the scenario and asked the following question to participants:

> Would you be willing to pay $____ pesos per month, over what you currently pay, for a water supply service that, for the next 50 years, would allow your home to have water 24 hours a day and to drink it directly from the main faucet of your household?
>
> ❑ Yes ❑ No

The bid or price that was offered to each participant was picked randomly from the following set of prices: $30, $50, $120, $200, $350 and $600 Mexican pesos ($4, $6, $14, $24, $42 and $71 CDN respectively). These bid levels were pre-tested in the focus groups and the pilot surveys and they were chosen based on two main factors: the number of yes/no responses for the highest and lowest bid levels and the behaviour of the proportion of yes/no responses across the whole set of bid levels. The final set of prices showed the smallest proportion of "yes" responses for the highest bid levels and the largest proportion of "yes" responses for the lowest bid levels. Moreover, for the final set of bid levels, the proportion of "yes" responses decreases as the prices increase.

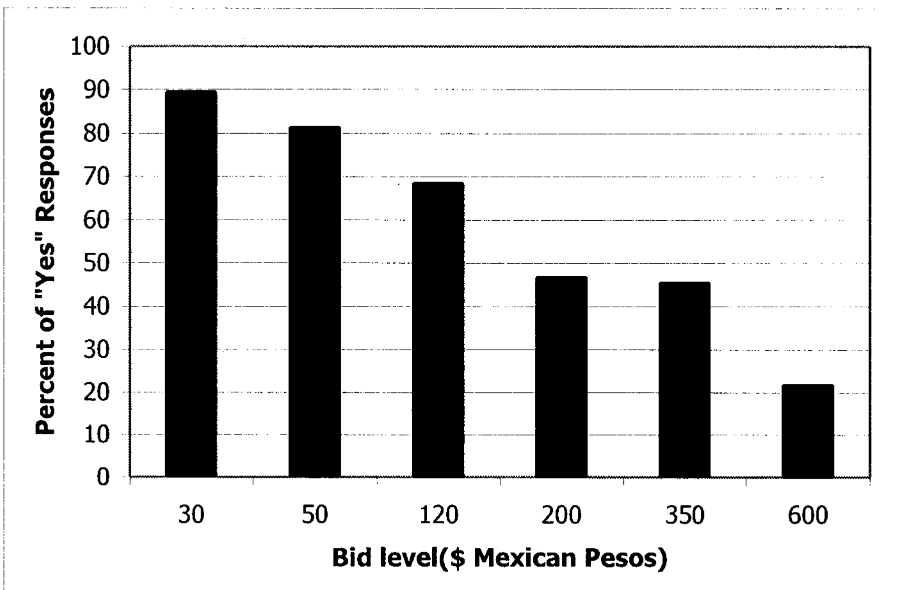
After reading the WTP question, the respondent had to answer if he or she will be willing to pay the specified amount. Moreover, some follow-up questions were used to analyze the veracity of the response and to detect possible sources of bias.

This section will present the results of the WTP question for water supply improvements and the analysis conducted using these data. Two kinds of analysis were conducted: non-parametric and parametric. The non-parametric analysis uses a distribution free estimation of willingness to pay. The parametric analysis will make use of an empirical model and some econometric tools to estimate the willingness to pay for water supply improvements in Queretaro.

4.1 WTP for water supply improvements: Non-parametric analysis

The question of WTP for water supply improvements was answered by a total of 627 participants. The results of this question are shown in Figure 13 and demonstrate that as price increases the percentage of people willing to pay the specified amount decreases. For the highest bid level, only about 21% of respondents answered yes. For the lowest price level, about 90% of participants answered yes.

Figure 13. WTP for water supply improvements in regular neighbourhoods, percentage of respondents that answer yes



Haab and McConnell (2003) present a detailed exposition of a non-parametric method to estimate the mean and median WTP in contingent valuation studies using discrete choice questions. In order to estimate the non-parametric mean and median WTP, it is necessary to use the Turnbull estimator of the probability density function (PDF). This estimator is distribution-free and it imposes a monotonicity restriction that guarantees that as the offered price increases, the percentage of observed "yes" responses decreases. Therefore, the Turnbull estimator can be used for samples that do not present monotonicity in the proportion of the "yes" responses to the bid levels.

The Turnbull estimator is defined in the following equations (Haab and McConnell, 2003, pp. 65-70):

$$f_j^* = F_j^* - F_{j-1}^* \tag{3.1}$$

Where f_j^* is the estimated PDF for the j^{th} bid level, F_j^* is the estimated cumulative distribution function (CDF) for the j^{th} bid level and F_j^* is the CDF for the $(j-1)^{th}$ bid level. The CDF for each bid level is calculated in the following way:

$$F_j^* = F_j = \frac{N_j}{T_j} \text{ if } F_{j+1} < F_j \tag{3.2}$$

$$\text{and } F_j^* = \frac{N_j + N_{j+1}}{T_j + T_{j+1}} \text{ if } F_{j+1} > F_j \tag{3.3}$$

Where N_j is the number of "no" responses for the j^{th} bid level and T_j is the total number of observations for the j^{th} bid level. The calculation of the Turnbull estimator needs to compare the proportion of the yes/no responses against the bid levels. If the proportion of responses does not reduce or increase monotonically then it is necessary to pool the observations of the j^{th} and $(j+1)^{th}$ bid levels that are not monotonic and create just one set of observations with the j^{th} and $(j+2)^{th}$ bid levels as boundaries and calculate F_j^*.

For the sample of connected households, Table 7 shows the estimated CDF (F_j^*) and the Turnbull estimator of the PDF (f_j^*). Since all the proportions of "no" responses increase monotonically it was not necessary to pool any set of observations. With the estimated CDFs and PDFs, it is possible to calculate a range of the median WTP. The lower bound of the median WTP will be the price where the CDF becomes higher than 0.5 (Haab and McConnell, 2003, p. 72). The upper bound of the median WTP will be the next higher bid level. Therefore, for the case of the households connected to the water supply system the median WTP falls in a range between the bid levels $120 and $200 since between these two prices the CDF becomes 0.5.

Table 7. Turnbull estimators of the WTP for water supply improvements

Bid Level	N_j	T_j	F_j^*	f_j^*
30	8	76	0.105	0.105
50	11	59	0.186	0.081
120	41	130	0.315	0.128
200	66	124	0.532	0.216
350	67	123	0.544	0.012
600	90	115	0.782	0.237

The Turnbull estimator can also be used to estimate the lower bound mean and variance WTP. The expected value and variance of the lower bound WTP are defined as (Haab and McConnell, 2003, pp. 71-79):

$$E_{LB}(WTP) = \sum_{j=0}^{M} t_j (F_{j+1}^* - F_j^*) \tag{3.4}$$

$$Variance(E_{LB}(WTP)) = \sum_{j=1}^{M*} \frac{F_j^*(1-F_j^*)}{T_j^*}(t_j - t_{j-1})^2 \tag{3.5}$$

Where t_j is the j^{th} bid level. The upper bound on WTP can be estimated using a similar formula. However, this cannot be done without setting an arbitrary highest bid level that might lead to some bias in the estimates. Therefore, only the lower bound value of the WTP was calculated. Using equations 3.4 and 3.5, the lower bound WTP for water supply improvements is estimated to be $251.10 Mexican Pesos ($28.86 CDN), and the standard deviation of this value is equal to $12.68 Mexican Pesos ($1.45 CDN).

With the calculated lower bound WTP, it is possible to build a confidence interval for this estimate. Assuming that the distribution of the standard deviation is asymptotically normal, a 95% confidence interval for the lower bound WTP is $275.95 Mexican Pesos($33 CDN)-$225.14 Mexican Pesos ($27 CDN).[12]

Although the non-parametric estimates help significantly to obtain an idea of where the estimated WTP will fall, the non-parametric analysis is limited not only because it cannot estimate a whole range of WTP estimates but also because it requires a significant number of calculations to know how several covariates or variables of importance might affect residents' WTP for water. Therefore, it is necessary to turn to the parametric analysis to find the effect of relevant variables in the WTP estimates.

4.2 WTP for water supply improvements: Parametric analysis

4.2.1 Model of the preferences for water supply improvements

The empirical model used to analyze the WTP for water supply improvements needs to specify the individual's preference function. According to Haab and McConnell (2003, p. 26), a kind of utility function commonly used is the linear utility function:

[12] This confidence interval was calculated as $251.10 \pm 1.96*12.68$. Where ± 1.96 is the range of values of the standard normal probability function at a 95% confidence level.

$$V_{ij}(Y_j) = \alpha_i z_j + \beta_i(Y_j) \quad (3.6)$$

Where V_{ij} is the utility level in the i^{th} scenario or condition for the j^{th} individual, α_i is a vector of m parameters, z_j is a vector of m variables related to the j^{th} individual, β_i is the coefficient or marginal utility of income and Y_j is the individual's discretionary income. [13] The WTP question asks the individual to choose between the proposed scenario at the specified bid level and the current situation of the water supply service. Therefore, the model assumes that the individual compares the utility levels before and after the new good or service is provided. The utility levels of the current and new scenarios are defined in the following functions:

$$V_{1j}(Y_j - t_j) = \alpha_1 z_j + \beta_1(Y_j - t_j) + \varepsilon_{1j} \quad (3.7)$$

$$V_{0j}(Y_j) = \alpha_0 z_j + \beta_0(Y_j) + \varepsilon_{0j} \quad (3.8)$$

V_1 is the utility level that the j^{th} individual gets in the new scenario if he pays the specified t_j bid level, V_0 is the status quo utility level and ε_j is an error or undetermined term for i^{th} utility level. The change in the utility level is defined as:

$$V_{1j} - V_{0j} = \alpha z_j + \beta t_j + \varepsilon_j \quad (3.9)$$

Equation 3.9 assumes that the marginal utility of income is the same in the status quo and the new scenario, therefore β_0 and β_1 are the same and the income variable is dropped. Moreover, $\alpha \equiv \alpha_1 - \alpha_0$ and $\varepsilon_j \equiv \varepsilon_{1j} - \varepsilon_{0j}$. Equation 3.9 represents the comparison that each individual makes to determine

[13] Discretionary income is the amount of income left after the individual has accomplished his essentials needs such as food, clothing, housing, etc. In other words, it is considered as the level of income after paying the individual fixed costs for living.

his or her preferences for the new good or service and it is used to specify the probability of a respondent answering "yes" to the WTP question:

$$\Pr(yes_j) = P(v_{1j} > v_{0j}) \tag{3.10}$$

$$\Pr(yes_j) = P(v_{1j} - v_{0j} > 0) \tag{3.11}$$

$$\Pr(yes_j) = P(\alpha z_j + \beta t_j + \varepsilon_j > 0) \tag{3.12}$$

Equations 3.10 to 3.12 define the probability of answering yes as a function of the difference in the utility levels of the new scenario and the status quo. If the error term of equation 3.12 is assumed to be independent and identically distributed, it is possible to estimate the parameters of the utility difference using the logistic or normal distributions (Haab and McConnell, 2003, p. 26). If the errors of the utility difference are assumed to follow a logistic distribution, equation 3.12 can be estimated as a logit.

The logit model that estimates the probability that the j^{th} respondent answers "yes" to the WTP question for water supply improvements is defined as:

$$\Pr(Yes_j) = \frac{1}{1 + \exp(-\alpha z_j - \beta t_j)} \tag{3.13}$$

The parameters of the utility difference in this model can be estimated maximizing the likelihood function of the logit model.[14] Moreover, the coefficients that are estimated from 3.13 are used to form the difference of the utility functions (equation 3.9). Note that the logit model is a non-linear model of the probability of answering "yes". It is also possible to model the probability of answering "yes" as a linear probability model (LPM) and estimate the parameters

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[14] A detailed description of the logit model and the procedures to estimate its parameters is in Green (1993, pp. 635-659).

using ordinary least squares (OLS). However, the use of a LPM presents two major problems: the errors are heteroscedastic and the probability of answering "yes" is not bounded between zero and one. The problem of heteroskedatiscity generates estimated coefficients that are not efficient, i.e. the coefficients do not have minimum variance and it is not possible to do hypothesis testing. The problem of non-bounded predictions produces estimated probabilities that could be negative or greater than one. Although there are some approaches to solve the problems of the LPM, the logit and the probit models are usually preferred (Gujarati, 1995, pp. 542-544 and Green, 1993).

4.2.2 Results of the estimation

The strategy to estimate model 3.13 was divided in three steps. First, model 3.13 was estimated using the bid levels as the only explanatory variable. Second, the model was estimated several times to analyze the effects of exogenous variables, such as demographic characteristics, and the effects of endogenous variables[15] related to the water supply service conditions. Finally, the third step was to estimate the model validating the data of the responses to the WTP question, i.e., the sample of responses was corrected for effects such as warm glow, rejection of the scenario, etc.

[15] Endogenous variables are considered in this analysis as those factors that are correlated with the WTP for water but it is not clear which is the direction of this relation. For example, the expenditure of bottled water might be correlated with the WTP for water supply improvements but it is not clear if it determines the WTP value or the WTP value determines the expenditure in bottled water.

The coefficients and the marginal effects were estimated for all the specifications of model 3.13. Note that the values of the marginal effects in a logit model are not the same as the values of the estimated coefficients because the probability of answering "yes" does not have a linear relation with the independent variables of the model (Gujarati, 1995). Therefore, it is necessary to find how much the probability of "yes" changes when one of the variable changes. For accomplishing this, consider that the expected value of the probability of answering "yes" with respect to a vector "x" of parameters is defined in the following expression (Greene, 1993):

$$\begin{aligned} E[y \mid x] &= 0[1 - F(\beta' x)] + 1[F(\beta' x)] \\ &= F(\beta' x) \end{aligned} \tag{3.14}$$

Where x is a vector of independent variables, β is the vector of coefficients estimated in the model and y is the probability of answering "yes." $F(\beta' x)$ is the probability distribution function (in the case of a logit model this would be the logistic distribution function). Equation 3.14 says that the expected value of the probability of answering "yes" given x is equal to the product of the probability when the individual answers "no" (y equals zero) and the probability when he/she answers "yes" (y equals one). It is possible to know how much the expected value of the probability of answering "yes" will change when x changes by deriving 3.14 with respect to x (Greene, 1993):

$$\begin{aligned} \frac{\partial E[y \mid x]}{\partial x} &= \{\frac{\partial F(\beta' x)}{\partial(\beta' x)}\}\beta \\ &= f(\beta' x)\beta \end{aligned} \tag{3.15}$$

Equation 3.15 shows that the marginal change of the probability of answering "yes" with respect to a marginal change in the vector of parameters x

depends not only in the vector of coefficients but also in how the distribution function changes when the matrix of parameters changes $d(\beta'x)$. The derivative of the distribution function $F(\beta'x)$ with respect to $\beta'x$ is equal to its density function (lower term in equation 3.15). Therefore, the marginal effect of x in y is equal to the product of the density function times the vector of coefficients β. For the logistic distribution the density function is defined as:

$$\frac{d\Delta[\beta' x]}{d(\beta' x)} = \frac{e^{\beta' x}}{1+e^{\beta' x}} \qquad (3.16)$$

Substituting equation 3.16 into 3.15 yields:

$$\frac{\partial E[y \mid x]}{\partial x} = \frac{e^{\beta' x}}{1+e^{\beta' x}}\beta \qquad (3.17)$$

Equation 3.17 shows clearly that the marginal change in the expected value of the probability of answering "yes" will depend on the value that the vector x takes. Greene (1993) recommends calculating the marginal effects (equation 3.17) at the mean values of the variables included in x or in any other value that might be of interest.

The preparation of the data and the estimation of the specifications of model 3.13 were done using Stata 9.2 (StataCorp LP, 2006). The results of the first logit model, where the only parameter estimated is the bid level, are shown in Table 8. In this specification of the model, the bid level has a negative relation with the probability of answering "yes" to the WTP question. The probability of answering yes decreases by 0.1% when there is an increase of one Mexican peso in the bid levels. Moreover, the bid level coefficient in specification 1 is equal to the marginal utility of income by the definition of the utility difference in equation 3.9. However, although this model shows that the probability of answering "yes" decreases as the bid levels increase, it does not contain any component to determine the effect of other variables in the probability of answering "yes" and the WTP estimates. The second step in the estimation of model 3.13 was to include as explanatory variables demographics and the conditions of the water supply service.

Table 8. Specification 1 of the WTP logit model for connected houses (bid levels and intercept)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.394* (9.33)		
Bid level	-0.0047* (-9.60)	251.48	-.0011
Obs.	627		
Log-likelihood	-375.19		
Restricted Log-likelihood	112.86		
P-value chisquare (d.f.=1)	0.00		
Pseudo r^2	0.13		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.

Table 9, shows the estimated parameters of specifications 2 and 2-A of the model, which analyze the effect of some demographic variables in the probability of answering "yes" to the WTP question. Specification 2 of the model shows the relation between some demographics data (exogenous variables) and the probability of answering yes. In this model, the price level, number of children, age and level of income are statistically significant with a 99% confidence level. Moreover, the results show that as the number of children and the level of

Table 9. Specifications 2 and 2-A of the WTP logit model for connected houses (demographic variables)

Model 2		Model 2-A	
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.642* (2.89)	Intercept	0.678** (1.97)
Bid level	-0.005* (-9.60)	Bid level	-0.003*** (-1.74)
Number of children living in the household	0.167* (2.49)	Bid level & gender(1=female)	-0.001 (-1.35)
Age	-0.021* (-2.92)	Bid level & age	-0.00005** (-2.16)
Education	0.025 (1.17)	Bid level & marital status (1=married)	-0.0007 (-0.98)
Gender (1=female)	-0.115 (-0.51)	Bid level & education	0.0001 (1.45)
Married (1=married)	-0.188 (-0.92)	Number of children living in the household	0.088 (1.05)
Job (1=have a job)	0.159 (0.80)	Number of people living in the household	0.09*** (1.79)
Income (median)	0.000049* (3.15)	Job (Participant having a job=1)	0.31 (1.46)
		Property (Participant owning the property=1)	-0.318 (-1.27)
		Income*housewife	0.00004*** (1.77)
		Income	0.00003** (2.16)
Obs.	627	Obs.	626
Log-likelihood	-351.32	Log-likelihood	-350.18
Restricted Log-likelihood	160.60	Restricted Log-likelihood	161.69
P-value chisquare (d.f.=8)	0.00	P-value chisquare (d.f.=11)	0.00
Pseudo r^2	0.186	Pseudo r^2	0.187

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 90% confidence level.

income increase the probability of answering "yes" increases (the marginal effects of the coefficients estimated in Table 12 can be found in Appendix A, section 7.) On the other hand, the coefficients of price and age are negative. Therefore as the price specified and participant's age increase the probability of answering "yes" decreases. Specification 2 gives a preliminary idea of how the demographic variables are affecting the individual's decision to answer "yes". However, there could be differences in the marginal utility of income due to the effect of individual characteristics. Therefore, it might be necessary to find any interaction between the marginal utility of income and some participant's socio-economic characteristics such as gender, age, etc. This might be a way of building a more explanatory model of the participant's answer to the WTP question.

Specification 2-A of the model estimated the effect of the interaction between the bid levels and some demographic variables on the probability of answering "yes" to the WTP question (Table 9).[16]The results of specification 2-A show that, from all the interactions between the bid levels and some demographics, only the product of bid levels and age is statistically significant (at the 95% confidence level). To calculate the final effect of age in the marginal utility of money the coefficients of the bid level and bid*age were added. Since the absolute effect of bid level plus bid*age is higher than the absolute effect of the bid level alone, older people are more sensitive to money and are less willing to pay for the water supply improvements. Model 2-A also shows that the variables of number of people living in the household, income*housewife and

[16] One observation is dropped because one participant did not answer how many people live in total in the household.

income are statistically significant at a 90% confidence level. The variable income*housewife captures the effect of the interaction between level of income and housewife (housewife is a dummy variable that is equal to one when the participant has this occupation.) Therefore, the probability of a person answering "yes" to the WTP question increases if that person is a housewife with high income levels.

Specifications 2 and 2-A gave some preliminary results on how the probability of answering "yes" is affected by exogenous variables. However, parameters related to the characteristics of the current water supply service might be significantly driving the individual's response too. Table 10 shows the estimation results of specification 3 of the model where the parameters are variables of the individual's perception of the water supply service.

The variables presented in specification 3 are divided in two main groups. The first group is formed by variables of consumption and expenditure in water: monthly water utility expenditure, monthly expenditure in bottled water, number of toilets in the household and availability of water pumping system (cistern, pump and water tank). The second group is formed by three dummy variables about the participant's satisfaction levels and concerns about the water supply service: current satisfaction level with the current water supply system, opinion about drinking water straight from the tap and knowledge of people getting sick in the household because of drinking tap water.[17]

In specification 3, the variables that are statistically significant with a 95% confidence level are the bid level, the monthly expenditure in water utility bill,

[17] Seven observations are dropped in the estimation of the model because only 620 participants completed the question of their opinion about tap water for drinking.

Table 10. **Specification 3 of the WTP logit model for connected houses (water supply service perceptions)**

	Coefficients[a]
Dependent variable: Probability that the participant is willing to pay a specified bid level	
Intercept	1.22*
	(3.43)
Bid level	-0.0049*
	(-9.44)
Consumption and expenditure	
Household's monthly expenditure in water utility bill	0.0014**
	(2.08)
Household's monthly expenditure in bottled drinking water	0.0017**
	(2.28)
Number of toilets in the household	0.232**
	(2.02)
Availability of water pumping system	0.379
1=availability of pump, cistern and water tank	(1.33)
Satisfaction and concerns about water	
Satisfaction level with current water supply service	-0.70**
1=satisfied with the water supply service	(-2.35)
Opinion about tap water for drinking	-0.33
1=Tap water is good for drinking	(-1.51)
People sick in the household because of drinking water	0.19
1=Somebody has been sick by drinking tap water	(0.57)
Obs.	620
Log-likelihood	-352.58
Restricted Log-likelihood	147.71
P-value chisquare (d.f.=1)	0.00
Pseudo r^2	0.173

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.

the monthly expenditure in bottled water, the number of toilets in the household and the satisfaction level with the current water supply system. For the variables of expenditure in water utility bill and bottled water, there is a positive relation between the amount spent in water and the probability of "answering yes" to the WTP question. Moreover, expenditure in bottled water has a marginal effect (equal to 0.0004, see Appendix A, section 7) that is relatively close to the value of the marginal effect of expenditure in the water utility bill (equal to 0.0003, see Appendix A, section 7). The bottled water expenditure might have a higher marginal effect in the probability of answering "yes" because it is directly related to the need to obtain drinking water which has a higher priority than the water for domestic use in the household.

The variable of number of toilets (number of washrooms) is related to the household's level of water consumption. The results from specification 3 show that as the number of toilets increase the probability of answering "yes" and the willingness to pay for the water supply improvements increases. Although most of Queretaro residents do not know exactly how much water is used in his/her household, they might know a rough estimate of how much water is needed to satisfy his/her household's water demand. The number of washrooms might capture the effect on how much water the household needs. If the household needs a significant amount of water, the household head is willing to pay for the improvements to guarantee a better supply of the household's water demand.

In the case of the variable of level of satisfaction with the water supply service, there is a negative relation with the probability of a "yes" response. Since satisfaction level is a dummy variable that is equal to one when people declared to be satisfied with the service, the results from specification 3 show that when people are satisfied with the water supply service they are less likely to pay for an increase in their water bill in exchange for water supply improvements. In other words, the coefficient of the dummy variable of satisfaction level demonstrates that people that are satisfied with the current water supply service prefer that there are no changes to this service.

Note that for specifications 2, 2-A and 3 the log-likelihood is around -350 and the pseudo-R^2 between 0.17 and 0.18. These models are similar in their ability to explain the probability of "yes" responses and they present some relevant variables that are statistically significant. The next step was to combine all of these models and create a final model that includes most of the relevant variables that affect the WTP for the water supply improvements.

Table 11 shows the results of the estimation of a model that includes variables related to the current water supply service and socio-economic variables.

In specification 4 of the model, all of the variables are statistically significant (at least at a 90% confidence level). Water utility bill, expenditure on bottled water, availability of pumping system, number of children and income have a positive effect on the probability of answering "yes" to the WTP question. Bid levels, satisfaction with the water service and age have a negative impact on the WTP for water supply improvements. Note in Table 11 that the variables with the highest marginal effects are availability of water pumping system and the satisfaction level with the current water supply service.

In the case of the variable of the availability of the water supply system, the marginal effect is 0.138 which means that when participants have adequate storage containers the probability of answering "yes" to the WTP question increases by almost 14%. Note that for this variable the marginal effect is calculated at the mean levels.

Table 11. Specification 4 of the WTP logit model for connected houses (demographics and water supply service perceptions)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	2.26* (4.75)		
Bids	-0.0052* (-9.68)	251.48	-0.0012
Household's monthly expenditure in water utility bill	0.0015** (2.18)	151.15	0.00038
Household's monthly expenditure in bottled drinking water	0.0014*** (1.82)	141.53	0.00035
Availability of water pumping system 1=availability of pump, cistern and water tank	0.582** (2.05)	0.188	0.138
Satisfaction level with current water supply service 1=satisfied with the water supply service	-0.688** (-2.29)	0.877	-0.16
Number of children living in the household	0.12*** (1.80)	1.62	0.029
Age	-0.026* (-4.01)	41.25	-0.0066
Income	0.00003* (2.52)	6676.66	9.53e-06
Obs.	627		
Log-likelihood	-342.92		
Restricted Log-likelihood	177.41		
P-value chisquare (d.f.=8)	0.00		
Pseudo r^2	0.20		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 90% confidence level.

Availability of water supply system is a dummy variable that takes a value of one when residents have adequate water storage containers and zero when they do not have adequate storage containers. Therefore, the marginal effect might be different for each of the two values of this variable keeping everything else constant. For example, by calculating the probability of answering "yes" when the variable of availability of water storage containers equals one or zero and using the values of the variable of expenditures in the water utility bill, it was possible to know that the marginal effect of availability of adequate containers is larger for households with low water utility bills. This means that respondents that have adequate water storage containers have a higher probability of answering "yes" when they spend less in water than participants with higher water utility bills. This seems to be consistent with the fact that people without water storage containers do not have enough water available and therefore their water utility bills are lower than for the rest of participants. Since they lack of water and do not have adequate containers they are more willing to pay for the improvements.

Despite the variation of the marginal effect of a dummy variable, the use of the mean values of these variables to calculate their marginal effects provides a good approximation of the probability change in a logit model when the dummy variable is one (Green, 1993). In the case of the variable of satisfaction with the current water supply service, the value of the marginal effect of this variable shows that the probability of answering "yes" decreases by 0.16 when participants stated that they were satisfied with their water service.

Specification 4 of the model explains better the response to the WTP question than specifications 1, 2, 2-A or 3 because the log-likelihood and the pseudo-R^2 of specification 4 are the highest. Therefore, specification 4 may be used to estimate the WTP for water supply improvements.

Before conducting the analysis of the WTP estimates, an evaluation of the participants' response was made to reduce any possible biases in the estimation of model 4. In Chapter 2, it was shown that CV studies might present certain biases in the responses to the WTP estimates (see Chapter 2, section 3.2). Therefore it is necessary to make sure that the data is reliable and there are no biases in the participant's response.

One of the ways of validating the data was to use a question that asked to participants how certain they were about their response to the WTP question (in a one to ten scale). Participants that answered "yes" and declared to be sure with less than six units of certainty were changed to "no" responses. A total of 73 "yes" responses from participants that were not very sure about their responses were changed to "no." This transformation allows having a more robust estimation of the willingness to pay lower bound (Champ *et al.*, 1997).

Another way of validating the data was to look for participants that answered "no" to the WTP question because they rejected the scenario. After answering the WTP question some participants declared that they responded "no" because they did not believe in the characteristics of the scenario or they did not have enough information to answer "yes". A total of 25 observations were dropped because they answered "no" to the WTP question as a way of rejecting the scenario.

The last validation of the data from the WTP question was done to correct warm glow effects. In "warm glow" answers to the WTP question, the participant is looking to be seen as a person willing to pay a significant amount of money or has some other personal reasons to state high WTP estimates that are not consistent with his/her individual's choice if he/she were really going to pay for the proposed scenario. Nunes and Schokkaert (2001) analyzed the influence of warm glow effects in the WTP responses. Using a follow-up question that asked participants that answered "yes" to state their maximum WTP for the water supply improvements, it was possible to compare the stated maximum WTP, the bid level offered to the participants and their current water expenditures. If the participant stated a considerably high maximum WTP (more than $600 Mexican pesos), his/her maximum WTP was compared to his/her current water expenditures. If the water expenditures were lower than the maximum WTP and the offered bid level then the participant's response was considered to be affected by warm glow effects. A total of 3 observations were dropped because they were considered as "warm glow" responses. In these observations, participants stated that their maximum WTP for the water supply improvements was over $600 Mexican Pesos (about $71 CDN) per month but their water expenditures were lower than the bid offered and their maximum WTP.

Specification 4 of the model was estimated again using the validated data of the responses to the WTP question (Table 12). In specification 4-A of the model almost all the variables are statistically significant (at least at a 90% confidence level). The household's monthly expenditure in water utility bill is statistically significant at the 89% confidence level. Satisfaction level with the water service is only statistically significant at the 88% confidence level. Moreover, note that 28 observations were dropped (after the data validation) and now the model is estimated using 599 observations.

The variables with a positive effect on the probability of answering "yes" to the WTP question are household's monthly expenditure in water utility bill, household's expenditure in bottled water, availability of water pumping system, number of children in the household and income.

Table 12. **Specification 4-A of the WTP logit model for connected houses (responses to the WTP question corrected for possible biases)**

	Coefficients[a]	**Mean Values**	**Marginal effects**
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.355* (2.86)		
Bids	-0.005* (-8.63)	250.05	-0.001
Household's monthly expenditure in water utility bill	0.0011 (1.60)	153.63	0.0002
Household's monthly expenditure in bottled drinking water	0.0014*** (1.85)	140.11	0.0003
Availability of water pumping system 1=availability of pump, cistern and water tank	0.627** (2.18)	0.19	0.155
Satisfaction level with current water supply service 1=satisfied with the water supply service	-0.442 (-1.52)	0.87	-0.109
Number of children living in the household	0.110*** (1.66)	1.64	0.027
Age	-0.026* (-3.87)	41.31	-0.006
Income	0.00007* (4.26)	6748.84	0.00001
Obs.	599		
Log-likelihood	-326.07		
Restricted Log-likelihood	171.60		
P-value chisquare (d.f.=8)	0.00		
Pseudo R2	0.20		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 90% confidence level.

On the other hand, bid levels, satisfaction with the water service and age have a negative effect on the probability of answering "yes" (See Table 12). Note that the coefficients and marginal effects of most of the variables are close or similar to the estimated parameters and marginal effects in specification 4. For example, the marginal effect of availability of adequate water storage containers is now 0.155 which means that when the participants' house has an adequate storage container the probability of answering "yes" increases by 0.155.

After estimating different types of specifications of model 3.13,[18] it is possible to compare the WTP estimates derived from them. According to Hanemann (1989, p. 1058) and Haab and McConnell (2003, p. 31-38), in the case of a linear utility model such as 3.6 and a symmetric mean zero error, the mean and median WTP result the same. Therefore the mean and median WTP from dichotomous choice questions, based in a linear utility model, are defined in the following equation:[19]

$$E(\mathrm{WTP} \mid \alpha, \beta, z_j) = \left(\frac{\alpha}{\beta}\right)\bar{z} \qquad (3.14)$$

Where α is the vector of estimated parameters (in the case of specification 4, there are 9 parameters), β is the value of the parameter estimated for the bid level and $\bar{z}$ is the vector of the means from the variables used in the model. The results of the calculation of the estimated WTP for Models 1 to 4-A are shown in Table 13.

[18] Models such as the utility model log linear in income and box-cox transformations of income were tested. However, none of these models improved the estimation since the log-likehoods and pseudo-R^2s were significantly lower. For an explanation of the log-linear and box-cox utility models see Haab and McConnell (2003, pp. 36-46.)

[19] For a demonstration of this see Haab and McConnell (2003, p. 34.)

Table 13. Estimated means and medians WTP for water supply improvements in connected houses

Specification of the model	Mean or Median WTP (Mexican Pesos)
1	$291.65
2	$295.00
2-A	$325.32
3	$297.94
4	$296.76
4-A	$197.52

The mean WTP estimates from specifications 1 to 4 are consistent with the lower bound WTP calculated in section 4.1 (approximately $251 Mexican Pesos). In the case of specification 4-A of the model, the willingness to pay estimated with the logit model is also consistent with the lower bound WTP from the non-parametric approach, which is equal to approximately $195 Mexican pesos. Note that for specifications 1 to 4, the WTP estimates do not vary considerably. However, there is a significant difference between the estimated mean WTP in specification 4 and specification 4-A. The validation of the data produces a drop in the WTP estimates because most of the responses to the WTP question were corrected for uncertainty effects. When correcting for uncertainty, "yes" answers were changed to "no" when the participant was uncertain about his or her response to the WTP question. Since the number of "no" answers increases, this produces a decrease in the final WTP estimate. The data was also corrected for underestimations of the WTP estimates because of participants that rejected the scenario and answered "no". However, the changes in the responses to the WTP question due to uncertainty have a higher effect (because of the number of changed observations) than the changes done to responses from participants that rejected the scenario and the final effect is that the WTP estimate drops.Based on the results of specification 4-A and assuming a conservative inclusion criteria, households in Queretaro are willing to pay on average approximately $197.52 Mexican pesos (about $23 CDN) per month on top of what they currently pay for the water utility bill for having water 24 hours a day and being able to drink water straight from the tap. This amount of money represents approximately 3% of the households' average income per month.

According to the results of the *Conteo de Poblacion y Vivienda 2005* (Count of population and houses 2005, Instituto Nacional de Geografia, Estadistica e Informatica, 2006a) there are an estimated amount of 203,192 households with piped water services in Queretaro. Based on the WTP estimate of specification 4-A, the total average economic benefits amounts to at least $40,134,484 Mexican pesos ($4,777,915 CDN) every month. On the other hand, based on the WTP estimate from specification 4 the total average economic benefits are equal to $60,299,258 Mexican pesos ($7,178,483 CDN) every month.

Considering that the survey requested to participants to answer yes/no to a specific WTP for water supply improvements for the next 50 years, it is possible to calculate the present value of the economic benefits derived from models 4 and 4-A. Using estimates of the population for the next 50 years,[20] the mean

[20] The *Consejo Nacional de Poblacion* (2006b) published estimates of the population until 2030. For the following years, it was assumed that the population growth rate will remain constant.

WTP value of specification 4 and assuming a discount rate of 3%,[21] the economic benefits derived from the water supply improvements add to approximately $ 25,493 million Mexican pesos. Alternatively, a conservative estimate of the present value of the total economic benefits can be calculated using the WTP estimate of specification 4-A and assuming a discount rate of 10%. Using this criterion the benefits derived from water supply improvements add to 5,746 million Mexican pesos. These results show that the people living in houses with piped water are willing to pay a significant amount of money to have a 24 hour running service and water that is safe to drink from the tap.

The government of the State of Queretaro has announced that the project "El Infiernillo" will increase the supply of water to the city. This project will cost at least $2,000 million Mexican pesos (see Chapter 2, section 2.2). However, the project may not be able to provide a 24 hour water supply service and does not intend to guarantee that water is safe to drink straight from the tap. The results of the WTP estimation show that if the government provides a 24-hour service and guarantees that water will be good enough to drink from the tap, the residents of Queretaro are willing to pay an amount of money that may add to more than ten times the cost of projects such as "El Infiernillo." Therefore, the estimated benefits from the results of WTP question provide evidence that the residents of regular neighbourhoods are willing to pay a considerable amount of money for improving the water availability and quality of their households.

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[21] A discount rate of 3% is commonly used by U.S. municipalities and the Canadian Treasury Board recommends this discount rate for health and environment cost-benefit analyses (Boardman *et al.,* 2001.)

In order to have a better idea of the range of the estimated WTP, confidence intervals for the mean WTP can be calculated. Using the Krinsky-Robb procedure (Haab and McConnell, 2003, pp. 110-113), it is possible to estimate a confidence interval for the mean WTP derived from the parametric estimation of model 3.13. The Krinsky-Robb procedure assumes that the estimated WTP is asymptotically normal and requires that a random draw of the model's parameters is estimated using the original vector of coefficients and the covariance matrix of these parameters. For the case of specifications 1 to 4-A, the draw of the parameters for each model was done 1,000 times. Finally, for each of the new parameters, a mean WTP was estimated and the highest and lowest 2.5% mean WTP estimates were dropped to find a confidence interval of 95%. Table 14 shows the confidence intervals for each of the estimated parametric models.

Table 14. Estimated 95% confidence intervals and empirical statistics for the WTP estimates

Model	Mean or Median WTP (Mexican Pesos)	Confidence Interval (Prob=0.95) (Mexican Pesos)	Mean WTP (draw estimates)	Standard deviation (draw estimates)	Median WTP (draw estimates)
1.	$291.65	253.88-331.36	292.52	19.29	291.98
2	$295.00	257.12-335.02	295.87	19.98	295.27
2-A	$325.32	205.21-711.02	397.24	1181.56	322.45
3	$297.94	260.37-339.90	298.73	20.59	298.48
4	$296.76	263.06-337.85	298.05	19.48	297.12
4-A	$197.52	158.94-234.39	198.01	18.93	198.03

Note in Table 14, that the mean WTP estimates for every model fall in the estimated confidence intervals and are very close to the mean and median WTP estimated values from the draw. Note also that the estimated WTP standard deviations are very similar in all the models except model 2-A. Remember that this model has as explanatory variables the interaction effects of bid levels and demographics. Also note that the standard deviation for Model 2-A is considerably high (it is equal to 1181.56). Since some of the parameters in Model 2-A are a combination between the bids and demographic variables, the variance of each of the parameters of the interaction variables is high because it will include the variance of the bid parameter and the variance of the parameter of the demographic variable. Moreover, the high value of the standard deviation provokes that the 95% confidence interval becomes larger than for the rest of the models (see Table 14).

In the case of model 4-A, the mean WTP falls in a range of \$158.94 to \$234.39 Mexican pesos (\$18.26 to \$26.94 CDN) with a 95% confidence level. This means that in 95 cases out of 100, the residents of Queretaro will be willing to pay on average between \$158.94 and \$234.39 pesos for the proposed water supply improvements.

Another use of the WTP estimates of specification 4-A is the calculation of the mean WTP for each income strata of the sample. For doing this, it is necessary to use equation 3.14 and calculate a mean WTP for each of the income groups (varying the income levels). The results of the calculation of the mean WTP for each income bracket are shown in Table 15. These estimates were calculated using the median income levels.

Table 15 shows that there are considerable differences in the mean WTP across income strata. The mean WTP for the highest income bracket is slightly more than 10 times the estimated WTP for the lowest income stratum. For low income households (first 4 income groups) the average WTP is $145.74 pesos ($17 CDN) per month. For medium income households (more than $6,601 and less than $20,000), the average WTP is $281.81 Mexican pesos ($33 CDN) per month. Finally, for high income households (above $20,000 pesos per month) the average WTP is $733.19 Mexican Pesos ($87 CDN) per month.

Table 15. Income strata and mean WTP for water supply improvements (connected houses)

Income Level	Mean WTP	Mean expenditure in bottled water
0 to $1,300 pesos	$112.12	$106.97
$1,301 to $2,600 pesos	$130.33	$141.60
$2,601 to $5,000 pesos	$156.24	$136.75
$5,001 to $6,600 pesos	$184.25	$163.02
$6,601 to $10,000 pesos	$219.26	$177.83
$10,001 to $15,000 pesos	$278.07	$146.36
$15,001 to $20,000 pesos	$348.09	$154.40
$20,001 to $25,000 pesos	$418.11	$121.83
$25,001 to $50,000 pesos	$628.16	$127.47
More than $50,000 pesos	$1,153.30	$50.66

Table 15 also compares the mean WTP of each income stratum with the average expenditures in bottled water. For almost all of the income levels, the mean WTP is higher than the expenditures in bottled water. In addition, the difference between WTP and expenditure in bottled water is larger for income strata above $15,000 pesos. This might be happening because participants in higher income strata spend money on water pumping systems, filters and water storage containers and their WTP is affected by these expenditures. It is also possible to speculate that participants from the lower income strata considered the water supply improvements as a substitute for bottled water. These participants may have first visualized the improvements as a reliable source of drinking water and then thought of the enhancement of their households' water availability.

Although Table 15 presents the WTP for water supply improvements of a single household from each income group in Queretaro, a better approach would be to have estimates of the economic benefits for the total number of households in each income bracket. In this way, it could be possible to know an estimate of the distribution of the benefits derived from the water supply improvements proposed in the survey.

One way of estimating the total economic benefits for each income strata is obtaining data about the number of households in each income group. Unfortunately, disaggregated data of the income levels in Queretaro are scarce and it was not possible to find an estimate of the number of households in each income group.

Another way of estimating the total economic benefits of the households in each income level is to assume that the sample of the survey conducted in connected households is representative of the population and use the proportions of households in each income bracket of the sample to build an estimate of households' income groups for the whole city. In section 2.1.1, it was shown that the sample of the survey presents proportions of participants in each income group that are close or similar to the proportions of habitants in each income bracket of the population of Queretaro. Moreover, considering that most of participants were household heads, the responses of the survey might have a reasonable degree of representativity since they show a decision that might be made for the household. Nevertheless, since the survey was not administered with a pure random sampling procedure, the proportion of household's in the population's income groups inferred from the sample might not be completely representative of the population of Queretaro. Therefore, it is important to note that the total benefit estimates that can be inferred for the population income groups might have some limitations in the power to represent the real total benefits for each income group.

Using the sample to build the number of households in the income groups of the city of Queretaro and the results of Table 15, it was possible to calculate the total economic benefits for each income group of Queretaro (Table 16).

Table 16. Estimated total economic benefits for the water supply improvements in each income group.

Level of income	Percentage of households in each income group (sample)	Number of households	Total Economic Benefits for the households of each income group (Mexican Pesos)
0 to 1300 pesos	0.1494	30,356.88	$3,403,613.92
1301 to 2600 pesos	0.2099	42,650	$5,558,574.60
2601 to 5000 pesos	0.256	52,017.15	$8,127,159.83
5001 to 6600 pesos	0.1113	22,615.27	$4,166,863.42
6601 to 10000 pesos	0.1129	22,940.38	$5,029,907.02
10001 to 15000 pesos	0.0604	12,272.8	$3,412,696.61
15001 to 20000 pesos	0.0397	8,066.722	$2,807,945.40
20001 to 25000 pesos	0.0191	3,880.967	$1,622,671.20
25001 to 50000 pesos	0.0366	7,436.827	$4,671,517.37
More than 50000 pesos	0.0048	975.3216	$1,124,838.40
		Total Economic Benefits	$39,925,787.78

In 2005, there were 203,192 households in Queretaro (Instituto Nacional de Geografia, Estadistica e Informatica, 2006a). Using this information, the estimated number of households in each income bracket is shown in the second column of Table 16. The total economic benefits for each income group are presented in the last column.

There are some significant differences on how the benefits derived from water supply improvements might be distributed. The first 4 income groups have 53% of the benefits from water supply improvements. This happens because these income groups share the highest proportion of the total population of Queretaro. However, middle and high income groups also have significant gains derived from a better water supply system. In the case of middle income households, their economic benefits represent about 28% of the total economic benefits derived from water service improvements. On the other hand high income households might share about 18.5% of the total benefits. This is not surprising either because households in these income groups spend significant amounts of money in bottled water and there might be a considerable increase in welfare if the water supply system could provide water that could be good enough to drink straight from the tap.

The results presented in Tables 14, 15 and 16 are estimates of the economic benefits from water supply improvements. These estimates can be compared with the costs of providing the proposed scenario in the survey (water 24 hours a day and good enough to drink from the tap.)

The analysis presented in this chapter provides evidence that it might be feasible to finance projects to increase the quality and quantity of water in Queretaro. The residents of the city are willing to pay a considerable amount of money to guarantee a better residential water service in the next 50 years. The next task would be to conduct a sound cost benefit analysis that allows determining the feasibility of the projects proposed by the survey of connected households. This can be done by having complete information on all the costs and benefits involved in those projects.

5. Conclusions

This chapter presented the results of the contingent valuation (CV) survey that analyzed the willingness to pay for water supply improvements in Queretaro's households with piped water. Moreover, the survey collected information about different aspects related to the current water supply service and socio-economic characteristics of Queretaro's residents.

The results from the survey show that in Queretaro there are considerable inequalities in the distribution of income and wealth. This situation also occurs in terms of the distribution of the benefits from water. In terms of water availability, residents with low income levels are the most affected people in Queretaro. This happens because of the variability of the supply of water from the city's water system and because residents with low income levels cannot afford buying adequate water storage containers and pumping systems for their households to avoid water shortages.

The CEA has an organized monitoring system of the households' water consumption. Moreover, the CEA has an increasing block tariff structure for charging Queretaro's residents for the water services. On average, the respondents declared that they are paying $151.17 Mexican Pesos ($18 CDN) per month for the water utility bill of their households. However, for residents with income levels lower than $2,600 pesos ($309 CDN) per month (less than two times the minimum wage), the average expenditure in the water utility bill represents more than 5% of their monthly income level. This situation becomes worse for people with the lowest income levels since the average expenditure in the water utility bill might represent up to 22% the individual monthly income of household heads.

In the case of the water quality from the water supply service, most of the participants of the survey declared themselves unconfident that the water is good enough for drinking. Only 10% of the participants declared that in their households they drink water straight from the tap. Moreover, approximately 76% of participants stated that they get drinking water for their households by buying bottled water.

In the participants' households, the average monthly expenditure in bottled water is $131 Mexican Pesos per month ($16 CDN). For households with the lowest income levels (at least 7% of the population), the average expenditure in bottled water represents 16.46% the income of household heads. Therefore, most of the people that do not buy bottled water belong to the lowest income brackets and they have to drink directly from the tap or boil the water.

Most of the people connected to the water supply service are satisfied with the current water supply service. However, at least a third of the participants claimed that the water supply service is not adequate because of water cut-offs, bad water quality and deficient management of the water resources. These people stated that there is a need to improve the water supply service in order to guarantee the water quality and supply for the city.

The main component of the survey asked to respondents if they would be willing to pay a specified amount of money for having water 24 hours a day and being able to drink water straight from the tap. This question was analyzed using non-parametric and parametric methods designed for dichotomous choice questions in CV surveys.

The non-parametric method used the Turnbull estimator to calculate a distribution free estimate of the lower bound mean WTP. Using this method the estimated lower bound of the mean WTP is equal to $251.10 Mexican Pesos ($30 CDN).

The strategy to estimate the parametric model of the response to the WTP question was divided in three main steps. First, a model that included only the bid levels as an explanatory variable was estimated. Second, several models were estimated using as explanatory variables demographics and characteristics of the water supply service. Finally, the third step involved correcting the responses to the WTP question for biases due to uncertainty, rejection of the scenario and warm glow effects. The final specification of the model (specification 4-A) was estimated using the data corrected.

In specification 4-A, household's expenditure in bottled water, availability of water pumping system, number of children in the household and income are variables that are statistically significant (at least at a 90% confidence level) and have a positive effect in the probability of answering "yes" and the individual's WTP. For example, an increase of one child living in the household produces a 2.7% increase in the probability of answering "yes". Bid levels, satisfaction with the water service and age are variables that also are statistically significant (at least a 90% confidence level) but have a negative effect on the probability of answering "yes". The results show that older participants and respondents satisfied with the current water supply service are less likely to answer "yes" to the WTP question.

The mean and median WTP calculated with the parameters of specification 4-A are equal to $197.52 Mexican pesos (about $23 CDN). This means that on average, the participants are willing to pay about $197 pesos on top of what they currently pay for their water utility bill for having a water supply service running 24 hours a day and water that is good enough to drink straight from the tap. Therefore, if the proposed water supply improvements were done, the average total economic benefits for all of Queretaro's households connected to the water supply system add to at least $40,134,484 Mexican pesos ($4,777,915 CDN) every month. Moreover, in 95 cases out of 100 the total average economic benefits falls in a range between $32,295,336 and $47,626,173 Mexican Pesos.

Finally, using the mean WTP calculated from Model 4-A and inferring the population's number of households in each income group with the sample data, it was possible to calculate an estimate of the economic benefits for each of the income groups. The results show that the groups with the highest economic benefits correspond to households where the participants earn less than $10,000 Mexican pesos ($1,191 CDN) per month. For example, households in the first three income strata (participants earning less than $5,000 Mexican Pesos [$595.24 CDN] per month) share approximately 53% of the total economic benefits derived from water supply improvements. This is due to the proportion of the number of households in these income brackets but also to the fact that these residents have less water availability and quality than residents from higher income strata.

The results of the WTP estimation show that if the government undertakes the water supply improvements proposed in the survey, the residents of Queretaro are willing to pay an amount of money that is much higher than the cost of projects such as "El Infiernillo." The present value of the benefits generated from the proposed water supply improvements may add up to $25,000 million Mexican Pesos (about $3,000 million CDN). Therefore, the results of WTP question provide evidence that the residents of regular neighbourhoods are willing to pay a considerable amount of money for improving the water availability and quality of their households.

Chapter 4

Willingness to pay for water supply improvements in Queretaro, Mexico: The case of informal settlements

1. Introduction

Since the 1940s, some cities in Mexico developed what are known as "irregular" or "informal" settlements. These residential areas were typically inhabited by people with very low income levels that migrated from rural areas to the cities. Queretaro is one of the cities in Mexico that has a considerable amount of people living in the informal settlements. The expansion of the city and the reform of 1992 to the property regime of "ejidos" motivated that several terrains in the edges of the urban area were used by people to build new residential zones (See Chapter 2, section 2.3). Currently in Queretaro, the informal settlements occupy a significant proportion of the city and the houses of these neighbourhoods do not have piped water, paved streets, and in many cases electricity and sewage services.

The households of the informal settlements in Queretaro do not have adequate levels of water availability and quality. Most residents usually get their water from tanker trucks or from public taps and a significant proportion of people pay more than three times the monthly water utility bill of an average household connected to the supply system.

This chapter will show the results of the survey conducted in Queretaro's informal settlements. The analysis will determine the residents' willingness to pay (WTP) for water supply improvements. With this information it is possible to calculate the economic benefits that residents in the informal settlements might have from a water supply system that guarantees both water availability and quality to their households.

2. Survey design and administration

The data was also collected with an in-person household survey. The informal settlements survey was pre-tested by conducting 70 pilot surveys in some irregular settlements of Queretaro. The administration of these pilot surveys was used to improve the design of the questionnaire and pre-test different price ranges of the WTP question for water supply improvements.

The questionnaire was divided into six sections (See Appendix D). The first section contained questions about the current sources of water for the household and their expenditures on water. The second section asked participants about the house's water availability. This section was used to analyze how residents of the informal settlements obtain and store the water in their homes. The third section gathered data on residents' perceptions about the quality of the water supplied to the informal settlements. The fourth section analyzes residents' satisfaction levels with the current water service for their households. The fifth section presents the WTP question for water supply improvements. Finally, the sixth section of the survey gathers data on the socio-economic characteristics of the participants and their households.

The WTP question for water supply improvements of the survey for informal settlements or non-connected houses is very similar to the one for homes connected to the city's water system. The WTP question presents to participants a hypothetical scenario where they would be connected to the water supply system, have water 24 hours a day and receive water that is good enough to drink straight from the tap. Participants were explained that these improvements might be done through projects such as water treatment plants, use of high technology to purify water, reduction of water leakages and the development of new water sources. As in the survey for connected houses, the WTP question for people without piped water also includes a paragraph of "cheap talk" that requested the participant to answer this question as if he or she was really going to pay for the water supply improvements. This was done for trying to reduce any bias in the responses of the participant and obtain a realistic answer. The WTP question also included a figure with colored images to help the participant to understand the proposed scenario (See Appendix D). This illustration aimed to call participant's attention and explain better the scenario because most of people in informal settlements have a very low education level.

2.1 Survey application and sample design

The survey for non-connected houses was administered to a total of 202 homes in Queretaro's informal settlements. This survey was completed during the last week of July, 2005 by eight of the enumerators that participated in the survey for the connected houses. Since these enumerators already had experience conducting surveys, their training consisted of explaining the design of the questionnaire and the WTP question to them.

The organization of the work schedules, administration of the survey, the procedures to request participation and the reading of the questionnaire were exactly the same as in the survey for connected houses. Enumerators usually worked in groups of two or three people during daylight times and they were supervised to guarantee the quality of the survey. The enumeration team knocked on the doors of randomly selected homes and invited the residents to participate in the survey. As in the survey for connected houses, the enumerators always requested to conduct the survey with one of the household heads. In case the household head was not available, the enumerators conducted the survey to a household member that was aware of the characteristics of the water supply service and the family's expenditures.

Approximately 476 houses were visited and about 202 households accepted to participate. The rate of participation was high (75.6%) as only 65 households refused to participate (see Appendix B, section 1). Each survey took an average of 16.1 minutes to be filled and the enumeration team visited a total of 28 neighbourhoods.

The neighbourhoods surveyed were located in all of the existent informal settlements of the City of Queretaro: Northwest area (from San Pedro Martir to Francisco Villa), Northeast area (San Jose El Alto), South area (above Lomas de Casa Blanca and beside Reforma Agraria) and Southwest Area (in Corregidora, beside La Negreta). These four areas are subsequently divided into neighbourhoods. For sampling purposes, the neighbourhoods and houses were randomly surveyed based on an estimate of the size and the number of residents in each settlement. This procedure was used because there was not enough data on the demographic and socio-economic characteristics of the informal settlements' residents. These people tend to have more homogenous characteristics than participants connected to the water supply system. Therefore, it is expected that the sample participants adequately represent the informal settlements' population.

3. Descriptive statistics

This section provides a summary of the results from the sections about the water supply service and the socio-economic characteristics of the participant and his or her household. Additional descriptive statistics and tables derived from the survey are in Appendix B.

3.1 Socio-economic characteristics of respondents

3.1.1 Individual characteristics

In the survey for non-connected houses the majority of respondents were household heads or people that knew about the household expenses. The average age of participants was approximately 35 years old (the youngest participant was 16 and the oldest 78 years old). As in the survey for connected houses, most of participants were women (approximately 78%). This was due to random events and because in the irregular settlements the female household head was also referred sometimes by other household members as the person that knew and made decisions about the household's expenditures and the water services. Although the sample under represents the population of male residents, it represents significantly the opinion of the household heads that know more about the water supply services and might have a higher influence in the household's decisions related to this service.

Approximately 84% of the respondents were married or living with a partner. Of the total of participants, 58% reported to work on household duties (Table 1). About 35% of participants reported to be working either as a wage earner, a labourer or were self-employed. Only 3.47% of respondents reported being unemployed. The rest of participants were either retired, students or their main occupation is volunteering.

Table 1. Main occupations of participants from the informal settlements

Occupation	Percentage of respondents
Housewife	58.42%
Self employed without employees	13.37%
Labourer or employee	11.39%
Wage earner	10.4%
Unemployed	3.47%
Student	1.49%
Retired	0.99%
Volunteering	0.5%

The level of education of the residents from the informal settlements is considerably lower than from the residents of regular neighbourhoods. Table 2 shows the individual levels of education of participants from the informal settlements. Almost 14% of the participants stated they did not complete any education degree. About 37% of the participants studied elementary school and about a third completed junior high school. Less than 13% of the participants had completed high school or a technical career. Only 1% of the respondents obtained an undergraduate degree and no one reported graduate level education.

Table 2. Levels of education of participants from the informal settlements

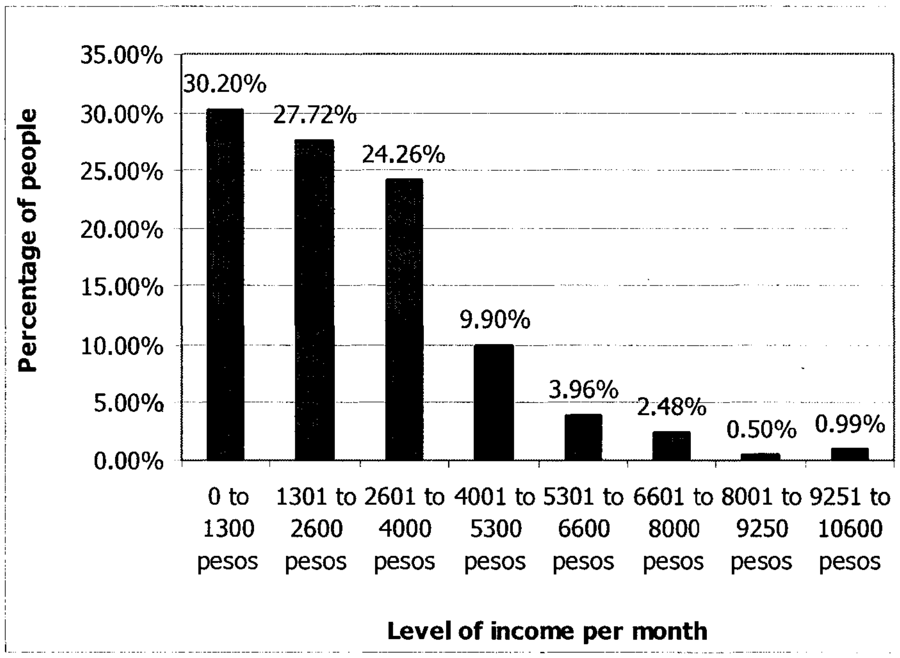
Level of Education	Percentage of participants with the level of education
None	13.86%
Kindergarten	2.48%
Elementary school	37.13%
Junior high school	32.67%
High school	7.92%
Commercial or technical career	4.95%
Undergraduate degree	0.99%

The individual levels of income in the informal settlements are considerably lower than for the rest of the City of Queretaro. The informal settlements are also more homogenous in the participants' levels of income. Figure 1 shows the monthly individual levels of income that participants reported in the survey.

Approximately 30% of the participants reported having an individual monthly income of less than $1,300 Mexican pesos (about $155 CDN) per month. Almost 52% of participants earn between $1,301 and $4000 Mexican pesos ($155 to $476 CDN) per month. Less than 10% of participants earn more than $5,300 Mexican pesos ($631 CDN) per month. Only three participants reported income levels of more than $8,000 and up to $10,600 Mexican Pesos ($952 to $1,262 CDN) per month. The average monthly income is $2,562 Mexican pesos ($305 CDN).

The data in Figure 1 also demonstrate that the income distribution for the non-connected houses survey is fairly homogenous with more than 81% of the respondents earning less than $4,000 pesos. In regular neighbourhoods the median income is approximately $3,800 pesos. In addition, the regular settlements have a more even distribution of income. The Gini coefficient of the distribution of income in informal settlements is equal to 0.38. In the sample from regular neighbourhoods the Gini coefficient is equal to 0.54 (see chapter 3, section 3.1.1, p. 48).

Figure 1. Monthly levels of income of participants from the informal settlements

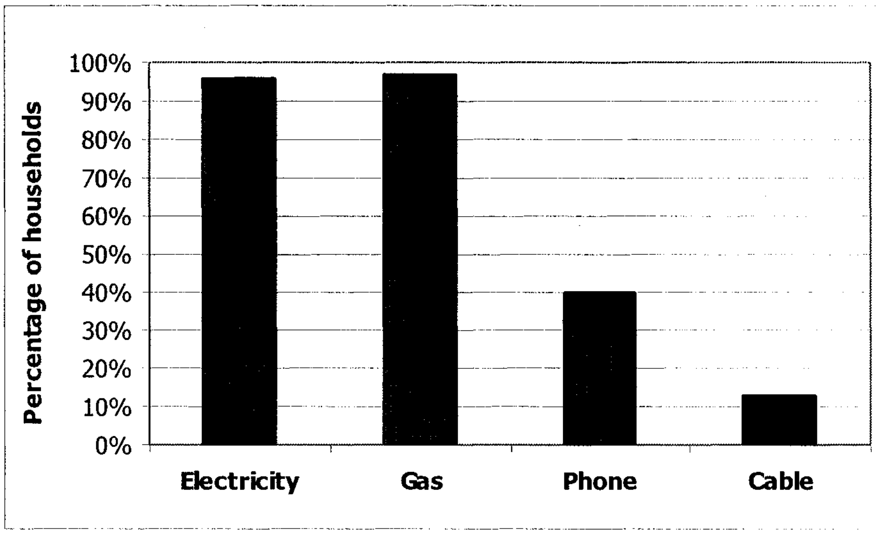


3.1.2 Household Characteristics

The results of the survey for the informal settlements show that on average, there are 5 people living in the participants' houses (see Appendix B, section 2.2, for detailed summary statistics). About four people correspond to the members of the nuclear family and there is an average of two children per house. Therefore, the structure of the non-connected households is very similar to homes connected to the water supply system.

Besides water, most homes in informal settlement have other utility services such as gas and electricity (Figure 2).

Figure 2. Percentage of participants' households with each of the basic utility services



Between 97% and 96% of the households from the informal settlements have gas and electricity.[22] Alternatively, most of the households (60%) do not have telephone and only about 13% have cable or private TV services (Figure 2). Some of these homes are not properly connected to the electricity supply system and about 21% of the households surveyed reported not paying for the electricity service. This happens because sometimes a group of houses share a single connection or because of the existence of illegal connections. The households that pay for the electricity usually pay directly to the *Comision Federal de Electricidad* (Federal Electricity Commission [CFE]) or to the leader of the neighbourhood or informal settlement. On average, respondents from the

[22] All the homes in the informal settlements receive gas via the delivery of LP gas tanks.

informal settlements of Queretaro pay $179 Mexican Pesos per month for electricity ($21 CDN).

The houses in the informal settlements are smaller than in regular neighbourhoods. On average, a house in the informal settlements has approximately 4 rooms. Table 3 shows the materials used in the building of participants' houses.

Table 3. Materials of the houses in the informal settlements

Walls		Ceilings		Floors	
Materials	Percentage of houses	Materials	Percentage of houses	Materials	Percentage of houses
Concrete, cement or bricks	87.13%	Concrete, cement or bricks	62.38%	Cement	73.27%
Waste materials	7.93%	Asbestos, cardboard or metal sheets	36.64%	Dirt	13.86%
Concrete, cement or bricks and other materials	1.99%	Concrete, cement or bricks and other materials	3.96%	Ceramics, wood or other kind of parquet	12.38%
Asbestos, metal sheets or cardboard sheets	1.98%			Waste materials	0.5%
Other materials	0.99%				

The majority of the houses have their walls, ceilings and floors made of cement and/or bricks (Table 3). However, almost 8% of the houses have walls built with waste materials such as pieces of wood or metal. Table 3 also shows that there are houses with walls made up of cardboard or asbestos sheets. Only about 12.38% of the surveyed homes have floors made of ceramics, wood or other kind of parquet. These houses are similar to those in middle income residential areas of Queretaro (houses made of bricks and cement with floors of ceramic or other kind of parquet). On the other hand, about 73% of the houses in the informal settlements have cement floors and 14% have floors of dirt or waste materials. Appendix E (section 1) shows two pictures of common houses in Queretaro's informal settlements.

The survey for the informal settlements also gathered information to know if participants own their houses or if they are living in a rented or lent home. In the survey, most of participants (approximately 80%) declared that they own their house and they have paid completely for their home. About 6% of participants declared that they were currently paying for their house, 8.54% said that is was lent and 5.53% stated that they were renting the house (see Appendix B, section 2.2-v).

Other variables related to the household's wealth and income levels are the total number of people working in the home and the vehicles that household members have for transportation. In the case of the number of people working, households from the informal settlements have on average between one to two people working to earn money. However, about 2.5% of the participants declared that there was nobody in their house working.

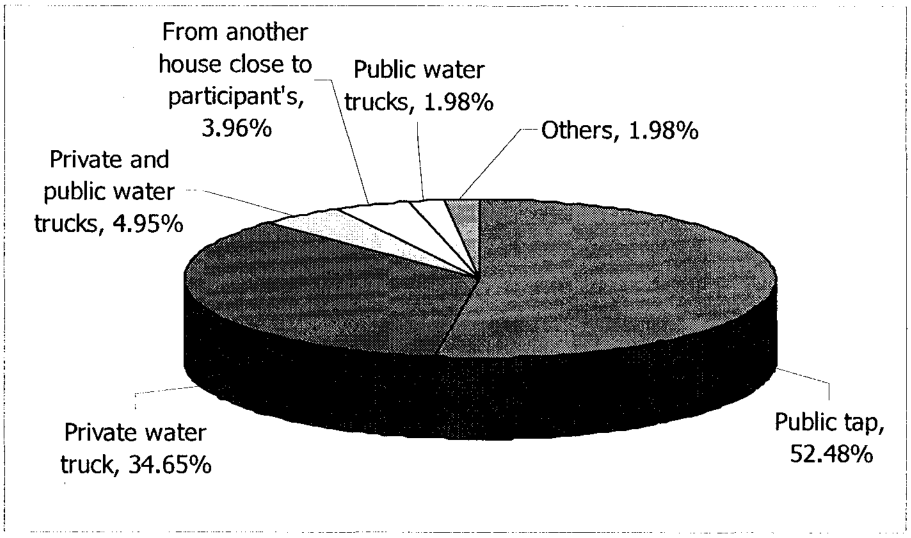
In the case of the vehicles used for transportation, only 45% of the respondents' declared owning vehicles such as bicycles, cars and motorcycles. About 20% of participants own one or more bicycles, 31% own one or more cars and less than 1% have a motorcycle. The rest of participants use buses or taxis to transport themselves and their fellow household's members.

3.2 Households water supply service characteristics

3.2.1 Sources of water and water expenditures

In Queretaro's informal settlements, residents do not have the common water supply service available in regular neighbourhoods. Instead, they depend in the delivery of water via public taps, water trucks, or fellow neighbours. The survey asked participants to state the main source of water for their households. 52% of respondents stated they get water from public taps, 35% from water trucks, and 2% get their water from public water trucks (Figure 3).

Figure 3. Sources of water for households in the informal settlements



The public water trucks are sent by the municipal government, the CEA or the Federal Army and usually deliver the water to the houses for free. However, sometimes the water from the public water trucks is not enough and residents that depend on this source have to buy water from private trucks. About 5% of respondents reported using public and private trucks. Appendix E (section 2) shows pictures of the common public taps and the tanker trucks that supply water in the informal settlements.

Some participants get their water from a connected house through a simple hose or pipe line (almost 4% of participants, Figure 3). Approximately 2% of respondents declared that they either have irregular connections to the main water supply system or combine the public taps service with buying water from private trucks.

Residents of the informal settlements typically pay for the water supplied to their households. Only 5% of respondents declared that they do not pay for water. Residents that get their water from the public tap usually pay directly to the CEA or to a person assigned by the residents to pay the CEA the water bill of the public tap. Residents that buy water from private trucks typically pay to the driver. Participants that get their water from public water trucks do not pay a per unit price, but they do tip the truck driver a minimal fee for his service. The respondents that get water from nearby houses pay their neighbour directly.

On average, respondents from the informal settlements pay a total of $126.68 Mexican Pesos per month for household water (about $15 CDN). However, this estimate varies considerably depending on the source of water (Table 4). The non-connected houses that have the highest expenditures on water are homes buying it from private trucks. Notice in Table 4 that these people pay an average of $266 Mexican Pesos ($32 CDN) per month. This is almost twice the average amount of money spent by people connected to the regular water supply system. Even more shocking is that the people who reported the highest expenditures on water from private water trucks pay five times the average water utility bill in regular neighbourhoods.

Table 4. Water expenditures per month by sources of water for households in the informal settlements

Source of Water	Average expenditure per month (Mexican Pesos)	Standard Deviation (Mexican Pesos)	Median (Mexican Pesos)	Minimum (Mexican Pesos)	Maximum (Mexican Pesos)
private water truck	$266.34	$132.15	$240.00	$ 36.00	$800.00
private and public water trucks	$184.00	$ 93.36	$180.00	$ 60.00	$320.00
others	$115.00	$192.09	$ 30.00	$0	$400.00
from another house close to participant'	$ 45.00	$ 25.77	$ 50.00	$0	$ 80.00
public tap	$ 39.87	$ 47.78	$ 20.00	$0	$220.00
public water trucks	$ 15.00	$ 19.15	$ 10.00	$0	$ 40.00

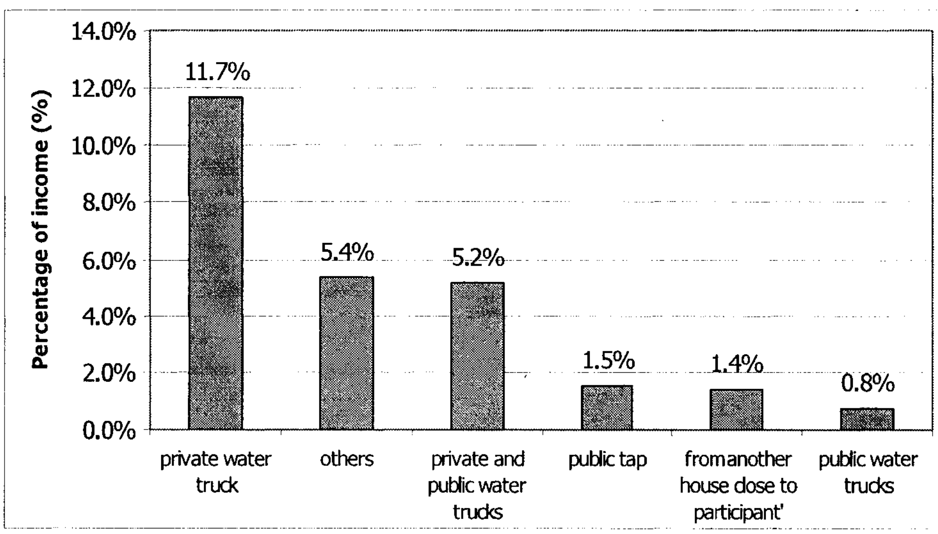
The households that combine buying water from private trucks and getting water from the public trucks are able to save about $84 Mexican pesos on average. These residents typically pay about $184 Mexican pesos per month. However, these residents still pay more than the average connected household.

The lowest water expenditures are for those residents that get their water from public taps or from public water trucks. Their average water expenditures are $39 and $15 Mexican pesos a month respectively. In the case of public water trucks the expenditure in water represents the tip that residents usually give to the drivers.

Figure 4 uses the data from Table 4 to show the households' average expenditures on water from each source as a percentage of the mean income levels. Participants that buy water from private trucks spend on average about 11.7% of their individual income.

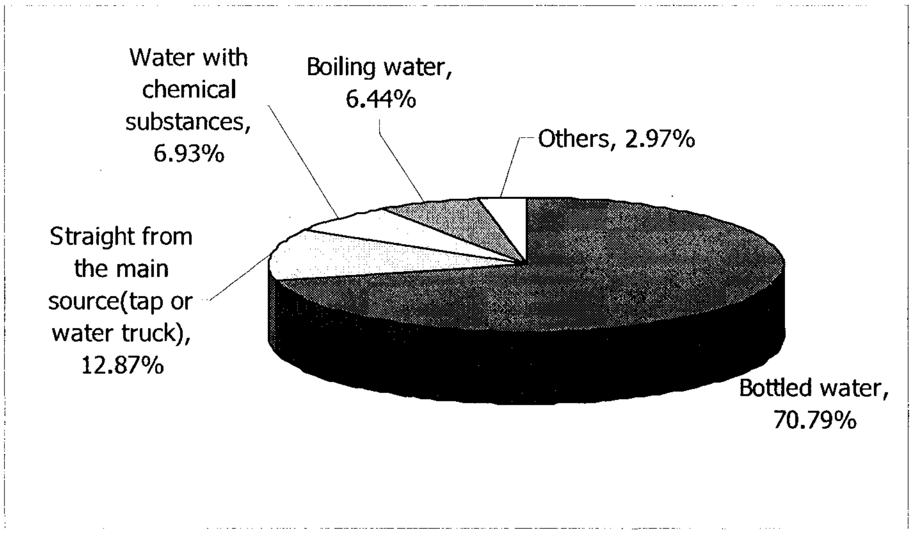
For respondents in the lowest individual income level (less than $1,300 per month) buying water from private trucks represents approximately 41% of their income (see Appendix B, section 3-ii). Alternatively, this expenditure for residents of the highest income level (more than $9,000 per month), only represents less than 3%. Participants that get water from public taps, public water trucks or from some neighbour's house spend less than 2% of their income on water for domestic use.

Figure 4. Households' average monthly expenditure on water for domestic use as a percentage of the mean income levels in the informal settlements.



The survey for non-connected houses also asked participants about their drinking water sources and expenditures. In the informal settlements, only about 13% of non-connected respondents stated that they drink water straight from their main source, either the public tap or the water truck. Only 7% of participants treat the water with chemicals (anti-bacterial compounds) and approximately 6% boil it. Most participants (71%) obtain the household's drinking water by buying bottled water (Figure 5). This proportion is only 5% lower than the percentage of people in regular neighbourhoods. The rest of participants (2.97%) get their drinking water from different sources such as going to a relative's house or combining sources such as boiling water and buying bottled water.

Figure 5. Sources of drinking water for households in the informal settlements



On average, residents from the informal settlements buy about 2 bottles of water per week (this is counting people that do not buy bottled water). These residents spend on average $131.93 Mexican Pesos ($16 CDN) per month on bottled water. The poorest residents in these neighbourhoods spend almost 20% of their monthly individual income on bottled water (see Appendix B, section 3-iii). Only for residents in the higher income bracket (more than $2,000 pesos per month) is the expenditure on bottled water less than 5% of the participant's individual income.

By adding the expenditures on bottled water and the water supply service for the households, it is possible to know that residents from the informal settlements spend on average about $258.61 Mexican pesos ($31 CDN) per month in total on water for their households.

Figure 6. Average total monthly expenditure on water as a percentage of the individual income levels in the informal settlements

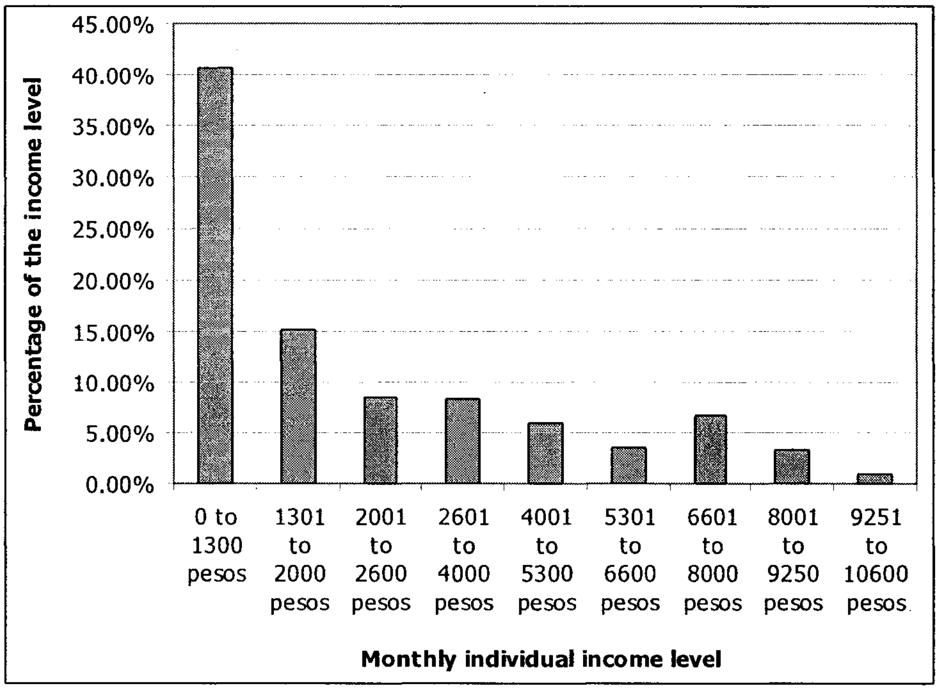


Figure 6 shows the percentage of income that residents in each income bracket spend in total on water (for drinking and domestic use). In the case of participants earning less than $1,300 Mexican pesos a month, getting water for their households represents on average about 40% of their income levels. As in the case of regular neighbourhoods, the residents with the lowest income levels have to spend a considerable proportion of one of the household head's individual earnings.

Despite the amount of money that residents of the informal settlements spend on water, the quality and availability of the households' water is lower than in regular neighbourhoods. In the next sections, it will be shown the findings of the survey about the residents' perception on the water availability and quality for their households.

3.2.2 Water availability

Residents from Queretaro's informal settlements lack of sufficient water supply. Most of the people in these neighbourhoods have to make significant efforts to obtain the water for domestic use in their households. Through the survey it was possible to know from people's opinion that it is difficult to get water from public taps because there are usually too many residents sharing a tap. In some neighbourhoods, participants reported more than ten houses getting water from a single tap. Moreover, the public taps present inadequate schedules in the delivery of water. For example, some neighbourhoods reported getting the water service in the early morning (between 2 a.m. and 7 a.m.) and many people declared that there are usually conflicts between residents related to the order of who gets water from the public tap.

In the case of water trucks, people reported that it is difficult to obtain water from this source because there are times when the trucks do not visit their neighbourhoods and they are left without water. Moreover, some participants mentioned that public trucks usually distribute the water unequally and it is common that drivers deliver water depending on the amount of tips that people are willing to give.

The survey revealed that a significant proportion of participants are not able to get water from the main source at least 1 day per week. When they do not have water, the residents have to look for alternative sources. Table 5 shows the number of days that participants do not have water and the percentage of respondents lacking of water in each of the specified number of days.

Table 5. Percentage of participants from the informal settlements without water in a regular week

Number of days in a regular week with water cut-offs	Percentage of participants
0	67.82%
1	7.43%
2	6.93%
3	8.42%
4	3.96%
5	4.46%
6	0.99%
7	0%

Approximately 68% of participants declared that they do not stay without water in a regular week. However, most participants (62%) stated that during the Spring (March to May), there is not enough water and they suffer water shortages that last on average nine days (Table 6). Almost 11% of respondents declared that during the summer they lack of water because usually the water trucks cannot enter their neighbourhoods due to bad road conditions. The residents without water during the summer declared that water shortages last on average almost eight days. Other residents declared that they lack water either during the Fall, the Winter or the Spring & Summer. However, these residents add to less than 4% of participants. Only 18.8% of participants declared that there are no water shortages at all in the informal settlements.

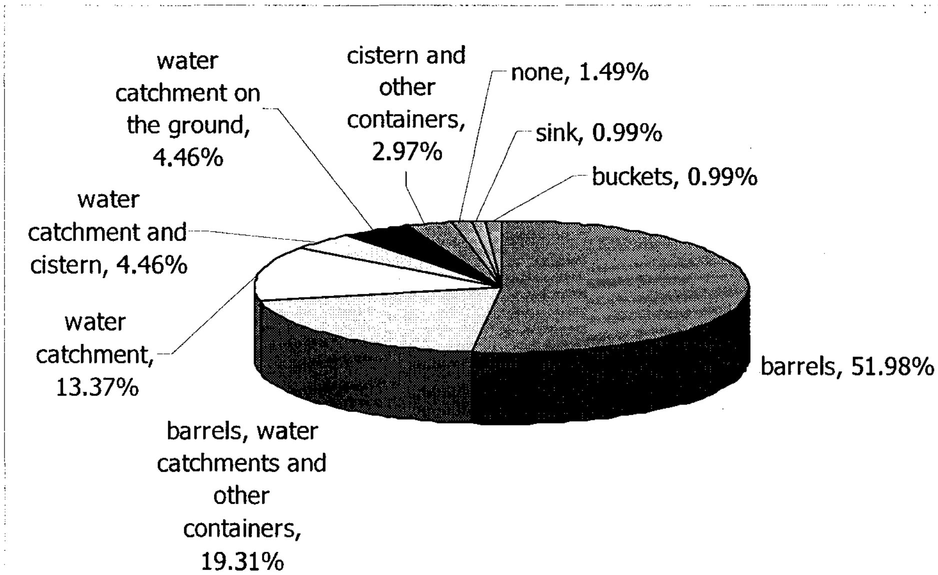
Table 6. Season when there is lack of water and average number of days without water in the informal settlements

Season	Percentage of participants	Average number of days without water in this season
Spring	62.38%	9.14
Summer	10.89%	7.63
Spring & Summer	1.98%	9.25
Fall	0.99%	5.5
Winter	0.5%	15
None	18.81%	-
Don't know	4.46%	-

In addition to the variability of the water supply services, the non-connected homes do not have adequate containers to store water. In the informal settlements, almost 52% of participants use barrels to store water (Figure 7). These barrels are usually metal barrels of 200 litres (see appendix E, section 3 for a picture of these containers.)

Only about 13% of the respondents declared having water catchments in their homes' roofs and 4.6% declared having a catchment and a cistern. Approximately 19% of participants combine the use of water catchments, barrels and cisterns to store water. About 2% of participants stated that they use small containers such as buckets and sinks (a picture of this kind of containers can be seen in Appendix E section 3). Approximately 1.5% of respondents do not have any containers at all because the public taps have a water catchment that stores water for them (see Appendix E, section 2 for a picture of a public tap and its water catchment).

Figure 7. Percentage of participants using different types of water containers in the informal settlements



From the total of participants only 7% reported having an electric pump to take water from their cisterns to the water catchment of their houses. Moreover, only 20% of the respondents have piped water installation in their households, i.e. a piped system that takes water from the catchment or the public tap to the household's faucets. The rest of the people have to get the water directly from either the water container (barrels, catchments, etc.) or the main pipe from the public tap.

Since most of participants store water for domestic use in barrels, the survey collected data on the number of barrels they buy in a regular week to know the amount of water available in every household. For the rest of participants, it is more complex to calculate the amount of water available since the types of water storage containers are very diverse as Figure 7 shows. A total of 115 participants' use only barrels to store water and fill an average of 4.76

barrels per week. Using these data and the information of the households' consumption of bottled water (considering that each bottle can store approximately 19 litres of water), it was possible to estimate the total amount of water for domestic use available per person in 115 households of the sample (57% of the respondents).

Table 7 shows the total amount of water available (water from the main source plus bottled water) per person per day in households that only store water in barrels. On average the total water available for most households is 33.34 litres per person per day. However, the households with the lowest water availability only have 4.08 litres per person per day.

Table 7. Water available per person per day in the informal settlements (only residents that store water in barrels)

Observations	Mean l/p/d[a]	Standard Deviation l/p/d	Median l/p/d	Minimum l/p/d	Maximum l/p/d
115	33.34	24.55	28.57	4.08	171.43

[a] litres per person per day

The water availability in the households of the informal settlements might be determined by choices made related to their water demand. However, residents with low water availability face significant constraints in obtaining water for their households. For example, although most of the neighbourhoods have public taps the water service is not running all day and it is common that the public taps only provide water for short periods of time.

According to Howard and Batram (2003), a household with intermediate access to water supply services should have at least 50 litres per person per day (l/p/d). The authors contend that high to very high levels of health concerns are present in households with less than 20 l/p/d. An analysis conducted by Gleick (1996) on the basic water requirements for human needs also supports the idea that the minimum amount of water recommended for a person for being able to guarantee an optimal level of basic needs (drinking, cooking, sanitation and human hygiene) is 50 litres per day. In developed countries such as the U.S., Netherlands or Sweden, the average residential use of water is estimated to be between 295 and 104 litres per person per day (Gleick, 1996.)

Table 8. Deciles of average water availability in households that store water in barrels (115 obs.)

Decile[a]	Average water available (litres/person/day)
1	12.03
2	15.24
3	20.54
4	23.67
5	28.57
6	30.38
7	36.45
8	46.18
9	57.14

[a] Each decile is calculated with the 9 values of the data that divide the sample in 10 equal parts. The first decile shows the lowest 10% of the data, the second decile presents the lowest 20% of the data, etc.

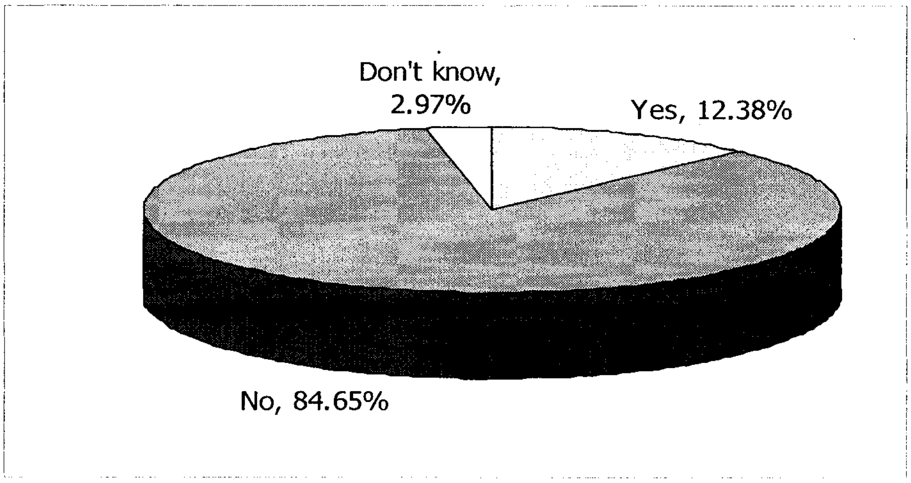
Table 8 shows the deciles of average water availability for the 115 households that use barrels. This table shows that about 30% of participants have less than 20 l/p/d. This water availability is comparable to the average water available in countries such as Somalia, Mozambique, Uganda and Cambodia (Gleick, 1996, p. 89). Therefore, there are a significant number of people in informal settlements living with very low levels of water available. From the 115 households that use barrels, about 84% of these households do not have enough water to meet the basic requirements for optimal living conditions.

3.2.3 Water quality

Besides the problems of water availability in the informal settlements, there are also problems related to the quality of the water. As in the survey for the connected houses, residents from irregular neighbourhoods were asked about their opinions of the quality of the water that they get for their homes.

Approximately 85% of respondents stated that they do not think that water from the main source is good for drinking and only 12% answered the opposite (Figure 8). Moreover, from the total of respondents that said that water is not good for drinking, approximately 88% mentioned that water from public taps and water trucks always or sometimes has low quality levels. In addition, only about 12% of respondents think that the problems in the water quality levels are temporary.

Figure 8. Percentage of respondents living in non-connected houses that think that water straight from their main source is good for drinking



Participants stated that the main reason for thinking that the water is not good for drinking is that it gets polluted or dirty while it is distributed (52.63% of the sample). For example, some participants said that the water trucks have their tanks dirty and that sometimes the water comes with twigs or dirt. In the case of public taps, residents reported that the water tanks that store water from the taps are not washed or sanitized often. Approximately 16% of participants that stated that it is not good to drink water straight from the main source said that the water smells and tastes too much like chlorine.

About 11.70% of participants said that they think the water contains pathogen organisms and that some of their household members got sick by drinking water from the water trucks or the public taps. The survey also included questions to know if some household member has been sick because of drinking water and to know the kinds of diseases. A total of 51 respondents (25.5% of the sample) declared that someone in their household has gotten sick because of drinking water straight from the main source. Moreover, approximately 94% of these participants said that diarrhoea and stomach infections such as gastroenteritis are the common diseases when drinking water straight from the main source. Other diseases mentioned because of drinking polluted water were skin rashes and blacking of teeth.

3.2.4 Sanitation and hygiene services

Besides the problem of water availability and quality the non-connected houses also lack of adequate sanitation and hygiene services. Most of the respondents at the time of survey did not have piped sewage systems or septic tanks (Table 9).

Table 9. Availability of sewage systems in the informal settlements

Type of Sewage System	Percentage of Participants
Connected to the Public Piped Sewage System	35%
Septic Tanks	35%
Do not have sewage or septic tanks	30%

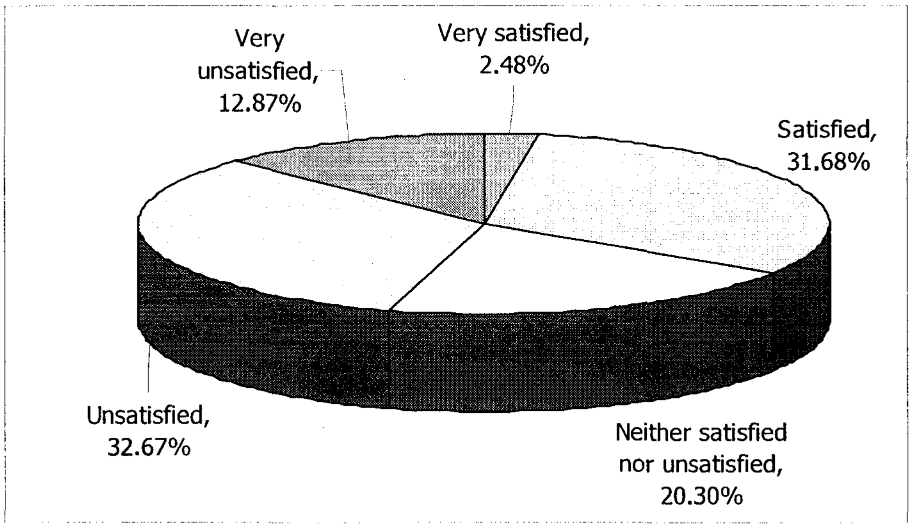
Only 35% of the respondents have access to the city's public sewage system. About 35% of the participants have built septic tanks for collecting waste waters, but 30% do not have this kind of collection system. The people without sewage systems opt for throwing their waste water into the streets or to lands next to their houses. More than 63% of respondents declared that they use some of their waste waters to irrigate their gardens. Appendix E (section 4) shows some pictures of how the waste waters are thrown to the streets of the irregular neighbourhoods.

The lack of availability of sewage systems affects directly the households' sanitation and hygiene services in the informal settlements. Only 57% of the respondents declared having one or more washrooms with toilets that use water. About 4% of the participants mentioned that they do not have a washroom or latrine for sanitation services. Moreover, only 17.8% of the survey respondents declared having a shower, the rest have to use water containers and/or a faucet for their personal hygiene.

3.2.5 Satisfaction levels with the current water supply service

The survey for non-connected houses also included some questions about the participant's satisfaction level with the current water supply service. Figure 9 shows the satisfaction levels and the percentage of respondents that stated each satisfaction level. From the total of respondents, approximately 53% of the participants answered that they are unsatisfied or very unsatisfied with the current water supply service. Only 34% responded that they are satisfied or very satisfied with the current water supply service. The rest of respondents answered that they are neither satisfied nor unsatisfied with the water services.

Figure 9. Satisfaction levels of the non-connected houses with the current water supply service



The reasons behind the participants' satisfaction levels were very diverse. Most of participants that are satisfied with the current water service said that they have enough water to cover their needs (30% of the sample). Other participants that are also satisfied mentioned that they used to buy water from trucks and now they have public taps which are much better (2.97% of respondents). About 2% of participants said that they are somewhat satisfied with the public taps but they would like to have their own private connection.

In the case of participants that are unsatisfied, most said they are not satisfied because they have to share the public taps and they do not have their own connection (20.30% of the sample). Other participants said that they lack of enough water (17.82% of the sample). About 15% of participants said they are not happy with the current water supply service for several reasons such as schedule of the supply service, conflicts with neighbours for the public taps, etc.

A primary factor related to the residents' level of satisfaction with the water services is their perception about the cost of water. The respondents' perception of water prices largely depends on where they get their water. About 54.5% of respondents stated that water was expensive and most of these residents got their water from private trucks (66%). The rest of participants stated that the water was adequately priced and about 80% of these respondents got their water from public taps. This is consistent with the information shown in section 3.2.1 (Table 4, p. 112), since participants using public taps pay less for water than residents that are supplied by water trucks.

4. Results from the WTP question for water supply improvements

In section 3, it was shown in detail the characteristics of the households and the current water supply service in the informal settlements. Since residents from these neighbourhoods would like significant improvements in the quality and availability of the water, the survey for irregular settlements analyzes the households' welfare gains or economic benefits from having their own private connection and an improved water availability and quality.

Similar to the connected survey, the non-connected survey presented a scenario to the respondents that proposed projects such as water treatment plants, improvements to the city's water distribution system and the development of new sources of water. These improvements would connect the informal settlements to the city's water supply system and guarantee 24 hour service and water that would be good enough to drink from the tap. This scenario is explained in section 5 of the questionnaire for non-connected houses (Appendix D). With the use of illustrations, the enumerators read the scenario script and asked the following question:

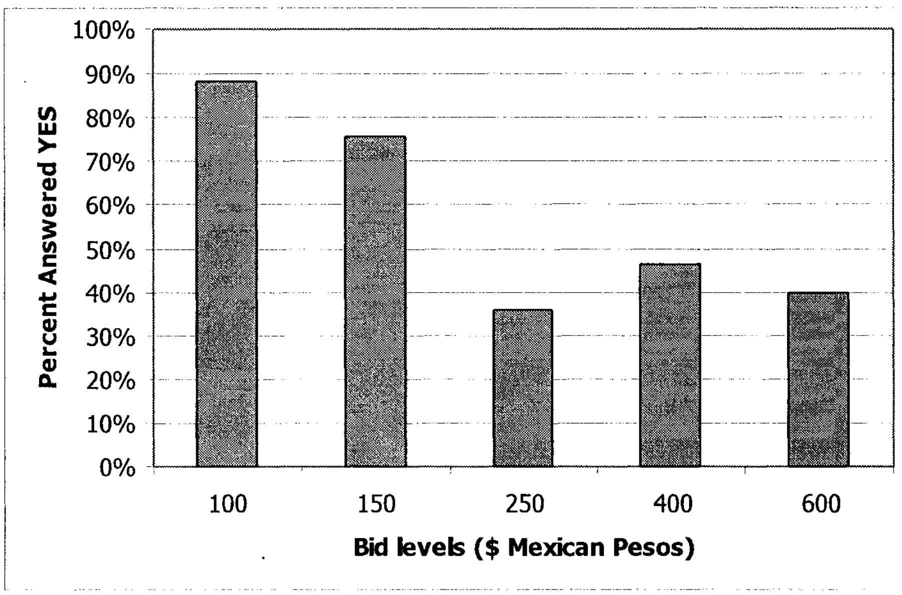
> Would you be willing to pay ______ pesos per month for being connected to the water supply system, for having water 24 hours a day and for being able to drink the water directly from the main faucet of your household?
>
> ❑ Yes ❑ No

The bid level or price presented to each participant of the survey was randomly selected from the following set of bids: \$100, \$150, \$250, \$400 and \$600 Mexican pesos (\$12, \$18, \$30, \$48 and \$71 CDN respectively). Then the respondent answered the WTP question and some follow-up questions. These questions help to control for uncertainty, hypothetical and warm glow effect bias. This section presents the results to the question for water supply service improvements and the analysis conducted to estimate the economic benefits derived from these improvements. As with the case of connected houses, the analysis is divided in non-parametric and parametric estimations.

4.1 WTP for water supply improvements: Non-parametric analysis

A total of 202 participants answered the question of WTP for water supply improvements in the informal settlements. Figure 10 shows the percentage of participants that answered "yes" to each of the bids in the WTP question. For most of the bid levels, as the prices increase, the proportion of "yes" responses decreases. The exception is bid level $250 where the proportion of "yes" responses is slightly lower than for $400 and $600.

Figure 10. Percentage of people in the informal settlements that answered yes to each of the bid levels of the WTP question



Chapter 3 (section 4.1) explained how to obtain a distribution-free estimator of the expected lower bound WTP. This estimator imposes a monotonicity restriction that guarantees that as the price increases the proportion of "yes" responses decreases. Using the definition presented in chapter 3 of the Turnbull estimator (equations 3.1, 3.2 and 3.3), it is possible to calculate each of the Turnbull estimators (f_j^*) for the bid levels of the WTP question for non-connected houses (Table 10).

In Table 10, N_j is the number of "no" responses for the j^{th} bid level, T_j is the total number of observations for the j^{th} bid level, Fj^* is the estimated CDF for the j^{th} bid level and f_j^* is the estimated PDF for the j^{th} bid level (Turnbull estimator). Note that for the $400 bid, the estimated CDF was pooled back and the new CDF for $250 is calculated using equation 3.3 to guarantee a monotonic behaviour of the proportion of "yes" responses.

Table 10. Turnbull estimators of the WTP for water supply improvements in the informal settlements

Bid Level	N_j	T_j	F_j^*	f_j^*
100	5	43	0.116	0.116
150	10	41	0.243	0.127
250	25	39	0.589	0.345
400	21	39	pooled back	
600	24	40	0.6	0.010

The expected value and variance of the lower bound WTP are calculated using equations 3.4 and 3.5:

$$E_{LB}(WTP) = \sum\nolimits_{j=0}^{M} t_j (F_{j+1}^* - F_j^*) \tag{3.4}$$

$$Variance(E_{LB}(WTP)) = \sum_{j=1}^{M*} \frac{F_j^*(1-F_j^*)}{T_j^*}(t_j - t_{j-1})^2 \tag{3.5}$$

Where t_j is the j^{th} bid level. The expected lower bound of the WTP for water supply improvements in the informal settlements is equal to $307.20 Mexican pesos ($37 CDN) per month and the variance of this estimate is equal to $800.01

Mexican Pesos ($95 CDN). As with the case of connected houses, it is possible to estimate a 95% confidence interval for the estimated lower bound WTP assuming that the standard deviation is asymptotically normal. The range of a 95% confidence interval is between $251.76 ($30 CDN) and $362.64 ($43 CDN). Therefore, with a 95% confidence level the lower bound WTP will fall between those values.

The lowed bound WTP estimated in this section will be used later to compare it with the parametric estimation of the WTP for water supply improvements. In the next section, the parametric estimation analyzes the effects of several variables in the WTP estimates.

4.2 WTP for water supply improvements: parametric analysis

The parametric estimation of the WTP estimates for non-connected houses follows the empirical model described and used in Chapter 3 (equations 3.6 to 3.13). The empirical estimation is based in the following function:

$$\Pr(Yes_j) = \frac{1}{1+\exp(-\alpha z_j - \beta t_j)} \qquad (3.13)$$

Where $\Pr(Yes_j)$ is the probability that the j^{th} respondent answers "yes" to the WTP question for water supply improvements in the informal settlements, α is a vector of m parameters, z_j is a vector of m variables related to the j^{th} individual, β is the vector of coefficients of the bid levels (marginal utility of income, see chapter 3, section 4.2.1) and t_j is the bid level. Equation 3.13 is a logit model and the parameters can be estimated by maximizing the likelihood function.

4.2.1 Results of the estimation

The estimation of model 3.13 and the WTP for water supply improvements in the informal settlements was done following the same steps as in the analysis of the WTP for connected houses. First, model 3.13 was estimated using only the bid levels as the explanatory variable. Second, a set of models with exogenous (socio-economic characteristics) and endogenous (characteristics of the water supply service) variables were estimated. Third, the model 3.13 was estimated using data that was validated or corrected for biases due to uncertainty, rejection of the scenario and warm glow effects. Finally, the expected WTP values and confidence intervals are estimated for every model.

Table 11. Specification 1 of the WTP logit model for non-connected houses (bid levels and intercept)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.448* (4.87)		
Bid level	-0.0037* (-4.44)	296.04	-0.0009
Obs.	202		
Log-likelihood	-126.74		
Restricted Log-likelihood	21.45		
P-value chisquare (d.f.=1)	0.0000		
Pseudo R2	0.078		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.

The results of the model that includes only the bid levels as the independent variable are presented in Table 16 (specification 1). Table 1 shows that there is a negative relationship between the bid level and the probability of a participant answering yes. Therefore, as expected, the probability of answering "yes" decreases as the offered price increases. Note that the marginal effect is equal to -0.0009, which means that the probability of answering "yes" decreases by 0.09% when the bid levels increase one peso.

Since specification 1 does not include any other variable than the bid levels, the next step is to estimate a model with the participant's socio-economic characteristics. Table 12 shows two models where the explanatory variables are socio-economic characteristics.

Specification 2 shows the relationship between the probability of answering "yes" to the WTP question and the number of people living in the household, the respondent's age, gender, marital status and income level. The only variables that are statistically significant (at a confidence level of at least 90%) are the bid levels and the number of people living in the household. In the case of the bid levels, there is a negative relation between the offered prices and the probability of answering "yes". Moreover, there is a positive relation between number of people living in the household and the participant's WTP. The marginal effect of this variable (evaluated at the mean) is equal to 0.25 (see Appendix B, section 7). Therefore, an increase of one person in the number of people living in the household produces an increase of 0.25 in the probability of answering "yes" to the WTP question.

In the case of age, its coefficient is statistically significant at an 85% confidence level. It is important to note that the coefficient and the marginal effect of this variable have the same sign as in the models run for connected houses (Chapter 3, section 4.2.2, Table 9). Therefore, this result is consistent to what was found in regular neighbourhoods: older people are less willing to pay for water supply improvements.

Table 12. Specifications 2 and 2-A of the WTP logit model for non-connected houses (demographic variables)

Specification 2		Specification 2-A	
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.564*** (1.65)	Intercept	1.523*** (1.88)
Bid level	-0.004* (-4.61)	Bid level	-0.002 (-1.57)
Number of people living in the household	0.104*** (1.65)	Bid level & marital status (1=married)	-0.0008 (-0.88)
Age	-0.019 (-1.43)	Bid level & gender(1=female)	-0.00005 (-0.04)
Gender (1=female)	-0.093 (-0.23)	Bid level & education	-0.00007 (-0.60)
Married (1=married)	-0.141 (-0.42)	Age	-0.022 (-1.50)
Income (median)	0.001 (1.48)	Number of people living in the household	0.088 (1.38)
		Income	0.0001 (1.57)
Obs.	202	Obs.	202
Log-likelihood	-122.03	Log-likelihood	-121.54
Restricted Log-likelihood	30.86	Restricted Log-likelihood	31.84
P-value chisquare (d.f.=6)	0.00	P-value chisquare (d.f.=7)	0.00
Pseudo R2	0.11	Pseudo R2	0.11

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 90% confidence level.

In the specification 2, gender and marital status are not statistically significant. This finding is consistent with the results of the connected households survey and might be due to lack of variability in the sample. Recall that in the survey of non-connected houses most of the participants in the sample are female and married.

Table 12 also shows that the income variable is not statistically significant. This might be due to some biases in the measurement of this variable. However, income might not be significant because there is a relatively low variability in the informal settlements income levels. Most of participants (81%) have an individual income level below $4000 Mexican pesos ($476 CDN) per month (see section 3.1.1 of this chapter).

In Table 12, the specification 2-A of the WTP logit model includes as explanatory variables the interaction effects between the bid levels and exogenous variables such as marital status, gender and education. This model attempts to find variability in the marginal utility of income due to some of the individual's socio-economic characteristics. The interaction effect between age and bid levels is not included in the model because there is a high correlation between this interaction variable and most of the independent variables in the specification 2-A. The results of the estimation show that none of the interactions between the bid levels and the socio-economic variables are statistically significant at least at a 90% confidence level. Therefore, there is not enough evidence to support that the marginal utility of income is different across various socio-economic groups of the sample.

It is also necessary to analyze the effect of factors related to the current water supply service on the participant's WTP for water supply improvements. Table 13 shows the results of the estimation of model 3.13, where the explanatory variables are the monthly expenditure on water for domestic use, the availability of adequate water storage containers (water catchments and cisterns) and the availability of a toilet that uses water (specification 3.)

Table 13. Specification 3 of the WTP logit model for non-connected houses (water supply service perceptions)

	Coefficients[a]
Dependent variable: Probability that the participant is willing to pay a specified bid level	
Intercept	0.574 (1.38)
Bid level	-0.004* (-4.72)
Consumption and expenditure	
Household's monthly expenditure on water for domestic use	0.004* (3.36)
Household's monthly expenditure in bottled drinking water	0.00004 (0.03)
Availability of adequate water storage containers 1=availability of water catchment and/or cistern	1.111* (2.75)
Lack of toilets that use water 1=Household that does not have toilets that use water	0.606** (1.77)
Obs.	202
Log-likelihood	-116.49
Restricted Log-likelihood	41.95
P-value chisquare (d.f.=5)	0.00
Pseudo R2	0.15

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 90% confidence level.

According to the results in Table 13, the household's expenditure on water for domestic use and the availability of adequate water storage containers are statistically significant at the 99% confidence level. In other words, households that spend more on water are more likely to answer "yes" to the WTP question. The probability of answering "yes" also increases if the house has cisterns and water catchments. This might be happening because participants that are able to have adequate water storage containers prefer to reduce the variation on water availability. Therefore they might like to have a source of water that provides water 24 hours a day (reliable water supply). It is also important to mention, that the marginal effect of this variable is equal to 0.25 (at the mean level, see Appendix B, section 7) and it is the highest marginal effect of specification 3.

Table 13 also shows that the dummy variable for houses without toilets that use water is statistically significant at the 90% confidence level. The coefficient and marginal effects for this variable are positive which means that houses without toilets that use water are more likely to answer "yes". The lack of toilets that use water may be capturing the desire or willingness to obtain better water services in the informal settlements. Remember from section 3.2.4 that a significant part of the houses do not have adequate sanitation and hygiene services. The results of the specification 3 of model 3.13 provide evidence that these households are willing to pay a certain amount of money in order to improve their household's sanitation services (washrooms).

Note that the specification 3 has a higher Log-Likelihood and pseudo-R^2 values than specifications 1, 2 and 2-A. Therefore, the variables of the water supply service characteristics appear to explain better the probability that a person answer "yes" to the WTP question. As in the case of connected houses, a final model was developed combining socio-economic variables and the variables of water supply service characteristics. Table 14 shows the results of a specification where the explanatory variables are a combination of demographic variables and characteristics of the water supply service.

Table 14. Specification 4 of the WTP logit model for non-connected houses (demographics and water supply service perceptions)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	0.403 (0.49)		
Bids	-0.004* (-4.92)	296.04	-0.0011
Household's monthly expenditure on water utility bill	0.003* (2.85)	126.68	0.0009
Availability of adequate water storage containers 1=availability of water catchment and/or cistern	1.136* (2.72)	0.252	0.246
Lack of toilets that use water 1=Household that does not have toilets that use water	0.744** (2.08)	0.425	0.173
Age	-0.021 (-1.55)	35.30	-0.005
Number of people working in the household	0.474** (2.08)	1.55	0.113
Number of people living in the household	0.004 (0.07)	5.28	0.001
Income	0.0001 (1.42)	2562.35	0.00003
Obs.	202		
Log-likelihood	-110.39		
Restricted Log-likelihood	54.14		
P-value chisquare (d.f.=8)	0.00		
Pseudo R2	0.19		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.

All of the variables that are statistically significant in specification 4 of the model, except bid levels, have a positive effect on the probability of answering "yes". Note that the variables with the higher marginal effects on the probability of answering "yes" are the dummy variables of availability of water storage containers and lack of toilets that use water. The probability of answering "yes" increases by 0.24 when the residents have adequate water storage containers. Alternatively, when the participant's household does not have toilets that use water the probability of answering "yes" increases by 0.17.

Although the specification 4 of the model seems to explain better the participant's answer to the WTP question for water supply improvements. The data of the responses to the WTP question can also be validated for possible biases, as was done for the case of connected houses. This allows using data that are corrected for biases due to uncertainty, rejection of scenario responses and warm glow effects.

The biases coming from uncertainty in the respondent's answer were corrected using a follow-up question that asked the participant to state their certainty level about his/her response to the WTP question (on a scale of 1 to 10). "Yes" responses with less than 6 units of certainty in their response were changed to "no" answers. A total of 28 responses to the WTP question were changed using this criterion.

In the case of participants answering "no" to the WTP question because they rejected the scenario, the procedure was to drop these observations. A total of 3 observations were dropped because the participant did not like or believe the scenario.

To reduce warm glow effects one observation was dropped. One participant answered "yes" to the WTP question and stated a high maximum WTP. In addition, the offered bid level and the stated maximum WTP were considerably higher than the participant's average water expenditures. This response seemed to be due to the participant's wish to show he/she was willing to spend a significant amount of money and not really thinking in their personal preferences and purchasing power.

After correcting the data for possible biases, specification 4 of the model was estimated again and the new results are shown in Table 15. The variables that are statistically significant (at least at a 95% confidence level) in specification 4-A are: bid levels, household's monthly expenditure on water for domestic use, availability of adequate storage containers, number of people working in the household and the individual's level of income. In the case of the bid variable, the regression results show that as the bid levels increase by one peso, the probability of answering "yes" decreases by 0.1%. In the case of the water expenditures variable, its coefficient and marginal effect show that people with higher water expenditures are more likely to answer "yes" to the WTP question. Moreover, a similar result happens with the variable of availability of water storage containers, since people with adequate water containers are more willing to pay for the improvements. When houses have adequate water storage containers the probability of answering "yes" to the WTP question increases by 26%. This result is consistent with the results of specification 3 of the model.

Participants that have adequate storage containers prefer to avoid water supply variability and are more likely to pay for the water supply improvements.

In the case of income and number of people working in the household, these variables have a positive effect on the probability of answering "yes" to the WTP question. The marginal effect of income is equal to 0.00005 which means that an increase of one peso in the individual income level increases the probability of

Table 15. Specification 4-A of the WTP logit model for non-connected houses (responses to the WTP question corrected for possible biases)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	-0.89 (-1.08)		
Bids	-0.004* (-4.70)	293.43	-0.001
Household's monthly expenditure on water utility bill	0.003* (2.70)	127.14	0.0008
Availability of adequate water storage containers 1=availability of water catchment and/or cistern	1.07* (2.69)	0.257	0.261
Lack of toilets that use water 1=Household that does not have toilets that use water	0.12 (0.35)	0.429	0.03
Age	-0.009 (-0.69)	35.46	-0.002
Number of people working in the household	0.587* (2.67)	1.54	0.143
Number of people living in the household	0.033 (0.47)	5.20	0.008
Income	0.0002** (2.26)	2574.21	0.00005
Obs.	198		
Log-likelihood	58.37		
Restricted Log-likelihood	-106.83		
P-value chisquare (d.f.=8)	0.00		
Pseudo R2	0.21		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.

answering "yes" to the WTP question by 0.0005 (i.e., an increase of $1000 pesos increase this probability by 0.05). In the case of the variable of number of household members working, an increase of one person working raises the probability of answering "yes" by 14%. The variable with the highest marginal effect is the dummy variable of availability of adequate water storage containers. When the participants have adequate water storage containers the probability of answering "yes" increases by 0.26. Note that this finding is very similar to the case of connected houses, respondents that are able and prefer to have adequate water storage containers are more likely to answer "yes" to the WTP question.

Participants that have adequate storage containers prefer to avoid water supply variability and are more likely to pay for the water supply improvements. In the case of income and number of people working in the household, these variables have a positive effect on the probability of answering "yes" to the WTP question. The marginal effect of income is equal to 0.00005 which means that an increase of one peso in the individual income level increases the probability of answering "yes" to the WTP question by 0.0005 (i.e., an increase of $1000 pesos increase this probability by 0.05). In the case of the variable of number of household members working, an increase of one person working raises the probability of answering "yes" by 14%. The variable with the highest marginal effect is the dummy variable of availability of adequate water storage containers. When the participants have adequate water storage containers the probability of answering "yes" increases by 0.26. Note that this finding is very similar to the case of connected houses, respondents that are able and prefer to have

adequate water storage containers are more likely to answer "yes" to the WTP question.

With the estimated parameters from models 1 to 4-A, it is possible to estimate the expected value of WTP for each of these models. The mean WTP was presented and defined in Chapter 3 as:

$$E(WTP| \alpha, \beta, z_j) = (\frac{\alpha}{\beta})\bar{z} \qquad (3.14)$$

Table 16 shows the estimated means or medians WTP for water supply improvements in non-connected houses of Queretaro. These estimates are the expected values of the residents' willingness to pay per month to be connected to the water supply system, have water 24 hours a day and that the water is good enough for drinking straight from the tap.

Table 16. Estimated means or medians WTP for water supply improvements in non-connected houses

Specification of the model	Mean or Median WTP (Mexican Pesos)
1	387.48
2	384.66
2-A	412.62
3	382.78
4	385.11
4-A	233.74

The estimated mean WTP values of specifications 1 to 4 are consistent with the lower bound WTP calculated using the non-parametric method (about $307 Mexican pesos). For the model's specification 4-A, the lower bound WTP using the non-parametric estimation is equal to $176.91 Mexican pesos. Therefore, the estimated WTP for model 4-A using the parametric approach is also consistent with the distribution-free lower bound mean WTP.

Based on the results of specification 4-A residents of the informal settlements are willing to pay per month an average of $233.74 Mexican pesos (about $28 CDN) per month for having a private water connection, water 24 hours a day and being able to drink water straight from the tap. This amount of money represents approximately 9% of the average income in the informal settlements.

In order to have a better idea of the range of the estimated WTP, confidence intervals for the mean WTP can be estimated. Using the Krinsky-Robb procedure (Haab and McConnell, 2003, pp. 110-113) it is possible to estimate a confidence interval for the mean WTP derived from the parametric estimation of model 3.13. This procedure uses the assumption that estimated WTP is asymptotically normal and requires that a random draw of the model's parameters are estimated using the original vector of coefficients and the covariance matrix of these parameters. The draw of the parameters for each specification of the model was done 1000 times. Finally, for each of the new parameters, a mean WTP was estimated and the highest and lowest 2.5% mean WTP estimates were dropped to set a 95% confidence level of these estimates. Table 17 shows the confidence intervals for each of the estimated parametric models. Note in Table 17, that all the mean WTP estimates fall inside the 95% confidence intervals. Moreover, for all of the models the empirical mean and median WTP estimates are relatively close to the mean WTP estimates calculated. In the case of model 4-A, the estimated mean WTP falls with a 95%

confidence level in a range between $147.87 and $302.64 Mexican pesos ($18-$36 CDN). The empirical standard deviation for this model is equal to $37.19 Mexican pesos.

Table 17. Estimated 95% confidence intervals and empirical statistics for the WTP estimates from the survey of the informal settlements

Specification of the Model	Mean or Median WTP (Mexican Pesos)	Confidence Interval (Prob=0.95) (Mexican Pesos)	Mean WTP (draw estimates, Mexican Pesos)	Standard deviation (draw estimates, Mexican Pesos)	Median WTP (draw estimates, Mexican Pesos)
1	387.48	306.95-503.27	393.0354	49.2237	388.4837
2	384.66	313.28-491.57	389.6533	48.15769	383.571
2-A	412.62	260.45-1072.60	458.4903	699.705	417.963
3	382.78	309.49-482.28	387.8436	43.11507	385.5238
4	385.11	311.71-484.07	388.5354	42.74811	385.2659
4-A	233.74	147.87-302.64	232.9338	37.1975	234.5011

According to the results of the *Conteo de Poblacion y Vivienda 2005* (Instituto Nacional de Geografia, Estadistica e Informatica, 2006a) there is an estimated number of 12,815 households without piped water services in Queretaro and its metropolitan area. Therefore, based on the estimated mean WTP from the specification 4-A of the model, the total amount of economic benefits derived from providing to these households a 24 hour water service and water that is good enough to drink straight from the tap adds to a total of approximately $2,995,378 Mexican pesos ($356,593 CDN) per month. In other words, Queretaro's informal settlements are willing to pay almost three million Mexican Pesos per month in order to get a water supply service with the characteristics of the scenario presented in the survey. Alternatively, based on specification 4 of the model the total benefits add to $ 4,935,185 Mexican Pesos ($587,522 CDN).

Using the estimates of the total benefits it is possible to calculate the present value of providing with water supply improvements to Queretaro's informal settlements for the next 50 years. In a conservative estimation using specification 4-A of the WTP model, a discount rate of 10% and assuming the proportion of houses in informal settlements will remain constant, the present value of the benefits for water supply improvements add to $410,549,959 Mexican pesos (about $49 million CDN). Alternatively, assuming a discount rate of 3%, the benefits for the next 50 years add to $1,266 million Mexican pesos (about $150 million CDN). These results are evidence that these neighbourhoods are willing to pay a significant amount of money to improve the current water supply services and guarantee a high level of water availability and quality.

5. Conclusions

This chapter presented the results of the survey of WTP for water supply improvements in the informal settlements of Queretaro. With the data of the households' socio-economic characteristics it was revealed that people from the informal settlements live in considerable levels of poverty as they have a very low level of income and wealth. A significant proportion of the population of these neighbourhoods live in houses built with basic materials such as brick and cement. There are also several residents that do not have an adequate place to live since their homes are built with waste materials such as cardboards and metal pieces.

One of the main needs in Queretaro's informal settlements is an adequate water supply service. In the neighbourhoods of these settlements the main sources of water are public taps and water trucks. However, the survey revealed that most of the residents in these settlements are unsatisfied with the current water supply services. The primary reason for this dissatisfaction is the lack of water availability. In some households, the water availability per person is as low as 4 litres per person per day. In addition, they also have problems of quality. Most residents of the informal settlements declared that the water they receive is not good enough of drinking. Some residents even stated that some household members have gotten sick because of drinking water straight from the public taps or the water trucks.

With the use of non-parametric and parametric procedures it was possible to estimate the mean WTP for water supply improvements in the informal settlements. The results of the estimation show that on average residents in informal settlement are willing to pay $233.74 Mexican Pesos ($28 CDN) per month for connecting to the water supply system, having water 24 hours a day and that water is good enough to drink straight from the tap. Moreover, the estimated total benefits for the whole population of the informal settlements add to $2,819,371 Mexican pesos ($335,639 CDN) per month.

The results of the survey have shown evidence that the irregular neighbourhoods lack water availability and have significant expenditures in water. These factors mean that the residents are likely to pay a significant amount of money in order to have better water supply services.

Chapter 5
Case study comparison, final conclusions and policy recommendations

1. Comparison of the cases of connected and non-connected houses

This thesis analyzed households' demand for water in Queretaro, Mexico and the residents' preferences for water supply improvements. Two surveys were conducted for obtaining the data of this study: one for houses that were connected to the city's water supply system, and one for houses that were not connected to the system.

The surveys revealed that there are significant contrasts in the wealth, income and water availability levels of the city's residents. Although Queretaro is one of the cities in Mexico with the highest economic growth rates in the last decade, there are a considerable number of people living in poverty conditions without adequate water supply services.

The survey of **households with piped water services** found that in regular neighbourhoods the average house has six rooms and is made of bricks and cement. On average the participant household consists of five people with at least one person under the age of 18. About 90% of the respondents completed elementary school and approximately 18% of participants have a post-secondary degree. The participants' average income level is $6,670 Mexican pesos ($794 CDN) per month (five times the minimum wage in Queretaro).

The survey for **households without piped water services** revealed that in the informal settlements the average house has less than four rooms and is usually made of bricks and cement. However, approximately 8% of the households live in extreme poverty conditions and their houses are often made of waste materials.

The average household in the informal settlements also consists of five people with at least one person under the age of 18. However, one of the main differences between residents of regular neighbourhoods and those from informal settlements is that the latter group tends to have lower levels of education. The survey of the informal settlements found that 83% of the participants completed elementary school but only about 13% finished high school or a technical school (in contrast to 25% of participants in regular neighbourhoods who have completed any of these diplomas). Less than one percent of participants from the informal settlements completed a post-secondary degree. The average income level of participants from the informal settlements is approximately $2,600 Mexican pesos ($309 CDN) per month (two times the minimum wage in Queretaro).

Another contrast between the informal settlements and regular neighbourhoods is the lack of public services in the former. In Queretaro's informal settlements there are no paved streets, public sewage, garbage collection and other important services such as schools or medical clinics. The lack of an adequate legislation and institutional framework of Queretaro's informal settlements has provoked that the residents of these neighbourhoods are not provided with basic public services. Although, the informal settlements are sometimes populated by residents that avoid paying property taxes and the cost of the public services, most of the residents in these settlements are usually people that cannot afford a house in the regular neighbourhoods.

In 2005, the CEA reported that 70% of the population of Queretaro that were connected to the city's water supply system had a water service running between 17 and 24 hours a day (see Chapter 2, section 2.2). However, the survey of connected houses found that approximately 55% of the participants' homes have water cut-offs at least once a week. These water cut-offs last on average 12 hours and usually occur in the mornings.

Despite the lack of a 24-hour water supply, most respondents with piped water services stated that they do not have problems with the water availability in their households (55% of the sample). This is mainly because the participants' houses have water storage tanks that allow them to have enough water while the service is not running. However, residents with low income levels cannot afford to buy adequate water storage systems and are vulnerable to the variability of the water supply.

The majority of the participants living in connected houses stated that tap water is not good for drinking. Only 10% of the respondents drink water straight from the tap. Participants earning less than $1,300 Mexican pesos ($155 CDN) per month represent the highest proportion of people that drink water from the tap.

About 35% of participants from regular neighbourhoods think that the tap water gets polluted in the distribution system. Alternatively, 20% of respondents stated that the water from the tap smells and tastes too much to chlorine. Most of participants that do not drink water from the tap opt for buying bottled water (76% of the sample). The rest of participants obtain the drinking water for their households boiling tap water or using water filters and chemicals.

On average the respondents with piped water services buy an additional eight bottles of water (20 litres each bottle) and spend about $141 Mexican pesos ($17 CDN) per month in this source of drinking water. Therefore, the total expenditures in water for households with piped water services are on average $292 Mexican pesos ($35 CDN) per month (drinking water plus water utility bill). The total expenditure in water represents more than 6% of the income for household heads earning less than $5,000 ($595 CDN) per month. For households in the lowest income bracket the expenditures in water represent on average almost 38.5% the income of one of the household heads.

The results from the willingness to pay question for water supply improvements for connected houses show that the surveyed households are willing to pay at least $197 Mexican pesos ($23 CDN) per month on top of the water utility bill for having a 24 hour service and water that is safe to drink from the tap. The present value of the benefits for Queretaro's connected households from improved water supply in the next 50 years totals approximately $25.5 billion Mexican pesos. In a conservative scenario the benefits derived from water supply improvements are equal to about $5.7 billion Mexican pesos. These estimates follow the findings of works such as Whittington, Briscoe and Mu (1991), that people in developing countries are willing to pay a considerable amount of money for water supply improvements. In the case of Mexico, Montes de Oca *et al.* (2003) found in 2001 that residents of Mexico City are willing to pay $284 Mexican pesos per month for water supply improvements on top of the water utility bill. Another example with similar results is Whittington *et al.* (2002) who found that in Kathmandu, Nepalese households are willing to pay for similar water supply improvements approximately $15.79 USD[23] per month for 500 litres of water a day. In the case of Queretaro's households, the WTP for water supply improvements is equal to $18 USD per month.[24]

In contrast to the connected houses, the survey of non-connected houses in the city's informal settlements revealed that these residents have a considerably low water availability and quality. Most of the informal settlements' residents obtain their household water from trucks or public taps. Although most of these residents reported that they do not experience water supply shortages, at least 17% of the participants in these neighbourhoods do not have access to enough water to meet their basic needs. The water availability of these respondents is similar to low income countries such as Cambodia or Somalia.

On average, the participants from the informal settlements spend $127 Mexican pesos ($15 CDN) per month on water for domestic use. However, households that are supplied by water trucks spend on average $266 Mexican pesos ($32 CDN) per month on water. This represents almost twice the average water utility bill in regular neighbourhoods.

Respondents that take water from the public taps stated that it is better for them to be supplied from this source than from the water trucks. However, they also reported that the public taps do not provide enough water to their household and they would rather have their own private water connection.

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[23] This amount is in dollars of 2005. Whittington *et al.* (2002) estimates are in U.S. dollars of 2001.

[24] At an exchange rate of $10.98 Mexican Pesos per U.S. dollar (average exchange rate of 2005, Instituto Nacional de Geografia, Estadistica e Informatica, 2006b)

The majority of respondents from the informal settlements do not have adequate water storage containers. Most store their water in metal barrels that usually become rusty and dirty. These containers usually do not have lids to protect the water from getting polluted. Even more shocking is the situation of participants from the lowest income brackets in the informal settlements since they usually store water in recycled buckets and small containers. This suggests that they are very sensitive to variations in the water supply service and are subjected to low water quality.

Most participants of the non-connected survey stated that the water from tanker trucks and the public taps is of very low quality. About 25% of the participants stated that at least one person in their house has been sick from drinking water straight from the tanker truck or the public tap. This may also happen because the residents lack adequate containers to keep the water clean.

The results from the WTP question in the survey for non-connected houses reveals that people in the informal settlement are willing to pay at least $233.74 Mexican pesos ($28 CDN) per month for having a private water connection, water 24 hours a day and being able to drink water straight from the tap. The WTP for water supply improvements in the informal settlements represents about 9% of the participants' average income level. This is consistent with the findings of Walker *et al.* (2000), who found that residents without piped water services in Latin-American urban areas are willing to pay higher proportions of their income for having increased water availability than residents with private water connections.

In a conservative scenario (assuming a discount rate of 10%), the present value for the next 50 years of the amount of money that residents from informal settlements are willing to pay for the improvements adds to $410 million Mexican pesos (about $49 million CDN). Therefore, despite the fact that these residents tend to have very low levels of income they are willing to pay a considerable amount of money for having an improved water supply service.

A summary of the results of water expenditures and WTP for water supply improvements in both regular neighbourhoods and the informal settlements are shown in Table 18.

Table 1. Summary of water expenditures and welfare measures of water supply improvements in regular neighborhoods and the informal settlements.

	Regular neighborhoods (Mexican Pesos)	Informal settlements (Mexican Pesos)
Average monthly expenditure in water for domestic use (Mexican Pesos)	$174.70	$126.70
Average monthly expenditure in drinking water	$141.10	$131.90
WTP for water supply improvements	$197	$233
WTP for water supply improvements as a percentage of average monthly income level	3%	9%
Economic benefits per month (Mexican Pesos)	$40 million	$2.9 million

The results shown in Table 1 confirm the hypothesis that residents from Queretaro are willing to pay a significant amount of money for having better residential water services. In addition, it was also possible to prove the hypothesis that residents from the informal settlements are willing to pay more for water supply improvements as a proportion of their income levels.

Even assuming a conservative scenario, the present value of the WTP for water supply improvements for the next 50 years (from the regular neighbourhoods and the informal settlements) adds to approximately $6 billion Mexican pesos. This is a significant amount of money considering that the government has stated that there is lack of funding to conduct large water supply improvements.

Most participants of both surveys think that the CEA and the government of the State of Queretaro are able to provide the necessary water supply improvements to the city. The participants stated that the government has the resources, the staff and the experience to provide adequate water supply services to Queretaro. This idea is also supported by the fact that most of participants did not want a private company or companies to manage Queretaro's water resources.

About 87% of the participants from connected houses said that they would like to pay for the water supply improvements through the CEA's water utility bill. Only 12% of the participants stated that they would like an increase in taxes. Therefore, it may be more consistent with residents' preferences to charge them directly in the water bill instead of increasing any kind of tax. In addition, this payment method also makes people feel that they are being charged for the amount of water they consume. In the case of participants from informal settlements, about 95% of these residents stated that they would also like to be charged in a monthly water utility bill for having a private connection, their consumption of water and the improvements to the water supply service.

2. Final conclusions

The contingent valuation surveys conducted in Queretaro and the analysis presented in this thesis provide useful insights about the potential benefits from better residential water supply services. Through two in-person surveys it was possible to know that Queretaro's residents from regular neighbourhoods and the informal settlements are willing to pay for having water supply improvements.

The scenarios presented in both surveys offered to participants improvements in their households' water availability and quality. In the case of the regular neighbourhoods, most participants have adequate water availability but they do not trust in the quality of the tap water. Therefore, their WTP for the improvements might be more affected by preferences related to the need for better water quality.

On the other hand, residents from the informal settlements do not have adequate water availability or quality. Therefore, it is difficult to tell which dimension of the water problem is affecting more the preferences of the participants from the informal settlements. It is possible to speculate that the quality of drinking water might be the most relevant element in participants' WTP for the improvements because people's health and life expectations depend on this factor. However, in the analysis conducted for the informal settlements it was not possible to find a clear relation between health concerns and the WTP for the improvements. A more accurate analysis of the relationship between health, water quality and preferences for having water supply improvements is left for future research.

One limitation of the research on connected houses is the lack of accurate data on the water consumption levels in Queretaro's households. Therefore, for future research it is advisable to compare the WTP for improvements in residential water supply services with accurate and detailed data on household water consumption. The surveys conducted in this thesis demonstrated that there are different levels of water consumption in Queretaro's households. By comparing the WTP for water improvements with accurate data of the consumption levels of these households it might be possible to build pricing policies that reflect the demand for water and that promote an adequate use of the water resources.

Another element to further investigate is the use of economic instruments to promote the conservation of Queretaro's water resources. Since the aquifer of the Valley of Queretaro is running out of water, it is recommended that a study be conducted on the economic incentives or instruments that can be used to support the conservation of water resources. The survey for connected houses included a section that collected information on residents' WTP for preserving Queretaro's aquifer. The analysis of this section is left for future research and it will complement the results of this thesis to promote policies and programs that provide the highest benefit at the lowest feasible cost to Queretaro's residents.

It is also important to further analyze the effects of the current tariff structure of Queretaro's residential water supply services. Boland and

Whittington (2000) made a revision of the tariff structures of the residential water supply services in developing countries and found that an increasing block tariff structure might produce an unequal distribution of the benefits derived from piped water services. According to these authors, poor people in developing countries might be paying more per cubic meter of water for their households than people with high income levels. This is provoked by the structure of the households in developing countries and the arrangement of the increasing block tariffs. Therefore, it would be beneficial to revise the effects of Queretaro's current tariff structure on the distribution of the benefits derived from water.

The CV method is a useful approach for estimating the economic benefits derived from water. However, the information provided by this thesis can be complemented with more research on the economic benefits derived from water. Young (2004) presents a description of inductive and deductive nonmarket water valuation methods for water resources that can be used to complement the welfare estimates of the CV method. Overall, this thesis is a point of reference for future studies of the demand for water in Queretaro and other parts of Latin America. The design of policies and programs to provide water supply improvements requires more research that analyzes what residents need and prefer in terms of residential water supply services.

3. Policy Recommendations

In order to improve Queretaro's water supply service, the researcher has developed the following eight recommendations:

1. It is advisable to conduct a complete cost-benefit analysis of the projects that the CEA, the municipal government and the government of the State of Queretaro are planning to do to improve the water supply services. In this thesis, it was shown that the present value of the possible cash flows derived from the residents' willingness to pay for the water supply improvements outweighs significantly the investment or financial costs of one of the main projects proposed by the government. However, it is recommended that a more complete cost-benefit analysis (CBA) be conducted. The CBA should take into account all the possible benefits and costs from the projects that provide exactly the water service improvements described in the surveys. In the case of projects such as "El Infiernillo" it is needed to include environmental costs of extracting water from springs in the middle of the Queretaro's mountains and building a pipeline that might cross through fragile ecosystems. In addition, providing water to the city not only generates a benefit for residential users but also for the industry and the commerce sectors. Comparing all the benefits and costs will provide an idea of which projects are more feasible to undertake.
2. Queretaro's residents want that there is water available for future generations. Therefore, it is necessary that any project of water supply improvements is planned for the long term and that provides the highest possible benefit at the lowest feasible cost.
3. Further research is also needed to better understand people's preferences for water supply improvements across time. In this thesis, the estimates presented are just for a single point in time and they assume that

preferences will remain constant. However, it will be useful to understand people's preferences after the water supply improvements are implemented. A survey of panel data where individuals' water expenditures and WTP for water are surveyed over time will provide very useful insight into how people's preferences and benefits evolve.

4. Queretaro needs pricing policies that are in accordance with the residents' demand for water. The survey presents estimates of the willingness to pay for water supply improvements. This information can be used to design pricing policies that may enable the collection of the finances necessary for the water supply improvements.
5. The solution to Queretaro's and Mexico's water problems requires a team work of professionals from different disciplines. Water involves environmental, economic, social, political and cultural components. All of these factors need to be taken into account when building solutions to Queretaro's problems. The current situation of the water resources in the city requires that engineers, public managers, anthropologists, economists and all the professionals involved in the management of water resources work together.
6. There is also a need for true commitment from both the government authorities and the residents of Queretaro to make an adequate use of the water resources. Implementing water supply improvements and charging people for them is a hard task if the government has low credibility. Government authorities need to remember that what is at stake is the sustainability of the city and situations such as corruption or favouring

privileged minorities will not help to solve Queretaro's water problems. On the other side, residents also need to be informed that the water resources are becoming very scarce and that they need to take care of the water that is available. Residents from Queretaro cannot expect that the government authorities can take all the necessary actions to guarantee the water supply. The residents are important stakeholders and should be part of any effort that is needed to solve Queretaro's water problems.

7. The whole society of Queretaro needs to work together for the sustainable development of the city. The informal settlements need to be considered as an important part of Queretaro. Therefore, it is also recommendable that a legal and institutional framework be developed that solves the lack of housing and spaces for poor people in Queretaro. If this is not done, the current situation of the informal settlements and their residents could become even more critical.
8. The development of water supply improvements could be another engine of Queretaro's growing economy. The proposed improvements will be a large infrastructure project that will take a number of years to complete. The project is expected to have a significant multiplier effect considering the number of employment hours that will be necessary. Furthermore, if local residents are involved in the overall the water supply improvements the process could increase social cohesion between the different neighbourhoods. The project could also be an exercise of local capacity building if neighbourhood residents are provided with jobs. The overall effect would be to increase the social welfare of all Queretarians.

This thesis showed that Queretaro's residents put a significant value in the city's water resources. As in other parts of the world, Queretaro needs an ongoing careful analysis of the demand for water to guarantee that water resources are used in accordance with people's preferences.

References

Altaf, M.A., D. Whittington, H. Jamal, and K.V. Smith. "Rethinking Rural Water Supply Policy in the Punjab, Pakistan." *Water Resources Research* 29 (1993):1943-54.

Arrow, K., R. Solow, P.R. Portney, E.E. Leamer, R. Radner, and H. Schuman. *Report of the NOAA Panel on Contingent Valuation* U.S. National Oceanographic and Atmospheric Administration, 1993.

Bank of Canada. "Exchange rates." http://www.bankofcanada.ca. Ottawa: 2006.

Boardman, A.E., D.H. Greenberg, A.R. Vining and D.L. Weimer. *Cost-benefit analysis: concepts and practice.* 2nd ed. New Jersey: Prentice Hall, 2001.

Boland, J.J., and D. Whittington "The Political Economy of Water Tariff Design in Developing Countries: Increasing Tariffs versus Uniform Price with Rebate." *The Political Economy of Water.* A. Dinar, ed. pp. 215-235. Washington, D.C.: The International Bank for Reconstruction and Development; The World Bank, 2000.

Briscoe, J., Furtado de Castro, Paulo, C. Griffin, J. North, and O. Olsen. "Toward Equitable and Sustainable Rural Water Supplies: A Contingent Valuation Study in Brazil." *World Bank Economic Review* 4 (1990):115-34.

Briseño, J.V. "Metodologia para Realizar Evaluaciones de Impacto Ambiental para Acuiferos Sobre explotados." MS thesis, Instituto Politecnico Nacional, 2004.

Campero, L.A. "Sera eje hidraulico de 108 kilometros, desde El Infiernillo." http://www.oem.com.mx/diariodequeretaro/. *Diario de Queretaro,* Queretaro: Organizacion Editorial Mexicana, April 8th, 2006.

Champ, P.A., K.J. Boyle, and T.C. Brown. *A Primer on Nonmarket Valuation,* 1st ed. pp. 576. Dordrecht: Kluwer Academic Publishers, 2003.

Champ, P.A., Bishop, R.C., Brown T.C. and McCollum, D.W. "Using Donation Mechanisms to Value Nonuse Benefits from Public Goods." *Journal of Environmental Economics and Management* 33 (1997): 151-62.

Comision Estatal de Aguas (CEA). "Agua potable: Servicios de la CEA," http://www.ceaqueretaro.gob.mx. Queretaro: 2006.

———"Acuerdo Tarifario." Santiago de Queretaro: 2002.

———"Plan Hidraulico del Estado de Queretaro: I. Agua Potable y Saneamiento." Queretaro: 1999.

Comision Nacional del Agua, and Comite Tecnico de Aguas Subterraneas del Acuifero de Queretaro. *Plan de Manejo Integrado del Agua del en el Area de Influencia del Acuifero de Valle de Queretaro, Qro.* Queretaro: 2002.

Comision para la Regularizacion de la Tenencia de la Tierra. "Origen de CORETT." http://www.corett.gob.mx/main.htm. Mexico: Secretaria de Desarrollo Social, 2006.

Consejo Nacional de Poblacion (CONAPO). "Indicadores demograficos basicos." http://www.conapo.gob.mx. Mexico: 2006a.

———"Proyecciones de la Población de México 2000-2050." http://www.conapo.gob.mx. Mexico: 2006b.

Cummings, R.G., and L.O. Taylor. "Unbiased Value Estimates for Environmental Goods: A Cheap Talk Design for the Contingent Valuation Method." *American Economic Review* 89 (1999):649-65.

Diario de Queretaro. "Faltan 533 litros de agua por segundo en la ciudad." *Diario de Queretaro.* Queretaro: Organizacion Editorial Mexicana, January 10th, 2005.

Freeman, A.M. *The measurement of environmental and resource values: theory and methods.* 2nd ed. Washington, D.C.: Resources for the Future, 2003.

Gleick, P.H. "Basic Water Requirements for Human Activities: Meeting Basic Needs." *Water International* 21 (1996):83-92.

Gobierno del Estado de Queretaro, "Queretaro, come and love it", Queretaro: Secretaria de Turismo, 2006 in http://www.venaqueretaro.com.

Goldblatt, M. "Assessing the effective demand for improved water supplies in informal settlements: a willingness to pay survey in Vlakfontein and Finetown, Johannesburg." *Geoforum* 30 (1999):27-41.

Gonzalez, A. "Pagaran empresas 2% sobre la nomina; va a agua y vialidad." *Diario de Queretaro*. Queretaro: Organización Editorial Mexicana, December 1st, 2000.

Grafton, R.Q., W. Adamowicz, D. Dupont, H. Nelson, R.J. Hill, and S. Renzetti. *The Economics of the Environment and Natural Resources*, 1st ed. Oxford: Blackwell Publishing, 2004.

Greene, W.H. *Econometric Analysis*, 2nd ed. New York: Macmillan Publishing Company, 1993.

Haab, T.C., and K.E. McConnell. *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation*. Cheltenham: Edward Elgar Publishing, 2003.

Hanemann, M.W. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Reply." *American Journal of Agricultural Economics* 71 (1989):1057-61.

Howard, G. and J. Batram. "Domestic Water Quantity: Service, Level and Health." Geneva: United Nations World Health Organization, 2003.

Instituto Nacional de Geografia, Estadistica e Informatica (INEGI). "II Conteo de Población y Vivienda 2005," http://www.inegi.gob.mx. Aguascalientes: 2006a.

———"Indicadores Economicos de Coyuntura." http://www.inegi.gob.mx. Aguascalientes: 2006b.

———*Sistema de Consulta para la Informacion Censal (SCINCE) por colonias.* Aguascalientes: 2001.

———"Sistema de Cuentas Nacionales Mexico." http://www.inegi.gob.mx. Aguascalientes: 2006c.

Montes de Oca, G.S., Bateman, I.J., Tinch, R. and P.G. Moffat. "Assessing the Willingness to Pay for Maintained and Improved Water Supplies in Mexico City." Working paper, Centre for Social and Economic Research on the Global Environment, University of East Anglia. Norwich: 2006.

Municipio de Queretaro. *Municipal Economic Yearbook 2005*. http://www.municipiodequeretaro.gob.mx. Queretaro: 2005.

Negrete, A.A. "Niveles de bombeo de las Aguas Subterraneas en el Valle de Queretaro: Historial y Pronostico." *Diario de Queretaro.* Queretaro: Organización Editorial Mexicana, 2000.

Nunes, P.A.L.D. and Schokkaert, E. "Identifying the warm glow effect in contingent valuation." *Journal of Environmental Economics and Management* 45 (2003): 231-245.

Perrusquia, G. *Sistemas Acuaticos Sustentables: Esutdio para la Ciudad de Queretaro y sus alrededores.* Queretaro: University of Chalmers; Consejo de Ciencia y Tecnologia del Estado de Queretaro; Universidad Autonoma de Queretaro; Instituto Tecnologico de Monterrey, 2003.

Raje, R.C., Dhobe, P.S., and Desphande, A.W. "Consumer's willingness to pay for more municipal supplied water: A case study. *Ecological Economics* 42 (2002):391-400.

Ramirez, C. "Llegara Agua a 7 de 10: Alrededor de 670 mil habitantes de la ciudad tienen diario un servicio regular de 17 a 24 horas de agua." *Periodico am.* Queretaro: February 9th, 2005.

Revenga, C. *Will There Be Enough Water?*, 1st ed. pp. 5. Washington: World Resources Institute, 2000.

Siembieda, W.J., and E. Lopez. "Expanding Housing Choices for the Sector Popular: Strategies for Mexico." *Housing Policy Debate* 8 (1997):651-77.

StataCorp Lp, *Stata 9.2*, College Station: 2006.

Thompson, G.D., and P.N. Wilson. "Ejido Reforms in Mexico: Conceptual Issues and Potential Outcomes." *Land Economics* 70 (1994):448-65.

United Nations Educational, Scientific and Cultural Organization (UNESCO), Division of Water. Sciences *Water for People, Water for Life-UN World Water Development Report (WWDR)*, 1st ed. pp. 576. Paris: UNESCO Publishing and Berghan Books, 2003.

United Nations Development Programme (UNDP). *Human Development Report.* New York: UNDP, 2005.

Universidad Autonoma de Queretaro and Comision Estatal de Aguas (CEA). *Estudio Integral del Recurso Agua en los Acuiferos del estado de Queretaro.* Queretaro: 2002.

Walker, I., Ordoñez, F., Serrano, P., Halpern, J. "Pricing Subsidies and the Poor: Demand for Improved Water Services in Central America." Working Paper, The World Bank. Washington, D.C.: 2000.

Ward, P., and E. Jimenez. "Residential land price changes in Mexican cities and the affordability of land for low income groups." *Urban Studies* 30 (1993):1521-43.

Whittington, D. "Improving the Performance of Contingent Valuation Studies in Developing Countries." *Environmental and Resource Economics* 22 (2002):323-67.

Whittington, D., D.T. Lauria, and X. Mu "A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria." *World Development* 19 (1991):179-98.

Whittington, D., J. Briscoe, and X. Mu. "Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of the Use of Contingent Valuation Surveys in Southern Haiti." *Economic Development and Cultural Change* 38 (1990):293-311.

Whittington, D., S.K. Pattanayak, J. Yang, and K.C. Bal Kumar. "Household demand for improved piped water services: evidence from Katmandu, Nepal." *Water policy* 4 (2002):531-56.

Young, R.A. *Determining the Economic Value of Water: Concepts and Methods*, 1st. ed. Washington, D.C.: Resources for the Future, 2004.

———*Measuring Economic Benefits for Water Investments and Policies.* Washington, D.C.: The World Bank, 1996.

Appendix A

Descriptive statistics and tables of the survey for connected houses

1. General statistics of survey administration

Approximate number of households visited:	**2500**
Number of households where people not at home:	**1315**
Number of surveys:	**629**
Number of households that did not want to participate:	**554**
Rate of participation:	**53%**
Number of enumerated neighborhoods:	**61**
Number of enumerators employed:	**13**
Average time used for each survey:	**19**
Dates of survey administration:	**June 18th to July 21st, 2005**

2. Participants socio-economic characteristics

2.1 Individual characteristics

i. Age

Mean	Standard Deviation	Median	Minimum	Maximum
41.33 years	15 years	39 years	16 years	87 years

ii. Gender: Female 69.79%, Male 30.21%.

iii. Marital status

	Percentage of participants
Single	17.81%
Married	69.16%
Free union	4.13%
Divorced	2.38%
Separated	2.38%
Widowed	4.13%

iv. Individual level of education

Level of Education	Percentage of participants with the level of education
None	8.74%
Kindergarten	1.11%
Elementary School	21.46%
Junior High	24.01%
Highschool	15.26%
Technical or commercial career	9.86%
Undergraduate degree	16.22%
Graduate degree	2.7%

v. Occupation and jobs

Occupation	Percentage of respondents
Housewife	42.93%
Self-employed without workers	18.92%
Wage earner	17.49%
Retired	6.84%
Labourer or employee	5.41%
Student	4.93%
Employer	1.43%
Unemployed	1.27%
Others	0.18%

Number of Jobs (occupied people)				
Mean	Standard Deviation	Median	Minimum	Maximum
1.14	0.459	1	1	4

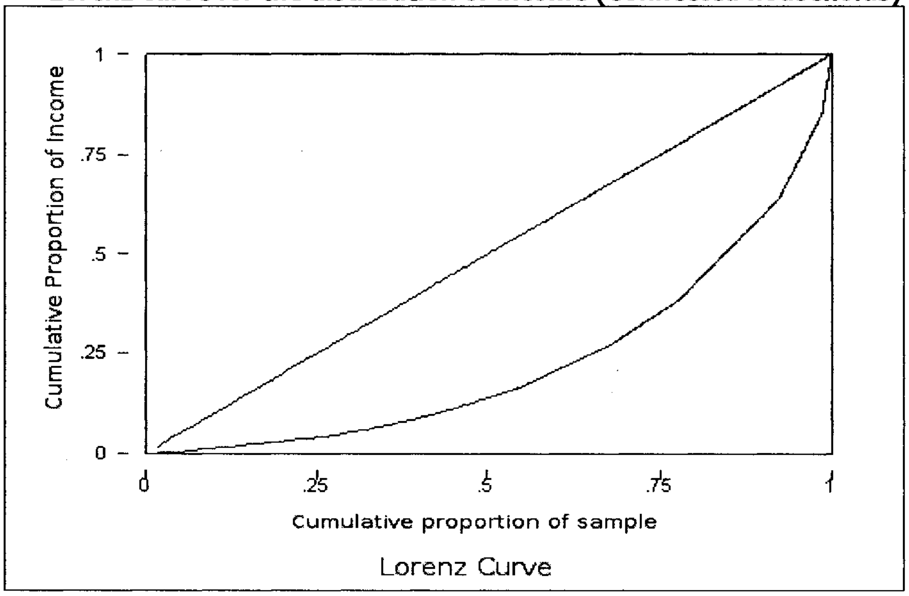
vi. Individual income

Level of income	Percent
0 to 1300 pesos	14.94%
1301 to 2600 pesos	20.99%
2601 to 5000 pesos	25.60%
5001 to 6600 pesos	11.13%
6601 to 10000 pesos	11.29%
10001 to 15000 pesos	6.04%
15001 to 20000 pesos	3.97%
20001 to 25000 pesos	1.91%
25001 to 50000 pesos	3.66%
More than 50000 pesos	0.48%

Level of income (Mexican Pesos)[a]				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
6670.69	9012.96	650	3800.50	75000

[a] Estimated statistics at the median levels of the ranges reported.

Lorenz curve for the distribution of income (Connected households)



2.2 Household characteristics

i. Composition of the households

People living in the household				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
5.11	2.54	5	1	20

People of the nuclear family living in the household				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
4.3	1.86	4	1	15

Number of children living in the household				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
1.61	1.52	1	0	9

ii. Size of the houses

Number of rooms in the household				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
6.13	2.64	6	1	26

v. Type of house property

Type of household ownership	Percentage of households
Self-owned and completely paid	74.4%
Rented	11.76%
Self-owned and paying it	8.11%
Lent	5.25%
Other	0.8%

vi. Number of cars available for transportation

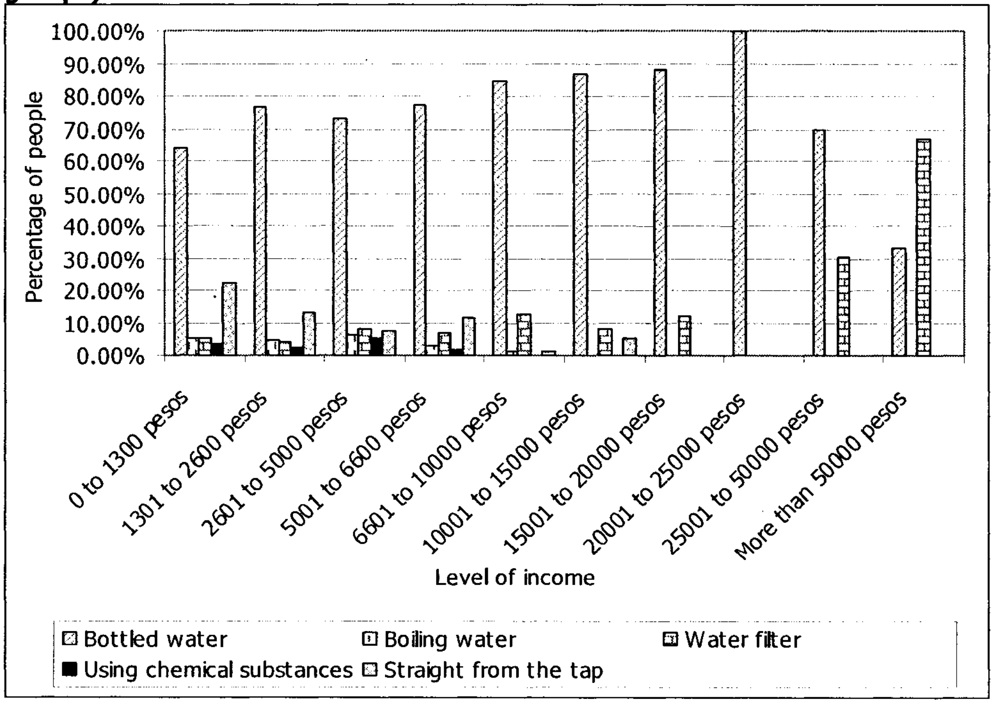
Do the people living in the household own a car?	Percentage of households
No	33.55%
Yes	66.45%

3. Sources of water for the household and water expenditures

i. Monthly expenditure on water utility bill

Monthly expenditure on water utility bill (Mexican Pesos)				
Mean	Standard Deviation	Median	Minimum	Maximum
151.17	174.71	100	0	2500

ii. Percentage of people using each source of drinking water (by income groups)



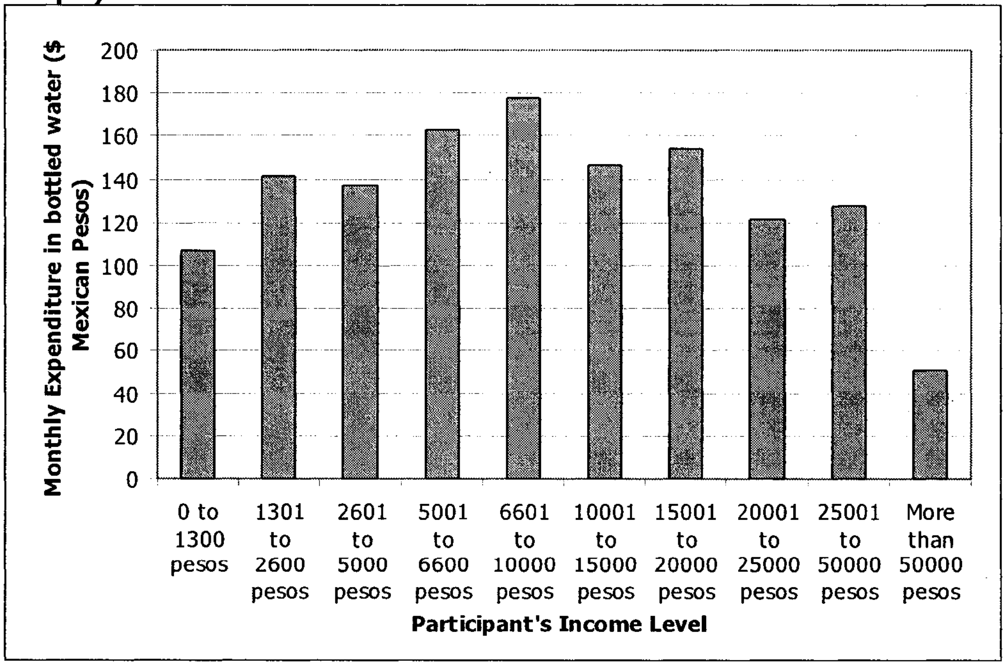
iv. Expenditures in bottled water

Number of bottles of water (20 litres) bought every week (includes people that do not buy bottled water)				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
2.03	1.75	2	0	12

Average price of water bottles of 20 litres				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
17.39	1.91	18	6	25

Monthly expenditure on bottled water (Mexican Pesos, includes people that do not buy bottled water)				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
141.13	122.05	144	0	720

Average monthly expenditure on bottled Water (by income groups, whole sample)



4. Water availability for the household.

i. Occurrence of Water Cut-Offs

Percentage of participants with water cut-Offs

Number of days in a regular week with water cut-offs	**Percentage of participants**
0	45.06%
1	6.53%
2	10.05%
3	9.21%
4	2.68%
5	2.51%
6	0.34%
7	23.62%
Observations	597

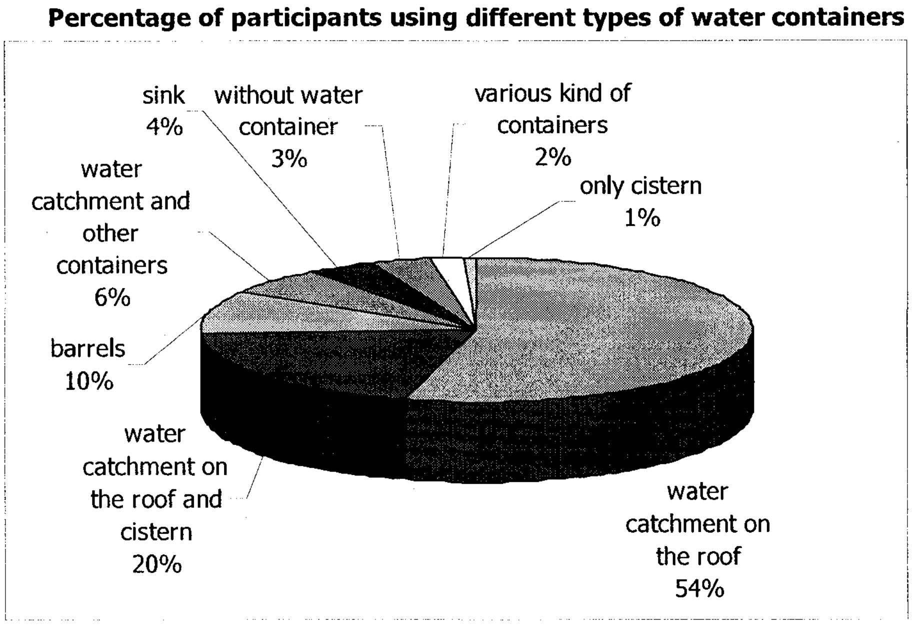
Number of days in a regular Week with water cut-Offs					
Observations	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
597	2.45	2.84	5	0	7

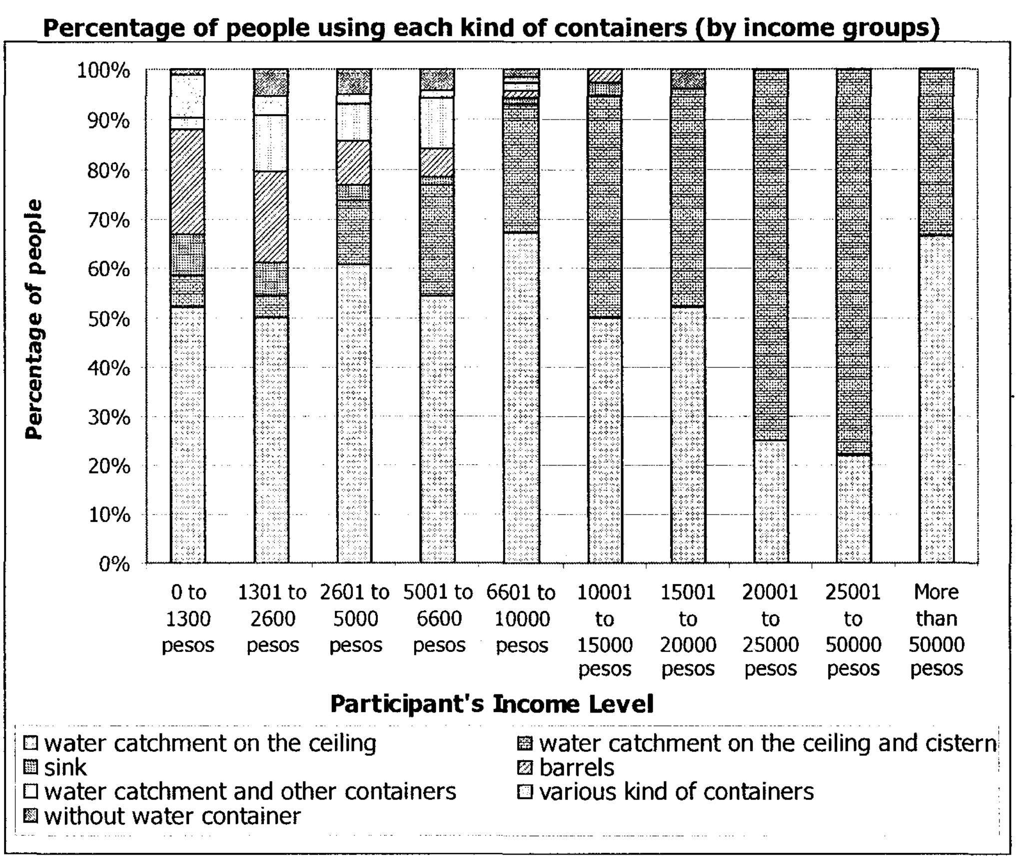
Moment of the day when water cut-offs occur

Moment of the day when they have the water cut-offs	Percentage of participants
Morning	20.12%
Noon	14.33%
Afternoon	19.82%
Day-light time	26.52%
Night	3.35%
Almost full day without water	4.88%
other times	2.44%
afternoon and night	3.96%
don't know/not sure	4.57%
Observations	328

Number of Hours that the water cut-offs usually last					
Observations	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
295	11.76	6.18	12	1	24

ii. Kinds of tanks or containers used in the households to store water

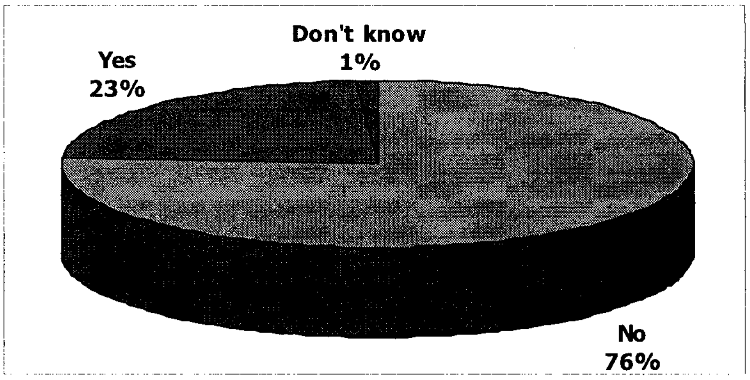




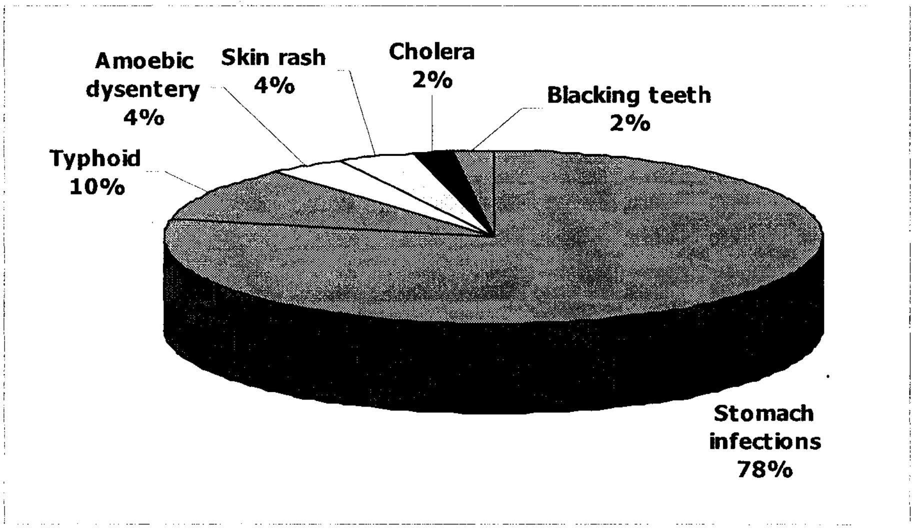
5. Water quality

i. People's water quality perceptions

Do they think that water straight from the tap is good for drinking?



Kinds of diseases for drinking water straight from the tap (percentage of participants that got sick)



6. Satisfaction levels with the current water supply service

Reasons for their current satisfaction level with the water supply service (percentage of participants that stated each reason)

Reasons stated by participant	**Percentage of respondents**	**Satisfaction Level**
There is no lack of water and/or it is enough with the amount they are supplied	55.25%	Satisfied or somewhat satisfied
The service is good and they have not had any problems	4.3%	
There is no lack of water and the water is of good quality	2.87%	
Water is of good quality	0.8%	
They are not completely satisfied because of several reasons	6.05%	
There is lack of water, it is not enough with the amount they are supplied	22.45	Unsatisfied
Water is not clean or it is of bad quality	2.55	
Water is too expensive	2.39	
They lack of water and water is not of good quality	1.75	
The service needs to be improved (several aspects of it)	1.59	

7. WTP for water supply improvements (estimation results and specifications of the WTP logit models)

Specification 2 of the WTP logit model for connected houses (demographic variables)

	Coefficients[a]	**Mean Values**	**Marginal effects**
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.642* (2.89)		
Bid level	-0.005* (-9.60)	251.48	-0.001
Number of children living in the household	0.167* (2.49)	1.62	0.041
Age	-0.021* (-2.92)	41.25	-0.005
Education	0.025 (1.17)	10.56	0.006
Gender (1=female)	-0.115 (-0.51)	0.698	-0.028
Married (1=married)	-0.188 (-0.92)	0.692	-0.046
Job (1=have a job)	0.159 (0.80)	0.483	0.039
Income (median)	0.000049* (3.15)	6676.66	0.00001
Obs.	627		
Log-likelihood	-351.32		
Restricted Log-likelihood	160.60		
P-value chisquare (d.f.=8)	0.00		
Pseudo r^2	0.186		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically signicant at the 90% confidence level.

Specification 2-A of the WTP logit model for connected houses (interaction effects of bid levels and demographic variables)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	0.678** (1.97)		
Bid level	-0.003*** (-1.74)	251.56	-0.007
Bid level & gender(1=female)	-0.001 (-1.35)	176.29	-0.002
Bid level & age	-0.00005** (-2.16)	10357.1	-0.00001
Bid level & marital status (1=married)	-0.0007 (-0.98)	178.77	-0.0001
Bid level & education	0.0001 (1.45)	2669.35	0.00002
Number of children living in the household	0.088 (1.05)	1.62	0.022
Number of people living in the household	0.09*** (1.79)	5.11	0.022
Job (Participant having a job=1)	0.31 (1.46)	0.48	-0.076
Property (Participant owning the property=1)	-0.318 (-1.27)	0.82	-0.077
Income*housewive	0.00004*** (1.77)	2321.66	0.00001
Income	0.00003** (2.16)	6686.29	8.61e-06
Obs.	626		
Log-likelihood	-350.18		
Restricted Log-likelihood	161.69		
P-value chisquare (d.f.=11)	0.00		
Pseudo r^2	0.187		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 90% confidence level.

Specification 3 of the WTP logit model for connected houses (water supply service perceptions)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.22* (3.43)		
Bid level	-0.0049* (-9.44)	249.88	-0.001
Consumption and expenditure			
Household's monthly expenditure in water utility bill	0.0014** (2.08)	150.77	0.0003
Household's monthly expenditure in bottled drinking water	0.0017** (2.28)	141.97	0.0004
Number of toilets in the household	0.232** (2.02)	1.64	0.057
Availability of water pumping system 1=availability of pump, cistern and water tank	0.379 (1.33)	0.187	0.091
Satisfaction and concerns about water			
Satisfaction level with current water supply service 1=satisfied with the water supply service	-0.70** (-2.35)	0.877	-0.163
Opinion about tap water for drinking 1=Tap water is good for drinking	-0.33 (-1.51)	0.232	-0.083
People sick in the household because of drinking water 1=Somebody has been sick by drinking tap water	0.19 (0.57)	0.082	0.046
Obs.	620		
Log-likelihood	-352.65		
Restricted Log-likelihood	147.58		
P-value chisquare (d.f.=8)	0.00		
Pseudo r^2	0.173		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically signicant at the 95% confidence level.

Appendix B

Descriptive statistics and tables of the survey for non-connected houses

1. General statistics of survey administration

Approximate number of households visited:	**471**
Number of households where people not at home:	**204**
Number of surveys:	**202**
Number of households that did not want to participate:	**65**
Rate of participation:	**75.6%**
Number of enumerated neighborhoods:	**28**
Number of enumerators employed:	**8**
Average time used for each survey:	**16.1 minutes**
Dates of survey administration:	**July 22nd-July 30th, 2005**

2. Participants socio-economic characteristics

2.1 Individual characteristics

i. Age

Mean	Standard Deviation	Median	Minimum	Maximum
35.3 years	12.14 years	32 years	16 years	78 years

ii. Gender: Female 78.22%, Male 21.78%.

iii. Marital status

	Percentage of participants
Single	9.41%
Married	67.82%
Living with a partner	16.34%
Divorced	0.99%
Separated	2.48%
Widowed	2.97%

iv. Participants' number of jobs

Number of Jobs				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
0.4	0.58	0	0	4

v. Individual income

Level of income	Percentage of participants
0 to 1300 pesos	30.2%
1301 to 2600 pesos	27.7%
2601 to 4000 pesos	24.2%
4001 to 5300 pesos	9.9%
5301 to 6600 pesos	3.9%
6601 to 8000 pesos	2.4%
8001 to 9250 pesos	0.5%
9251 to 10600 pesos	0.99%

Level of Income (Mexican Pesos)[a]				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
2562.35	1881.40	2300.50	650	9925.5

[a] Estimated statistics at the median levels of the ranges reported.

2.2 Household characteristics

i. Composition of the households

People living in the household				
Mean	Standard Deviation	Median	Minimum	Maximum
5.28	2.75	5	1	20

People of the nuclear family living in the household				
Mean	Standard Deviation	Median	Minimum	Maximum
4.46	1.62	4	1	10

Number of children living in the household				
Mean	Standard Deviation	Median	Minimum	Maximum
2.5	1.92	2	0	12

ii. Utility services in the households

Average expenditure in electricity				
Mean	Standard Deviation	Median	Minimum	Maximum
179.38	230.87	135	0	2000

iii. Size of the houses

Number of rooms in the household				
Mean	Standard Deviation	Median	Minimum	Maximum
3.86	1.82	4	1	10

iv. Type of house ownership

Type of Household Ownership	Percentage of households
self-owned and totally paid	79.9%
self-owned and currently paying	6.03%
lent	8.54%
rented	5.53%

v. Total number of people working in the household

Total number of people working household				
Mean	Standard Deviation	Median	Minimum	Maximum
1.56	0.97	1	0	5

vi. Vehicles available for transportation

Do the people living in the household own one or more vehicles for transportation?	Percentage of households
Yes	44.9%
No	55.1%

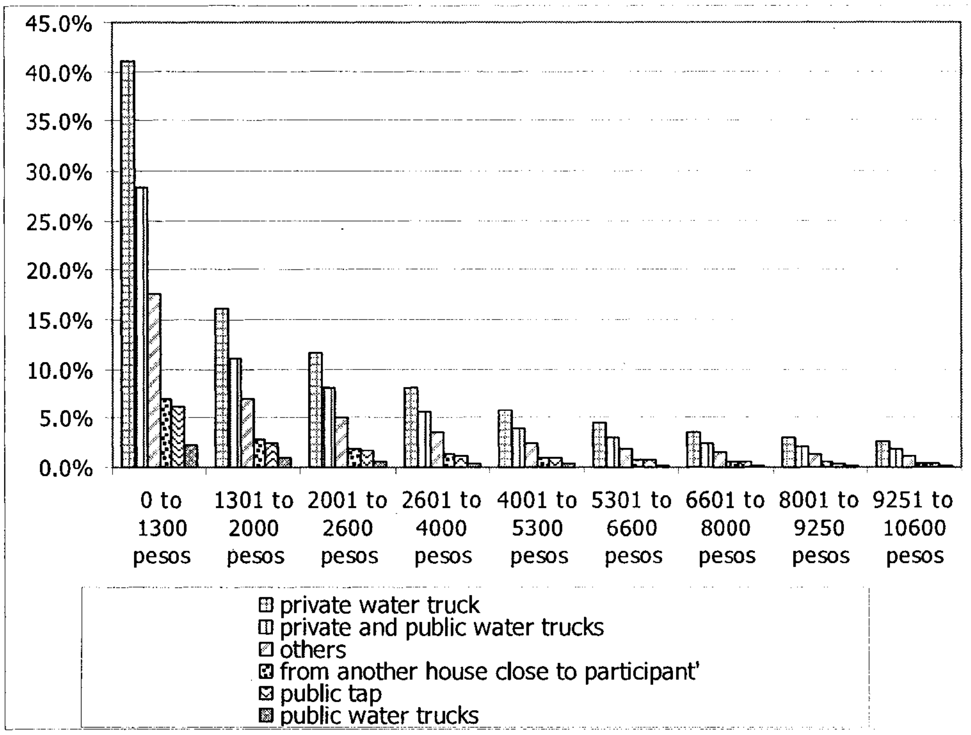
Percentage of households owning one or more bicycles	Percentage of households owning one or more cars
20.3%	31.2%

3. Sources of water for the household and water expenditures

i. Monthly expenditure in water for domestic use

Monthly expenditure on water utility bill (Mexican Pesos)				
Mean	Standard Deviation	Median	Minimum	Maximum
126.68	140.02	60	0	800

ii. Monthly expenditure in water for households as a percentage of the average income level

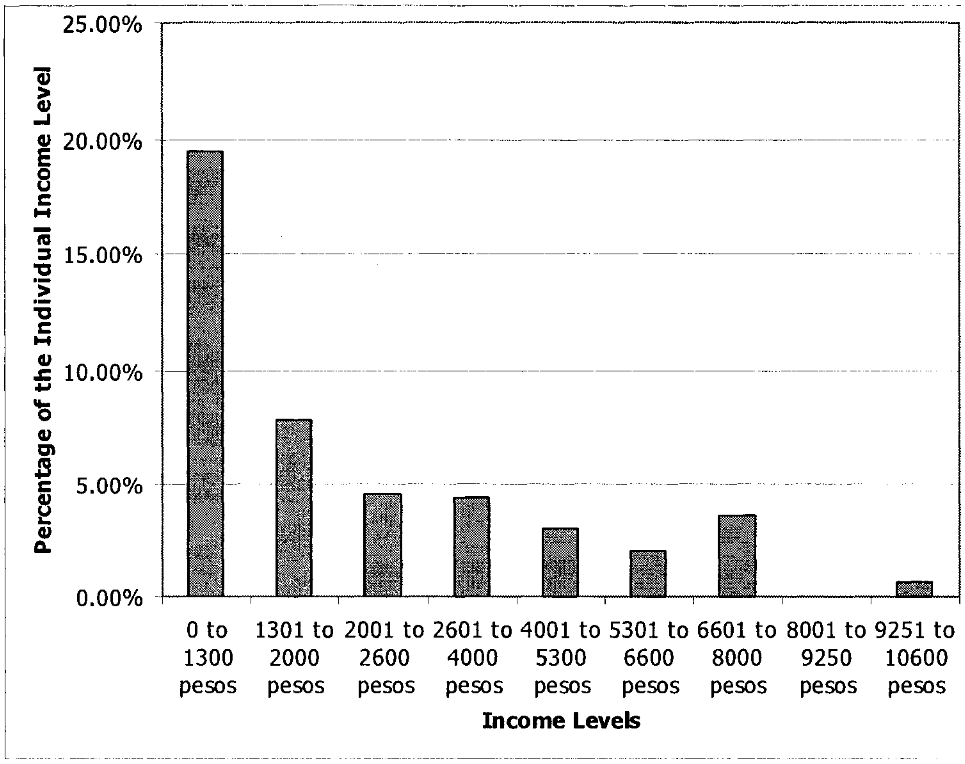


iii. Expenditures in bottled water

Number of bottles of water (20 liters) bought every week (includes people that do not buy bottled water)				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
1.95	1.78	2	0	10

Monthly expenditure on bottled water (Mexican Pesos, includes people that do not buy bottled water)				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
131.93	122.18	144	0	648

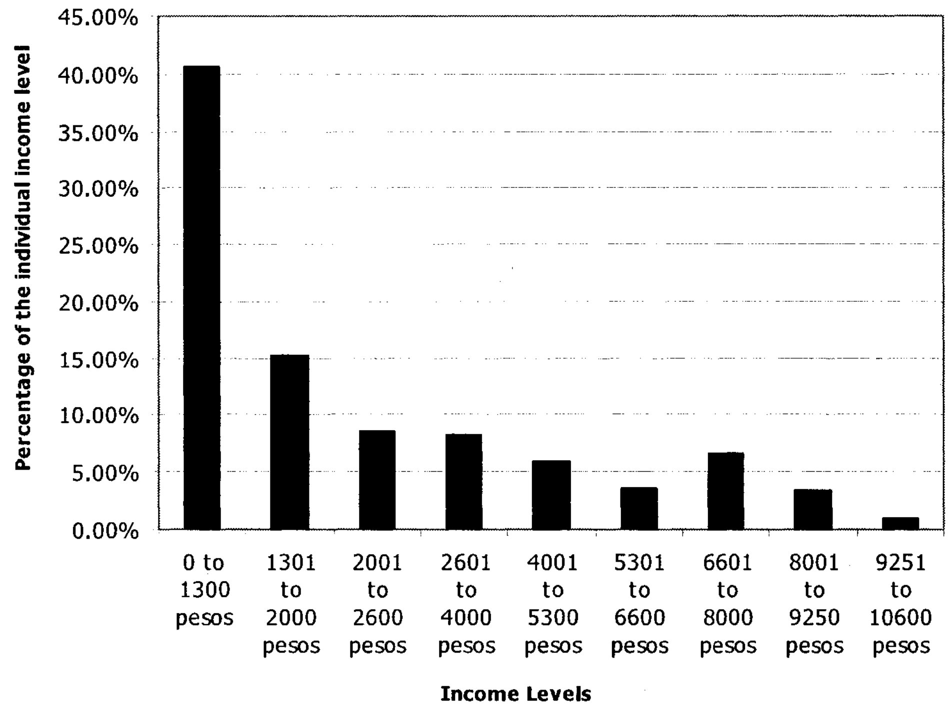
Average Monthly Expenditure on Bottled Water as a percentage of income (by income groups, whole sample)



iv. Total Expenditure in water

Total monthly expenditure on water (Mexican Pesos, includes people that do not buy bottled water)				
Mean	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
258.61	206.63	226	0	1032

Average Total Monthly Expenditure in Water as a percentage of income (by income groups)



4. Water availability for the household.

i. Number of days per week without water

Number of days in a regular week with water cut-offs					
Observations	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
202	0.91	1.55	0	0	6

ii. Amount of water available per person per day

Number of barrels bought in a regular week (people that only store water in barrels)					
Observations	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Maximum**
115	4.76	2.25	4	1	12

Amount of water available per person per day (people that only store water in barrels, not counting drinking water)					
Observations	**Mean l/p/day[a]**	**Standard Deviation l/p/day**	**Median l/p/day**	**Minimum l/p/day**	**Maximum l/p/day**
115	32.20	24.36	28.57	4.08	171.43

[a] litres per person per day

Amount of water available per person per day (people that only store water in barrels)					
Observations	**Mean l/p/day[a]**	**Standard Deviation l/p/day**	**Median l/p/day**	**Minimum l/p/day**	**Maximum l/p/day**
115	33.34	24.55	28.57	4.08	171.43

[a] litres per person per day

5. Water quality

i. People's water quality perceptions

Why do participants think that water is not good enough for drinking?

Reason	**Percentage of respondents**
It is dirty or gets polluted while it is distributed	52.63%
It has some flavor or smell he does not like	15.79%
They have gotten sick or think that the water has pathogen organisms	11.70%
They do not know where do they bring it from or do not have confidence on the water	8.19%
They are not used not to drink straight from the main source	4.09%
It has minerals that could be harmful	3.51%
It gets polluted while it is distributed and it has many minerals	1.75%
It has some color and harmful minerals	1.17%
It is dirty and has a flavor or smell he does not like	1.17%

6. Satisfaction levels with the current water supply service

Reasons for their current satisfaction level with the water supply service (percentage of participants that stated each reason)

Reasons for the satisfaction levels	**Percentage of participants**	**Satisfaction level**
They have enough water to cover their needs	30.20%	Satisfied
They used to buy water from water trucks and now they have a public tap	2.97%	
Although they are quite satisfied, they would like to have their own water connection	1.98%	
Water is good enough for drinking	0.99%	
They do not have enough water to cover their needs	17.82%	Unsatisfied
They are unsatisfied because they do not have their own water connection	20.30%	
Water is not clean and make people sick	2.97%	
They are not happy with the current water supply service for several reasons	14.85%	
Water is very expensive	7.92%	

7. WTP for water supply improvements (estimation results)

Specification 2 of the WTP logit model for non-connected houses (demographic variables)

	Coefficients[a]	**Mean Values**	**Marginal effects**
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.564*** (1.65)		
Bid level	-0.004* (-4.61)	296.04	-0.0009
Number of people living in the household	0.104*** (1.65)	5.28	0.253
Age	-0.019 (-1.43)	35.30	-0.004
Gender (1=female)	-0.093 (-0.23)	0.78	-0.022
Married (1=married)	-0.141 (-0.42)	0.67	-0.034
Income (median)	0.001 (1.48)	2562.35	0.00003
Obs.	202		
Log-likelihood	-122.03		
Restricted Log-likelihood	30.86		
P-value chisquare (d.f.=6)	0.00		
Pseudo R2	0.11		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically signicant at the 90% confidence level.

Specifications 2-A of the WTP logit model for non-connected houses (interaction effects of bid levels and demographic variables)

	Coefficients[a]	**Mean Values**	**Marginal effects**
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	1.523*** (1.88)		
Bid level	-0.002 (-1.57)	296.04	-0.006
Bid level & marital status (1=married)	-0.0008 (-0.88)	201.23	-0.002
Bid level & gender(1=female)	-0.00005 (-0.04)	232.42	-0.00001
Bid level & education	-0.00007 (-0.60)	2391.09	-0.00001
Age	-0.022 (-1.50)	35.30	-0.005
Number of people living in the household	0.088 (1.38)	5.28	0.021
Income	0.0001 (1.57)	2562.35	0.00003
Obs.	202		
Log-likelihood	-121.54		
Restricted Log-likelihood	31.84		
P-value chisquare (d.f.=7)	0.00		
Pseudo R2	0.11		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically significant at the 95% confidence level.
***Statistically significant at the 90% confidence level.

Specification 3 of the WTP logit model for non-connected houses (water supply service perceptions)

	Coefficients[a]	Mean Values	Marginal effects
Dependent variable: Probability that the participant is willing to pay a specified bid level			
Intercept	0.574 (1.38)		
Bid level	-0.004* (-4.72)	296.04	-0.001
Consumption and expenditure			
Household's monthly expenditure in water for domestic use	0.004* (3.36)	126.68	0.001
Household's monthly expenditure in bottled drinking water	0.00004 (0.03)	131.93	0.00001
Availability of adequate water storage containers 1=availability of water catchment and/or cistern	1.111* (2.75)	0.252	0.245
Lack of toilets that use water 1=Household that does not have toilets that use water	0.606** (1.77)	0.425	0.144
Obs.	202		
Log-likelihood	-116.49		
Restricted Log-likelihood	41.95		
P-value chisquare (d.f.=5)	0.00		
Pseudo R2	0.15		

[a] t-statistics under parenthesis.
*Statistically significant at the 99% confidence level.
**Statistically signicant at the 90% confidence level.

Appendix C

Script for the Survey, connected houses to the water supply system
Spanish Version

Diálogo del encuestador

Al tocar la puerta:

-¿Disculpe se encontrará el señor o la señora de la casa? ***O pedir que si pueden hablar con la persona que vive allí y se encarga de la casa.***

-Buenos días, mi nombre es...y hoy venimos a su domicilio para invitarlo a participar en una encuesta que estamos realizando sobre la demanda y la conservación del agua en Querétaro. Esta encuesta es parte de un proyecto de investigación realizado por Gustavo Mendoza como parte de sus estudios que está realizando en la Universidad de Alberta en Canadá. Esta persona junto con investigadores de esta universidad, desarrollaron esta encuesta para conocer lo que la gente de Querétaro demanda para mejorar el servicio de agua potable y para recolectar información acerca de las preferencias de la gente de Querétaro para conservar los recursos de agua de la ciudad. Participar en esta encuesta es muy fácil, usted solo tiene que contestar algunas preguntas acerca del servicio de provisión de agua para su domicilio y acerca de algunas decisiones que usted podría realizar para que se mejore este servicio. Así mismo, le vamos a preguntar acerca de algunas decisiones que usted podría realizar para conservar los recursos de agua de Querétaro.
Contestar la encuesta no debe tomar mas de media hora.

Si la persona ACEPTA PARTICIPAR para contestar la encuesta proceda a DARLE LA HOJA INFORMATIVA Y la HOJA DE CONSENTIMIENTO. Si la persona NO ACEPTA PARTICIPAR VAYA A LA SIGUIENTE CASA.

-Ahora permítame pasarle estas hojas que incluyen la información acerca de este estudio y una hoja de consentimiento. Todo lo que yo le he explicado es un resumen de lo que está escrito en estas hojas. Sin embargo, la Universidad de Alberta requiere que usted participe voluntariamente y que usted conozca de los propósitos de esta encuesta.

Toda la información que usted nos proporcione en sus repuestas es confidencial y no se compartirá con ninguna persona que no sean los investigadores.

-La Universidad de Alberta también requiere que antes de que contestemos la encuesta que le pida su consentimiento por escrito. Para ello, le pido atentamente que conteste las preguntas de consentimiento y que por favor firme la hoja de consentimiento

Nota: Cualquier pregunta o duda de la persona encuestada deberá ser contestada siempre con base en lo aprendido en las sesiones de entrenamiento. EL ENCUESTADOR DEBE ABSTENERSE DE RESPONDER DE CUALQUIER MANERA QUE NO SEA LO QUE SE ACORDÓ EN EL ENTRENAMIENTO.

Después que les den la hoja de consentimiento. *PREGUNTARLES LO SIGUIENTE:*

¿Cómo obtiene la mayor parte del agua para su casa?

- ❑ Agua entubada, su casa está conectada al sistema de abasto de agua de la Comisión Estatal de Aguas (CEAQ). ***Si la persona contesta esta opción, por favor proceda a contestar la encuesta para gente conectada al sistema de abasto de agua.***
- ❑ De pipa de agua.
- ❑ De otra casa cercana a la suya.
- ❑ De una llave pública o hidrante.
- ❑ Otra, por favor especifique________________________.

Si la persona contesto alguna de estas opciones, por favor proceda a contestar la encuesta para gente no conectada al sistema de abasto de agua.

UNIVERSITY OF ALBERTA Department of Rural Economy
Faculty of Agriculture, Forestry, and Home Economics

HOJA INFORMATIVA

La demanda por agua en la Ciudad de Querétaro, México: Un estudio de las preferencias de la gente por mejoras en el abastecimiento de agua y por la conservación de los recursos hídricos

Querétaro enfrenta una severa restricción del agua disponible para uso doméstico por lo que es necesario realizar inversiones en obras y proyectos que aseguren la disponibilidad de agua para cada habitante. Sin embargo, también es necesario que se garantice la preservación de las fuentes de abastecimiento de agua para las generaciones futuras.

Propósito de la encuesta: Esta encuesta es parte de una investigación para recolectar información acerca de la demanda por mejoras al servicio de agua potable en su domicilio. Además, a través de esta encuesta se recolectará información acerca de las preferencias de la gente de Querétaro por conservar la fuente de donde se extrae el agua para abastecer a la población, el acuífero del Valle de Querétaro.

Contexto de la investigación: Los problemas de abasto de agua en Querétaro podrían afectar gravemente el desarrollo de la ciudad. Por lo que una persona originaria de Querétaro junto con investigadores de la Universidad de Alberta decidieron realizar una investigación que permita analizar la demanda de agua potable y de conservación de las fuentes de agua.

Métodos: Le vamos a pedir que conteste una serie de preguntas acerca del servicio de agua potable en su domicilio y de algunas decisiones que usted podría realizar para mejorar dicho servicio. Así mismo, también haremos algunas preguntas acerca de la conservación de los recursos hídricos de Querétaro y de algunas decisiones que usted podría realizar para conservar el agua de Querétaro. El contestar esta encuesta no le debe tomar más de media hora.

Confidencialidad: La información que usted proporcione en esta encuesta es estrictamente confidencial. La encuesta la aplican un grupo de encuestadores formado por ciudadanos de Querétaro. Los encuestadores han firmado un acuerdo en el que se comprometen a guardar en absoluta confidencialidad la información que usted proporcione para esta encuesta. Los encuestadores deberán entregar todas las encuestas y los registros de su participación al investigador principal y sus profesores. El investigador principal y sus profesores serán las únicas personas que tendrán acceso a la información que usted proporcione, sin embargo, sabrán que usted participó pero ellos no podrán conocer cuáles fueron sus respuestas a la encuesta. Los resultados de esta encuesta serán publicados como un resumen total de todas las respuestas de los encuestados pero no habrá alguna forma de identificar sus respuestas a la encuesta.

Beneficios: Con su participación será posible recolectar información acerca de los beneficios económicos que se generarían por mejorar el sistema de abasto de agua y por la conservación de las fuentes de agua. Esta información sería de gran utilidad para promover la realización de proyectos que incrementen el abasto de agua para la ciudad y que a su vez garanticen la conservación de las fuentes de agua.

Riesgos: Los investigadores no visualizan algún riesgo directo para usted si participa en la encuesta. Los resultados de esta encuesta se utilizarán para promover proyectos relacionados con la disponibilidad de agua en Querétaro. Sin embargo, es posible que los proyectos específicos que usted prefiera no se realicen. Esto se podría deber a que sus puntos de vista pueden diferir de los de otros miembros de la comunidad o porque existen otras prioridades en las dependencias pertinentes.

Abstinencia: Usted se puede abstener de participar en esta encuesta antes de contestar alguna pregunta y durante el proceso de respuesta al cuestionario. Después de contestar la encuesta, existe un tiempo límite de 24 hrs. para solicitar que sus respuestas y su registro de participación sean destruidos. Después del tiempo límite de 24hrs., su registro de participación y sus respuestas serán separados y no habrá forma de identificar lo que usted respondió. Por lo tanto, después del tiempo límite no será posible resolver ninguna solicitud de abstinencia de participación. Le pedimos atentamente que comprenda que este proceso garantiza la confidencialidad de todos los participantes y sus respuestas.

Uso de la información: Esta encuesta se realiza como parte de la investigación que Gustavo A. Mendoza realiza en la Universidad de Alberta. Esta investigación no tiene ningún financiamiento por parte del Gobierno del Estado de Querétaro, del Gobierno Municipal de Querétaro o de ningún tipo de empresa o compañía privada. La información que usted provea servirá para entender la demanda y preferencias de la gente por mejorar el servicio de agua potable y por conservar las fuentes de agua disponibles para la ciudad. El reporte final será publicado y estará disponible para cualquier persona o entidad y será presentado ante dependencias tales como la Comisión Estatal de Aguas (CEAQ), el H. Ayuntamiento de Querétaro, la Comisión Nacional del Agua (CNA) y la Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). Le recordamos una vez más, que su registro será confidencial y no habrá manera de identificar sus respuestas a esta encuesta, solamente un resumen de los resultados será incluido en el reporte final.

Si usted tiene cualquier comentario o pregunta no dude en contactar a cualquiera de las siguientes personas:

Contactos:

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Si tiene alguna pregunta o comentario acerca de la forma en que se realiza esta investigación que no pueda resolver con los contactos arriba mencionados por favor contacte a: Georgie Jarvis, Secretaria del Consejo de Ética Humana, 2-14 Agriculture-Forestry Centre, Universidad de Alberta, Edmonton, AB T6G 2P5. Tel. en Canadá: 00-1-780-492-8126.

GRACIAS POR SU PARTICIPACIÓN

Hoja de Consentimiento

Título del proyecto: "La demanda por agua en la Ciudad de Querétaro, México: Un estudio de las preferencias de la gente por mejoras en el abastecimiento de agua y por la conservación de los recursos hídricos"

Investigadores:

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Consentimiento

Por favor marque con un círculo sus respuestas:

¿Ud. entiende que se le ha pedido participar en una encuesta sobre la demanda de agua y conservación de recursos hídricos en Querétaro, México?
SÍ NO

¿Ud. entiende que la información recopilada en esta encuesta es parte del proyecto de investigación del estudiante Gustavo A. Mendoza? SÍ NO

¿Entiende los beneficios y riesgos de la realización de este estudio de investigación?
SÍ NO

¿Ha leído y recibido una copia de la Hoja Informativa? SÍ NO

¿Ud. entiende que puede abstenerse de participar en este estudio dentro de un tiempo límite de 24 horas después de contestar la encuesta? En este caso los investigadores no usarán sus respuestas en este estudio y destruirán cualquier registro de participación o de respuestas. SÍ NO

¿Ud. está de acuerdo que después de 24hrs. que Ud. haya contestado la encuesta no será posible pedir que sus respuestas no sean utilizadas en este estudio ya que no se podrá identificar lo que Ud. respondió en la encuesta? SI NO

¿Ud. entiende que la información que provea será guardada en estricta confidencialidad y que cualquier vínculo entre sus respuestas y su nombre o dirección serán destruidos?
SÍ NO

¿Ud. entiende que los investigadores podrían saber que Ud. participó en este estudio, pero que ellos no podrán saber lo que Ud. respondió?

SÍ NO

¿Ud. sabe que podría contactar al estudiante o los profesores listados en la sección de investigadores si Ud. tiene cualquier pregunta acerca de la investigación o de la encuesta?

SÍ NO

¿Ud. nos otorga permiso para utilizar la información y los datos que proporcionó para los propósitos especificados en la hoja informativa?

SÍ NO

¿Ud. nos otorga permiso para utilizar la información y los datos que proporcionó en esta encuesta para futuras investigaciones y análisis?

SÍ NO

¿Ud. nos otorga permiso para compartir la información y datos que proporcionó con los investigadores listados en esta hoja de consentimiento?

SÍ NO

Este estudio me fue explicado por: ______________________________

Yo acepto tomar parte en este estudio:

Nombre del participante	Firma del participante	Fecha
Nombre del testigo	Firma del testigo	Fecha

Yo entiendo que la persona que firma esta forma comprende lo que envuelve este estudio y que voluntariamente dicha persona acuerda su participación.

Firma del Investigador	Fecha

No._____
Índice_____

UNIVERSITY OF ALBERTA
Departamento de Economía Rural
Faculty of Agriculture, Forestry, and Home Economics

La demanda por agua en Querétaro, México:

Un estudio de las preferencias de la gente por mejoras en el abastecimiento de agua y por la conservación de los recursos hídricos

Encuesta

Nombre del encuestador:________________________________.
Colonia:________________________________.
Fecha:________________________________.
Hora en que inició:________________________________.
Hora en que finalizó:________________________________.

Sección 1. Fuentes de abastecimiento de agua y características del hogar

1. ¿A quién le paga por el agua que recibe en su vivienda?
   1. A la Comisión Estatal de Aguas (CEA).
   2. Al dueño de la vivienda que habita (renta de cuarto, departamento o casa).
   3. No paga.
   4. Otro, por favor especifique________________________.

2. ¿Cuánto paga en promedio cada mes por el agua para su casa?
   1. I__I__I__I__I pesos por mes. ***PASE a la pregunta 4.***
   2. Se incluye en la renta. ***PASE a la pregunta 3.***

3. ¿Cuánto de lo que paga por renta piensa usted que se utiliza para pagar el agua?
   1. I__I__I__I__I pesos por mes
   2. No sabe.

4. ¿Usualmente de dónde se obtiene el agua para beber en su hogar?
   1. Compra de garrafones de agua. ***PASE a la pregunta 5.***
   2. Hirviendo el agua. ***PASE a la pregunta 6.***
   3. Usa un filtro para purificar el agua. ***PASE a la pregunta 6.***
   4. Usa sustancias químicas para purificar el agua. ***PASE a la pregunta 6.***
   5. Directamente de la llave sin filtrarla, hervirla o usar sustancias químicas para purificarla. ***PASE a la pregunta 6.***

5. ¿Cuántos garrafones de agua compra a la semana y cuánto paga por cada uno?
I__I__I garrafones a la semana, I__I__I pesos por cada uno.

6. ¿Me podría decir por favor el número de personas que viven en el hogar?
I__I__I personas en total.

7. ¿Me podría decir el número de personas de la familia nuclear (pareja e hijos) que viven en la casa del encuestado?
I__I__I personas en total.

8. ¿Cuántas personas menores de 18 años viven en el domicilio?
I__I__I personas menores de 18 años.

9. ¿Cuál es el número total de cuartos en el hogar (incluyendo la cocina, la sala y los baños)?

I___I___I cuartos en total.

Sección 2. Disponibilidad de agua para el hogar

10. ¿Usa usted algún tipo de contenedor (tinaco, cisterna, etc.) para almacenar el agua en su domicilio?

1. Sí. ***PASE a la pregunta 11.***
2. No. ***PASE a la pregunta 14.***

11. ¿Con qué tipo de contenedor cuenta para almacenar la mayor parte del agua para su vivienda?

1. Tinaco en el techo. ***PASE a la pregunta 14.***
2. Tinaco en el techo de su casa y cisterna (cisterna o contenedor con bomba en la planta baja de la casa) en la casa, edificio de departamentos o vecindario. ***PASE a la pregunta 12.***
3. Pileta. ***PASE a la pregunta 14.***
4. Tambos. ***PASE a la pregunta 14.***
5. Otro, por favor especifique________________________________. ***PASE a la pregunta 14.***

12. ¿Qué tipo de sistema tiene para bombear el agua a su casa (o apartamento)?

1. Bomba eléctrica. ***PASE a la pregunta 13.***
2. Bomba de gasolina. ***PASE a la pregunta 13.***
3. Bomba hidroneumática. ***PASE a la pregunta 14.***
4. No sabe. ***PASE a la pregunta 14.***
5. Ninguno. Usted saca el agua manualmente. ***PASE a la pregunta 14.***

13. ¿Cuántas veces al mes se utiliza la bomba? ¿Y cuándo lo hace durante cuánto tiempo se prende la bomba?

1. I___I___I___I veces al mes I___I___I___I minutos.
2. No sabe.

14. ¿En una semana normal cuántos días a la semana no tiene agua en lo absoluto o baja presión de agua que no se puede utilizar?

1. I__I días por semana. ***Si la persona contestó que no le falta agua nunca (0 días a la semana) PASE a la pregunta 17.***
2. No sabe. ***PASE a la pregunta 17.***

15. ¿En qué momento del día le cortan el agua o tiene baja presión de agua que no se puede utilizar?

1. Mañana.
2. Medio día.
3. Tarde.
4. Todo el día (el agua regresa en la noche).
5. Noche.
6. Otra, por favor especifique________________________________.
7. No sabe.

16. Cuando no tiene agua o tiene baja presión de agua que no se puede utilizar, cuántas horas al día dura esto:

1. I__I__I horas al día.
2. No sabe.

17. ¿Tiene usted instalación de agua entubada dentro de su casa, es decir, cuenta con llaves de agua en fregaderos, lavabos, etc.?

1. Sí. ***PASE a la pregunta 18.***
2. No. ***PASE a la pregunta 20.***

18. ¿Cuántas llaves de agua tiene en su casa?

I__I__I llaves de agua.

19. ¿Cuántas regaderas?

I__I__I regaderas.

20. ¿Cuenta con excusado o taza de baño que utilice agua? Si es así, ¿Cuántas tazas de baño tiene su hogar?

1. Sí tiene excusado o taza de baño al que se le puede echar agua. |__|__| tazas de baño.
2. No tiene excusado o taza de baño al que se le pueda echar agua.

21. ¿Tiene lavadora? Si es así, cuántas cargas de ropa se lavan a la semana.

1. |__|__| cargas de ropa por semana.
2. No tiene lavadora.
3. Sí tiene lavadora pero no sabe cuántas cargas de ropa se lavan a la semana.

22. ¿Tiene jardín o varias macetas con plantas en los patios o azoteas?

1. Sí.
2. No.

Sección 3. Calidad del agua para la vivienda.

23. ¿Piensa usted que el agua directamente de la llave es lo suficiente buena para tomarla?

1. Sí es lo suficientemente buena para beber. ***PASE a la pregunta 26.***
2. No es lo suficientemente buena para beber. ***PASE a la pregunta 24.***
3. No sabe. ***PASE a la pregunta 26.***

24. ¿Por qué piensa que el agua que recibe del sistema de abasto de agua no es lo suficientemente buena para beber?

1. Tiene algún olor que no le gusta.
2. Tiene algún sabor que no le gusta.
3. Tiene algún color.
4. Tiene organismos patógenos o microbios.
5. Se contamina a través del sistema de distribución de agua.
6. Tiene minerales que podrían ser perjudiciales.
7. Otra, por favor especifique______________________________.

25. ¿Qué tan frecuente es que el agua directamente de la llave no es lo suficientemente buena para beber?

1. Siempre.
2. Algunas veces.
3. Rara vez (casi nunca).

26. ¿Ud. sabe si alguien en su hogar se ha enfermado debido a que tomó agua directamente de la llave?

1. Sí. ***PASE a la pregunta 27.***
2. No. ***PASE a la pregunta 28.***

27. ¿Con qué tipo de enfermedad se enfermó la persona o personas que tomaron agua de la llave?

Diarrea.	1.
Cólera.	2.
Tifoidea.	3.
Problemas en los riñones.	4.
Hepatitis	5.
Otra, por favor especifique____________.	6.

Sección 4. Nivel de satisfacción del servicio de agua potable actual

28. ¿Qué tan satisfecho está usted con el servicio de agua que tiene actualmente para su hogar?

1. Muy satisfecho
2. Satisfecho
3. Ni satisfecho, ni insatisfecho
4. Insatisfecho
5. Muy insatisfecho

¿Por qué?

29. En su opinión, en el caso de su hogar ¿Piensa que lo que paga por tener agua en su hogar es muy alto?

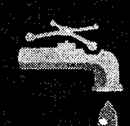
1. No, yo no pienso que mis pagos por el agua son muy altos.
2. Sí, yo pienso que mis pagos por el agua son muy altos.

Sección 5. Preferencias y disposición a pagar por mejorar el servicio de abasto de agua potable

Querétaro enfrenta restricciones en la cantidad y calidad del agua disponibles para el uso en los hogares. Por lo tanto, es necesario mejorar el sistema de abasto de agua de la ciudad. Por ejemplo, si las fugas del sistema de distribución de agua se redujeran a un nivel mínimo, se podría aumentar sustancialmente el agua disponible para la gente de Querétaro. Además, proyectos tales como plantas de tratamiento de aguas residuales, plantas purificadoras de alta tecnología y el desarrollo de nuevas fuentes de agua podrían ser otras maneras de incrementar la calidad y cantidad del agua en Querétaro, por 50 años por lo menos.

A continuación, se le preguntará a usted si elegiría mejoras significativas al sistema de abastecimiento que lleva agua a su hogar. Nosotros le pedimos que señale lo que haría si estos servicios, a los precios descritos, fueran disponibles para usted. Otras investigaciones han mostrado que cuando a la gente se le hacen preguntas hipotéticas como ésta, ellos usualmente escogen la mejora aun cuando ésta podría ser cara. Si ellos tuvieran que elegir si gastan el dinero realmente, ellos podrían no aceptar la mejora. Por favor, responda la pregunta como si en realidad usted fuera a pagar por las mejoras descritas.

Tabla 1. Mejoras al servicio de abasto de agua para su hogar

	Suponga que para los próximos 50 años:
Disponibilidad de Agua	AGUA 24 HORAS AL DÍA 
Calidad del Agua	SUFICIENTEMENTE BUENA PARA BEBER  Directamente de la llave

30. Suponga que se realizarán mejoras significativas al sistema de extracción, purificación, tratamiento y distribución del agua que llega a los hogares de la Cd. de Querétaro. ***Mostrar la Tabla 1 y mientras muestra la tabla señale lo siguiente:*** De modo que, por los siguientes 50 años, esas mejoras permitieran que usted y los habitantes de su casa tuvieran agua 24 hrs. al día y que la calidad del agua fuera tal que la pudiera beber directamente de la llave.

¿Estaría usted dispuesto a pagar $|__|__|__| pesos por mes, además de lo que usted paga, por un servicio de agua potable que, por los siguientes 50 años, permitiera que su hogar tuviera agua 24 horas al día y que pudiera beberla directamente de la llave principal de su hogar?

1. Sí
2. No

31. ¿Qué tan seguro está que usted realizaría esta elección hoy (de pagar la cantidad señalada por las mejoras en el servicio de agua para su casa)? En una escala del 1 al 10, por favor díganos que tan seguro está usted, donde el número uno corresponde a no muy seguro y el número 10 corresponde a muy seguro.

1	2	3	4	5	6	7	8	9	10
No muy seguro									Muy seguro

SIGUIENTES PREGUNTAS SÓLO PARA GENTE QUE CONTESTÓ "NO" EN LA PREGUNTA 30. Para GENTE QUE CONTESTÓ "SÍ" POR FAVOR PASE A LA PREGUNTA 34.

32. ¿Por qué contestó "No" en la pregunta de disposición a pagar por mejoras en el servicio de agua?

1. Es muy caro el monto de disposición a pagar.
2. Usted siente que no tiene suficiente información para contestar que sí.
3. Usted ya paga demasiado por el servicio de abasto de agua.
4. Usted no cree que el agua se pueda proveer con ese nivel de calidad.
5. Usted no cree que el agua se pueda proveer 24 horas al día.
6. Otra, por favor especifique__________________________.

33. ¿Estaría dispuesto a pagar alguna cantidad por las mejoras a este servicio? Si es así, ¿Cuánto?

1. Sí, |___|___|___| pesos. ***PASE a la pregunta 35.***
2. No. ***PASE a la pregunta 36.***

34. ¿Estaría dispuesto a pagar más por este servicio? Si es así ¿Cuál es la cantidad máxima que estaría dispuesto a pagar (además de lo que paga) por las mejoras al servicio de abasto de agua?

1. Sí, |___|___|___|___| pesos.
2. No.

35. ¿De qué forma preferiría que se le cobrarán estas mejoras al servicio de abasto de agua?

1. Forma actual, a través del recibo del servicio de agua.
2. A través de incrementos en los impuestos que cada persona paga.
3. Otra, por favor especifique

.

36. ¿Usted cree que la Comisión Estatal de Aguas y el Gobierno del Estado de Querétaro pueden hacer las mejoras necesarias para garantizar el abasto de agua a la población de la ciudad y para hacer que el agua sea lo suficientemente buena para tomar directamente de la llave principal de cada casa?

1. Sí.
2. No.

¿Por qué?

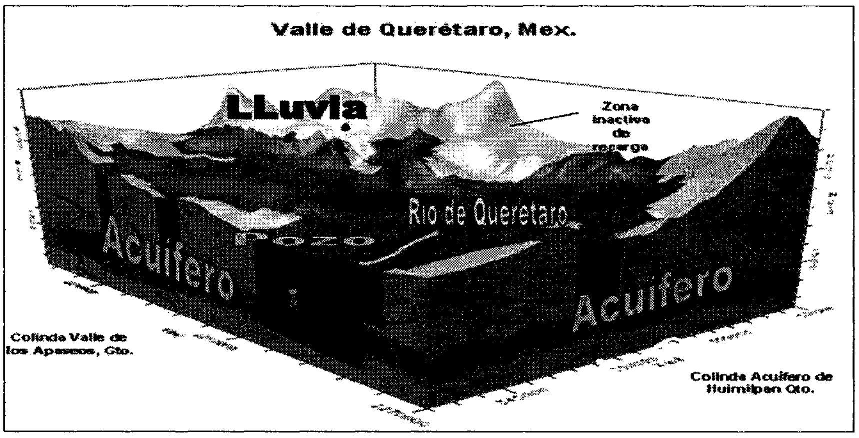
37. ¿Quién preferiría que administrara el sistema de abasto de agua de la Ciudad de Querétaro?

1. El gobierno municipal.
2. Gobierno del Estado de Querétaro (actual administrador de la Comisión Estatal de aguas).
3. El gobierno Federal.
4. Una compañía privada.
5. Otra, por favor especifique______________________________.
6. No sabe.

Sección 6. Conservación de los recursos hídricos de Querétaro.

La escasez de agua en Querétaro se debe al agotamiento del acuífero que provee de agua a la ciudad. (***Mostrar la Gráfica 1, Acuífero del Valle de Querétaro***) Un acuífero es un contenedor muy grande de agua entre las rocas y la tierra debajo de la superficie. La mayor parte del agua que se consume en la Cd. de Querétaro viene de pozos que sacan el agua de lo que se conoce como "Acuífero del Valle de Querétaro" .

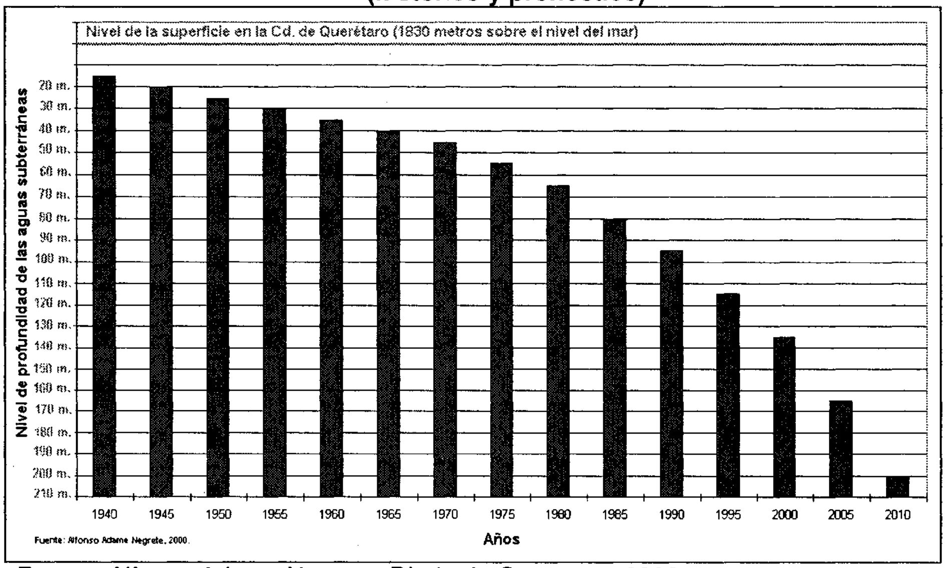
Gráfica 1. Acuífero del Valle de Querétaro



Jessica Vanesa Briceño Ruiz, "Metodología para Realizar Evaluaciones de Impacto Ambiental para Acuíferos Sobre explotados", Tésis, Instituto Politécnico Nacional, 2004.

Sin embargo, la cantidad extraída de agua del acuífero ha sido más grande que la cantidad de agua que ha recibido en los últimos 60 años. Esta situación ha empeorado desde 1980 porque Querétaro tuvo un rápido de crecimiento de la población, la cual demandó una cantidad considerable de agua. ***Mostrar la Gráfica 2, niveles de bombeo de agua subterránea en el Valle de Querétaro***: Esta gráfica muestra los niveles de profundidad del agua disponible en el acuífero en los últimos 60 años, en ella se puede ver el nivel de profundidad al que se ha tenido que excavar para poder encontrar agua en un pozo. (***Mostrar en la gráfica lo siguiente)*** En 1940, se encontraba agua a 15 m. de profundidad. En 1980, se encontraba agua a 65 m. de profundidad. Para 2005, el agua se extrae a 165 m. profundidad. También hay un pronóstico de los niveles de agua para el año 2010 si la tasa de extracción se mantiene igual (debajo de los 200 m. de profundidad). En esta gráfica, es posible observar que las reservas de agua han reducido sus niveles considerablemente. Si la ciudad se mantiene extrayendo a niveles de profundidad bajos, los costos de extracción se incrementarán considerablemente y el agua de los pozos podría no ser adecuada para beber porque podría contener sustancias dañinas tales como flúor y arsénico.

Gráfica 2. Niveles de bombeo del agua subterránea del valle de Querétaro (histórico y pronóstico)



Fuente: Alfonso Adame Negrete, Diario de Queretaro, 2000.

38. Suponga que a través de proyectos de conservación y recuperación del acuífero del Valle de Querétaro, tales como pozos de infiltración, protección de áreas de recarga, programas de ahorro de agua y desarrollo de fuentes alternativas de agua, podría ser posible preservar este recurso natural y que no decreciera el nivel de profundidad del agua por los próximos 50 años. De esta manera, sería posible tener una fuente de agua confiable. ¿Votaría usted por un programa que garantice el abasto del agua para la Cd. de Querétaro a través de una explotación adecuada del acuífero si cada hogar como el suyo tuviera que pagar $ I___I___I___I pesos por mes por ese programa, si la mayoría votara por él?

1. Sí
2. No

39. ¿Qué tan seguro está que usted realizaría esta elección hoy (de votar por un programa que conserve el acuífero y que tenga que pagar la cantidad señalada)? En una escala del 1 al 10, por favor díganos que tan seguro está usted. El número uno corresponde a no muy seguro y el número diez corresponde a muy seguro.

1	2	3	4	5	6	7	8	9	10
No muy seguro									Muy seguro

SIGUIENTE PREGUNTA SÓLO PARA GENTE QUE CONTESTÓ "NO" EN LA PREGUNTA 39. Para GENTE QUE CONTESTÓ "SÍ" POR FAVOR PASE A LA PREGUNTA 41.

40. Por favor díganos por qué contestó "No" en la pregunta 38:
    1. Es demasiado caro el monto de disposición a pagar por conservar el acuífero de la Cd. de Querétaro. ***PASE a la pregunta 42.***
    2. No le interesa que se conserven las fuentes de agua subterránea. ***PASE a la pregunta 42.***
    3. Siente que no tiene suficiente información para responder que sí. ***PASE a la pregunta 42.***
    4. Ya paga demasiado por impuestos al gobierno para que conserven los recursos naturales. *PASE a la pregunta 42.*
    5. No cree que se pueda lograr preservar las aguas subterráneas de Querétaro. ***PASE a la pregunta 42.***
    6. Otra, por favor explique______________________________________. ***PASE a la pregunta 42.***

41. ¿De qué forma preferiría que se le cobrarán los proyectos de conservación y recuperación del acuífero?
    1. A través de un recibo cada mes por el pago de los proyectos de conservación del acuífero.
    2. Por medio de incrementos en los impuestos que cada persona paga.
    3. Otra, por favor especifique

       .

42. ¿Quién le gustaría que administrara los trabajos y proyectos de conservación del Acuífero del Valle de Querétaro?
    1. El gobierno municipal.
    2. Gobierno del Estado de Querétaro (actual administrador de la Comisión Estatal de Aguas).
    3. El gobierno federal.
    4. Una empresa privada.
    5. Una organización no gubernamental dedicada al cuidado del medio ambiente.
    6. Un grupo de profesionistas y científicos dedicados al cuidado del medio ambiente.

Sección 7. Características socioeconómicas de la persona y su hogar.

43. ¿Cuenta su vivienda con los siguientes servicios? ***MARCAR cada respuesta.***

Servicio		
Electricidad	1. Sí	2. No
Teléfono	3. Sí	4. No
Tanques de gas/gas entubado	5. Sí	6. No
Televisión por cable o por satélite	7. Sí	8. No
Internet	9. Sí	10. No

44. ¿Cuánto se paga en promedio cada 2 meses o por bimestre por el servicio de luz?

|___|___|___|___| pesos bimestrales.

45. ¿De qué tipo es la propiedad de su casa?
   1. Prestada o la cuidan (ninguna de las personas que vive allí posee la casa).
   2. Rentada o alquilada.
   3. Propia y la están pagando.
   4. Propia y totalmente pagada en terreno propio.
   5. Propia en terreno de asentamiento irregular.
   6. Otro tipo de propiedad, por favor especifique________________.

46. ¿Cuál es el material predominante en los muros de la vivienda?
   1. Tabique, ladrillo, tabicón, cantera, cemento o concreto.
   2. Lámina de asbesto o metálica.
   3. Lámina de cartón.
   4. Materiales de desecho.
   5. Adobe.
   6. Otros materiales.

47. ¿Cuál es el material predominante en los techos de la vivienda?
   1. Losa de concreto, tabique, ladrillo, losa de concreto o techo de cemento.
   2. Lámina de asbesto o metálica.
   3. Lámina de cartón.
   4. Otros materiales.

48. ¿Cuál es el principal material en pisos?

 1. Tierra.
 2. Cemento o firme.
 3. Madera, mosaico u otros recubrimientos.

49. Me podría decir cuántos años cumplidos tiene usted por favor:

I___I___I años cumplidos.

50. Sexo del entrevistado

 1. Femenino
 2. Masculino

51. ¿En el momento actual:

 1. vive soltera (o)?
 2. está casada(o)?
 3. vive en unión libre?
 4. está divorciada (o)?
 5. está separada (o)?
 6. Viudo (a).

52. ¿Cuál es el nivel más alto de educación que usted completó?

 1. Ninguno
 2. Preescolar
 3. Primaria
 4. Secundaria
 5. Preparatoria o bachillerato
 6. Normal
 7. Carrera técnica o comercial
 8. Licenciatura
 9. Maestría o doctorado

53. ¿Cuántos empleos o trabajos tiene usted?

I___I empleo(s)

54. ¿Cuál es su ocupación principal?

1. Asalariado
2. Ama de casa
3. Estudiante
4. Pensionado o jubilado
5. Patrón o empleador
6. Obrero o empleado no agropecuario
7. Trabajador por cuenta propia (sin trabajadores renumerados)
8. Trabajador sin renumeración
9. Miembro de una cooperativa

55. ¿Cuántas personas incluyendo a las cabezas o jefes del hogar, que sean mayores de 15 años, trabajan para ganar dinero?

I__I___I personas.

56. ¿Qué vehículos poseen usted y los habitantes de su hogar para transportarse?

MARCAR cada respuesta.

Vehículo			¿Cuántos?
Bicicleta	1. Sí	2. No	
Motocicleta o Motoneta	3. Sí	4. No	
Automóvil	5. Sí	6. No	
Otros, especifique____________	7. Sí	8. No	

57. ¿Cuáles son los aparatos domésticos con los que cuenta su hogar? ***Preguntar de la siguiente manera: ¿Tiene aparato? ¿Cuántos? MARCAR cada respuesta.***

Aparato			¿Cuántos?
Radio (de los pequeños)	1. Sí	2. No	
Grabadora o estereo	3. Sí	4. No	
Televisión	5. Sí	6. No	
Videograbadora	7. Sí	8. No	
Computadora	9. Sí	10. No	
Estufa de gas	11. Sí	12. No	
Estufa de otro combustible	13. Sí	14. No	
Refrigerador	15. Sí	16. No	
Lavadora	17. Sí	18. No	
Calentador o boiler de gas	19. Sí	20. No	
Calentador o boiler de otro combustible	21. Sí	22. No	
Horno de microondas	23. Sí	24. No	
Plancha eléctrica	25. Sí	26. No	

58. En promedio, ¿Cuál es el ingreso por mes de usted o de las persona(s) que aportan dinero para el hogar? ***(Mostrar al participante esta página y pedirle que señale con el dedo su nivel de ingreso o de las personas que aportan dinero).***

1. De 0 a 1,300 pesos por mes
2. De 1,301 pesos a 2,600 pesos por mes
3. De 2,601 pesos a 5,000 pesos por mes
4. De 5,001 pesos a 6,600 pesos por mes
5. De 6,601 pesos a 10,000 pesos por mes
6. De 10,001 pesos a 15,000 pesos por mes
7. De 15,001 pesos a 20,000 pesos por mes
8. De 20,001 pesos a 25,000 pesos por mes
9. De 25,001 pesos a 50,000 pesos por mes
10. Más de 50,000 pesos por mes

Script for the Survey, connected houses to the water supply system
English Translation[25]

Dialogue for the enumerator

When you knock the door:

-¿Excuse me, is the lord or the lady of the house here? ***Or ask if you could talk with the person that lives there and takes care of the house.***

- Good morning, my name is...and today I came to your home to invite you to participate in a survey that we are doing about the demand and preservation of water resources in Queretaro. This survey is part of a research project conducted by Gustavo Mendoza as part of his studies done in the University of Alberta in Canada. This person and other researchers from this University developed this survey to know what Queretaro's people demand for improving the water supply service and to gather information about Queretaro's people preferences to preserve the water resources of the city.
Participating in the survey is very easy, you only have to answer some questions we are going to ask you about the water supply service in your household and about some decisions that you could make to improve that utility service. Thereby, we will also ask you about some decisions that you could make to conserve Queretaro's water resources. The survey should not take longer than 20 minutes.

If the person ACCEPTS TO PARTICIPATE to answer the survey proceed to GIVE HER THE INFORMATION SHEET AND the CONSENT FORM. If the person do NOT ACCEPT TO PARTICIPATE GO TO THE NEXT HOUSE.

-Now let me pass you these sheets that include the information about this study and a consent form. All what I have explained to you is a summary of what is written in these sheets. However, the University of Alberta requires that you participate voluntarily and that you know the purposes of this survey. All the information that you give us in your answers is confidential and it will be not be shared with other people that are not the researchers.

[25] The surveys were developed in Spanish and these translations are provided simply for reference.

-The University of Alberta also requires that before we conduct this survey that I ask you for written consent. For doing that we kindly ask you to answer the consent questions and to sign the consent form please.

Note: Any question or doubt from the participant must be answered always based in the instructions given to you in the training sessions. THE ENUMERATOR MUST AVOID OF ANSWERING THE PARTICIPANTS' QUESTIONS IN ANY WAY THAT IT IS NOT WHAT WAS AGREED IN THE TRAINING SESSIONS.

After getting back the consent form. ASK THEM THE FOLLOWING QUESTION.

How do you obtain most of the water for your house?

- ❑ Piped water, your house is connected to the water supply system from the Comision Estatal de Aguas Queretaro (CEAQ). ***If the person answered this, please proceed to answer the survey for people connected to the water supply system.***
- ❑ From other house close to yours.
- ❑ From water truck.
- ❑ From a public tap.
- ❑ From a well in your property.
- ❑ From a river or a creek.

If the person answered any of these options, please proceed to answer the survey for people not connected to the water supply system.

INFORMATION SHEET

Demand for Water in Queretaro, Mexico: A Study of the Preferences for Water Supply Improvements and Water Resources Conservation

Queretaro is facing a severe restriction in the available water for domestic use that makes necessary to realize investments in projects and public works that guarantee the water availability for each habitant. However, it is also necessary to guarantee, for future generations, the conservation of the water supply sources.

Survey purpose: This survey is part of a research project to collect information about the demand for improvements in the water supply service to your household. Moreover, through this survey it could be possible to gather information about Queretaro's people preferences to preserve the water supply source, the aquifer of the Valley of Queretaro.

Background: The problems of water supply in Queretaro could severely affect the development of the city. That is why a person native from Queretaro and scientists from the University of Alberta in Canada decided to do a research project that analyzes the demand for fresh water and for conservation of the water sources.

Methods: We are going to ask you a series of questions about the water supply service in your household and about some decisions that you could make to improve that utility service. Thereby, we will also ask you some questions about the conservation of water resources and about some decisions that you could make to preserve Queretaro's water. The survey should not take longer than twenty minutes.

Confidentiality: The information that you provide in this survey is strictly confidential. The survey is conducted by a group of enumerators that is formed by residents of Queretaro. The enumerators have signed an agreement where they commit to keep confidential the information shared by you. The enumerators will give all the answered surveys and the registries of participation to the principal researcher and his professors. The principal researcher and his professors will be the only people with access to the information that you give. Although, the researcher and his professors will know that you participated, they will not be able to know which survey answers were yours. The results of this survey will be published as a total summary of the answers from participants and there will not be a way to identify your answers to the survey.

Benefits: With your participation it will be possible to gather information about the benefits generated by improvements to the water supply system and by the conservation of the water sources. This information would be very useful to promote the realization of projects that increase the water supply for the city and that guarantee the water sources conservation.

Risks: The researchers do not anticipate any direct risks for you by participating in the survey. The results of this survey will be used to promote projects related to the water availability in Queretaro. However, it is possible that specific projects that you prefer might not be implemented. This may be because your views differ from those of others in the community or because of other priorities for the pertinent agencies.

Withdrawal: You can withdraw to participate in this survey before answering any question and while you respond to the questionnaire. After you answer the survey, there is a time limit of 24 hrs. to ask that your answers and your registry of participation are destroyed. After the time limit of 24 hrs, your registry of participation and your answers will be separated and there will not a be way to a identify what you answered in the survey. Therefore, after the time limit it will not be possible to resolve any solitude of withdrawal from participation in the survey. We kindly ask you to understand that this process guarantees the confidentiality of the participants and their answers.

Use of information: This survey is part of the research of Gustavo A. Mendoza at the University of Alberta. This research does not have any funding coming from the Government of the State of Queretaro, the Municipal Government of Queretaro neither by any company or enterprise. The information that you provide will help to analyze the demand and the preferences for improvements in the water supply system and for conserving the available water sources to the city. The final report will be published and will be available for any person or party and it will be presented to agencies such as the Water Commission of the State of Queretaro (CEA), the Municipality of the City of Queretaro, the National Commission of Water (CNA) and the Department of Environment and Natural Resources (SEMARNAT). We remind you one more time, that your registry will be kept confidential and that there will not be a way to identify your answers to the survey, only a summary of the results will be included in the final report.

If you have any questions or comments, please do not hesitate contacting the persons listed below.

Contacts:

Gustavo A. Mendoza
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If you have any question or comment with the way the research is being conducted that could not be resolved with the contacts listed above please contact: Georgie Jarvis, Secretary to the Human Research Ethics Board, 2-14 Agriculture-Forestry Centre, University of Alberta, Edmonton, AB T6G 2P5. Phone in Canada: 00-1-780-492-8126

THANK YOU FOR YOUR PARTICIPATION

CONSENT FORM

Project title: "Demand for Water in Queretaro, Mexico: A Study of the Preferences for Water Supply Improvements and Water Resources Conservation"

Researchers:

Gustavo A. Mendoza
Master of Science Candidate
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Phone in Canada: 00-1-780-492-2225
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Consent:

Please circle your answers:

Do you understand that you have been asked to participate in a survey about the demand for water and the conservation of water resources in the City of Queretaro?

YES NO

Do you understand that the information collected in this survey is part of the research project of the student Gustavo A. Mendoza? YES NO

Do you understand the benefits and risks involved in taking part in this research study?

YES NO

Have you read and received a copy of the attached Information Sheet? YES NO

Do you understand that you can quit taking part of this study within 24 hours after answering the survey? In this case, the researchers will not use your responses in the study and will destroy the records of your responses and participation.

YES NO

Do you agree that 24 hrs after you answered the survey the time limit to withdraw will have expired and it will not be possible to withdraw your participation in this study because your answers will be unidentifiable?

YES NO

Do you understand that the information that you provide will be kept in strict confidentiality and that any link between your answers and your name/address will be destroyed?

YES NO

Do you understand that the researchers may know that you participated in this study, but they will not know what you said?

YES NO

Do you know that you could contact the student or the professors listed above if you have any question about the research or the survey? YES NO

Do you give us permission to use the data and the information that you provided for the purposes specified in the information sheet? YES NO

Do you give us permission to use the data and the information that you provided in this survey for future research and analysis? YES NO

Do you give us permission to share the data and the information that you provided with the researchers listed in this consent form ?

YES NO

This study was explained to me by: ______________________________

I agree to take part in this study.:

______________________________ ________________ __________
Participant's name Participant's signature Date

______________________________ ________________ __________
Witness name Witness Signature Date

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

______________________________ __________________
Signature of Researcher Date

Number_____
Index_____
_____

UNIVERSITY OF ALBERTA
Department of Rural Economy
Faculty of Agriculture, Forestry, and Home Economics

Demand for Water in Queretaro, Mexico:

A Study of the Preferences for Water Supply Improvements and Water Resources Conservation

Survey

Enumerator's name:______________________________________.
Neighbourhood:____.
Date:____.
Start time: ____.
End time:____.

Section 1. Sources of water and household characteristics

1. Who do you pay for the water that you receive in your house?
    1. To the Comision Estatal de Aguas (CEA).
    2. To the landlord or owner of the house where you live. (rent of room, apartment or house).
    3. Do not pay.
    4. Other, please specify ______________________.

2. How much do you pay on average per month for the water of your household?
    1. I__I__I__I__I pesos per month. ***GO to question 4.***
    2. It is included in the rent. ***GO to question 3.***

3. How much of your rent each month do you think that goes to pay for water?
    3. I__I__I__I__I pesos per month.
    4. Do not know.

4. Usually, where do you get the water for drinking in your household?
    1. Buying bottled water. ***GO to question 5.***
    2. Boiling the water. ***GO to question 6.***
    3. Use a filter to purify the water. ***GO to question 6.***
    4. Use chemical substances to purify the water. ***GO to question 6.***
    5. Directly from the tap without filtering, boiling or using chemical substances to purify the water. ***GO to question 6.***

5. How many bottles of water do you buy per week and how much do you pay for each bottle? I__I__I__I bottles per week, I__I__I pesos per each bottle.

6. Can you tell me please the number of people that live in the household?
I__I__I people in total.

7. Can you tell me the number of people from the nuclear family (couple and children) that live in the household.?
I__I__I people in total.

8. How many people under 18 years old that live in the household?
I__I__I people under 18 years old.

9. Which is the number of rooms in the household (including the kitchen, living room and the bathrooms)?

I___I___I rooms in total.

Section 2. Water reliability for the household

10. Do you use some container (water catchment, cistern, etc.) for storing water in your household?

1. Yes. ***GO to question 11.***
2. No. ***GO to question 14.***

11. What kind of container do you use for storing most of the water for your home?

1. Water catchment on the roof. ***GO to question 14.***
2. Water catchment on the roof and a cistern in your home, apartment building or neighborhood. ***GO to question 12.***
3. Sink. *GO to question 14.*
4. Barrels. *GO to question 14.*
5. Other, please specify____________________________ ***GO to question 14.***

12. What kind of system do you have for pumping water from the cistern to your house?

1. Electric pump. ***GO to question 13.***
2. Gasoline pump. ***GO to question 13.***
3. Hydropneumatic pump. ***GO to question 14.***
4. Do not know. ***GO to question 14.***
5. None. You take out the water manually***. Go to question 14.***

13. How many times per month do you use the pump? And when you do it how long is the pump on?

1. I___I___I___I times per month I___I___I___I minutes.
2. Do not know.

14. In a normal week, how many days per week did you have no water at all or unusable water pressure?

1. I___I days per week. ***If the participant answered that he never lacks of water (0 days per week) GO to question 17.***
2. Do not have water cut offs or do not know. ***GO to question 17.***

15. At what time of day do you have unusable water pressure or a water cut-off?
    1. Morning.
    2. Noon.
    3. Afternoon.
    4. All day (water comes back in the night).
    5. Night.
    6. Other, please specify____.
    7. Do not know.

16. When you have no water at all or unusable water pressure how many hours per day does it usually last?
    1. I__I__I hours per day.
    2. Do not know.

17. Do you have piped water installation in your household, i.e. do you have water faucets in the sinks, washrooms, etc?
    1. Yes. ***GO to question 18.***
    2. No. ***GO to question 20.***

18. How many water faucets does your house have?

I__I__I water faucets.

19. How many showers?

I__I__I showers.

20. Do you have a toilette or washroom that you can to put water in? If so, how many toilettes does your household have?
    1. Yes, the household has a toilette where they can put water in. I__I__I toilettes.
    2. No, the household does not have a toilette where they can put water in.

21. Do you have washer machine? If so, how many loads of laundry are washed in your household per week?
    1. I__I__I loads of clothes per week.
    2. Do not have a washer.
    3. They have washer machine but he/she does not know how many loads of laundry are washed every week.

22. Do you have a garden or various pots with plants on the yards or the ceiling?
    1. Yes
    2. No

Section 3. Quality of the water for your household.

23. Do you think that the water straight from the tap is good enough for drinking?
    1. Yes it is good enough for drinking. ***GO to question 26.***
    2. No, it is not good enough for drinking. ***GO to question 24.***
    3. Do not know. ***GO to question 26.***

24. Why do you think that the water that you receive from the water supply system is not good enough for drinking?
    1. It has some smell that you do not like.
    2. It has some flavor that you do not like.
    3. It has some color.
    4. It has pathogen organisms.
    5. It gets polluted through the water distribution system.
    6. It has minerals that might be unhealthy.
    7. Other, please specify ______________________________.

25. How frequent it is that the water that you receive from the water supply system is not good enough for drinking?
    1. Always.
    2. Sometimes.
    3. Seldom (almost never).

26. Do you know if somebody in your household drunk water straight from the tap and got sick because of that?
    1. Yes. ***GO to question 27.***
    2. No. ***GO to question 28.***

27. With what kind of disease did the person or persons got sick because of drinking water from the tap?

Diarrhea	1.
Cholera	2.
Typhoid	3.
Kidney failure	4.
Hepatitis	5.
Other, please specify____________.	6.

Section 4. Satisfaction level with the current water supply service

28. How satisfied are you with the water supply service that you currently have for your home?

1. Very satisfied.
2. Satisfied.
3. Neither satisfied, nor satisfied.
4. Unsatisfied.
5. Very unsatisfied.

Why?

29. In your opinion and for the case of your house, do you think that what you pay for having water in your home is too high?

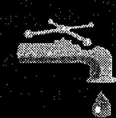
1. No, I do not think that my payments for the water are too high.
2. Yes, I think that my payments for the water are too high.

Section 5. Preferences and willingness to pay for improving the water supply service

Queretaro faces restrictions on the quantity and quality of the water available for households use. Therefore, it is necessary to improve the water supply system of the city. For example, if the leakages in the distribution system were reduced to a minimal level it could be increased substantially the amount of water available for Queretaro's people. Moreover, projects such as waste water treatment plants, high–tech purifying plants and the development of new water sources could be other ways of increasing the quality and quantity of the water available in Queretaro, for at least 50 years.

In the following question, you will be asked if you would choose significant improvements to the water supply system that takes water to your home. We are asking you to state what you would do if these services, at the described prices, were available to you. Research has shown that when people are asked hypothetical questions like this, they often say that they would choose the improvement even though it may be expensive. If they actually had to choose to really spend the money, they may choose not to accept the improvement. Please respond the question as if you actually had to pay for the improvement as described.

Table 1. Improvements to the water supply service of your home

	Suppose that for the next 50 years:
Water availability	24 HOURS A DAY 
Water quality	GOOD ENOUGH TO DRINK  Straight from the tap

30. Suppose that significant improvements were done to the city's water system of extraction, purification, treatment and distribution of the water for the households in the City of Queretaro. ***Show Table 1 and while you show the table say the following:*** In such a way, that for the next 50 years, those improvements would allow that you and the members of your household have water 24 hours a day and that the water quality is high enough so you can drink it directly from the tap.

Would you be willing to pay $|___|___|___| pesos per month, over what you currently pay, for a water supply service that, for the next 50 years, would allow your home to have water 24 hours a day and to drink it directly from the main faucet of your household?

❑ Yes ❑ No

31. How certain are you that you would actually make this choice today (of paying the stated amount for the water supply service improvements for your house)? In a scale of 1 to 10 please tell us how certain are you. Number one corresponds to not very certain and number 10 corresponds to very certain.

1	2	3	4	5	6	7	8	9	10
Not very certain									Very certain

FOLLOWING QUESTIONS ONLY FOR PEOPLE THAT ANSWERED "NO" IN QUESTION 30. For PEOPLE THAT ANSWERED "YES" PLEASE GO TO QUESTION 34.

32. Why did you answer "No" in question in the question of willingness to pay for improvements in the water supply service?

1. It is too expensive the amount of willingness to pay.
2. You feel that you do not have enough information to answer yes.
3. You already pay a lot for the water supply service.
4. You do not believe that water can be provided with such quality level.
5. You do not believe that water can be provided 24 hours per day.
6. Other, please specify______________________________.

33. Would you be willing to pay any amount for this service? If so, how much?

1. Yes, I___I___I___I pesos. ***Go to question 35.***
2. No. ***GO to question 36.***

34. Would you be willing to pay more for this service? If so, which is the maximum amount that you would be willing to pay (over what you currently pay) for the improvements in the water supply service?

1. Yes, I___I___I___I___I pesos.
2. No.

35. In which way would prefer to be charged for these improvements to the water supply service?

1. Current way, through the bill for the water utility service.
2. Through increases in the taxes paid by each person.
3. Other, please specify

36. Do you think that the Comision Estatal de Aguas and the Government of the State of Queretaro can do the necessary improvements to guarantee the water supply service to the city's population and to make that water is good enough for drinking directly from the main faucet of each house?

1. Yes.
2. No.

Why?

37. Who would prefer that manages the water supply system of the City of Queretaro?

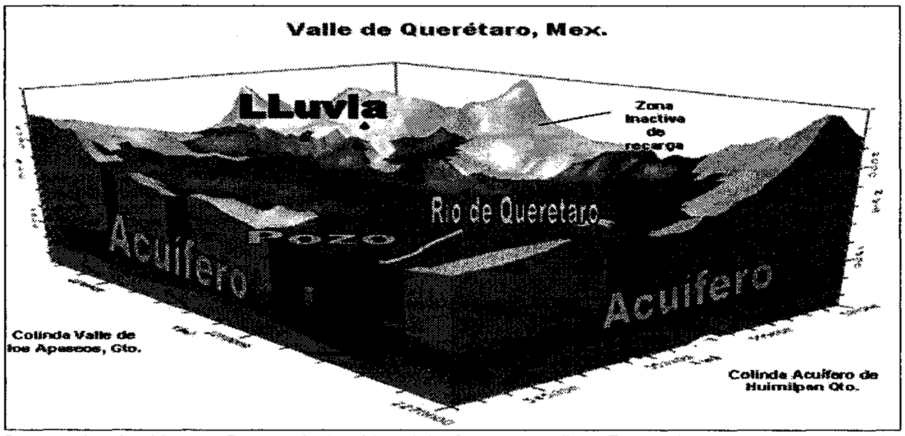
1. The Government of the city.
2. The Government of the State of Queretaro (current manager of the Comision Estatal de Aguas).
3. The Federal Government.
4. A private company.
5. Other, please specify____.
6. Do not know.

Section 6. Preservation of the water resources in Queretaro

Water scarcity in Queretaro is due to the depletion of the aquifer that supplies water to the city. (***Show the graph of the aquifer of the Valley of Queretaro***) An aquifer is a large container of water between rocks and soil underneath the surface. Most of the available water in Queretaro comes from wells that extract water from what is called the "Aquifer of the Valley of Queretaro".

However, the amount of water extracted from the aquifer has been larger than the amount that it has received in the last 60 years. This situation has worsened since 1980 because Queretaro had a fast population growth that demanded a considerable amount of water.

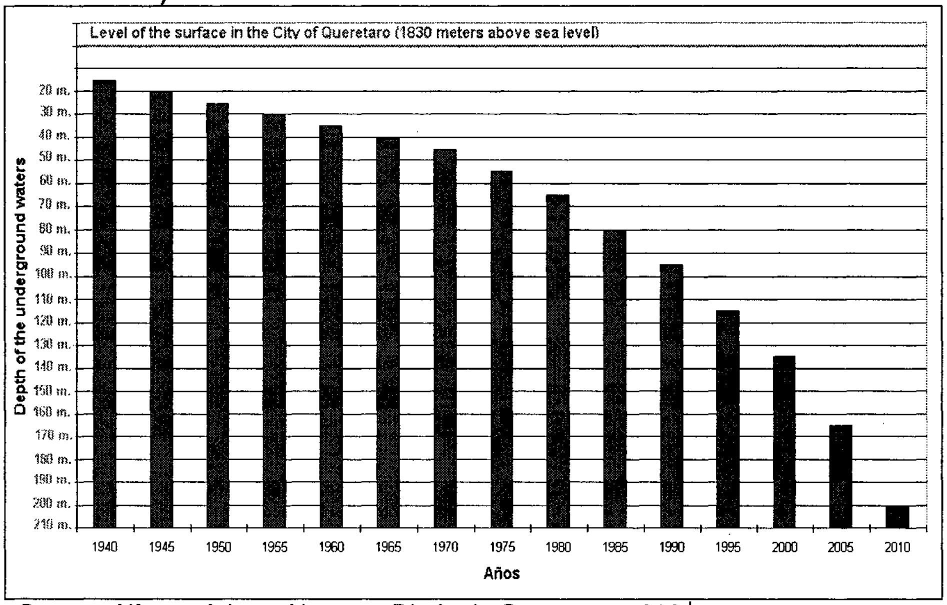
Graph 1. Aquifer of the Valley of Queretaro, source of underground water.



Source: Jessica Vanesa Briceño Ruiz, "Metodología para Realizar Evaluaciones de Impacto Ambiental para Acuíferos Sobre explotados", Tésis, Instituto Politécnico Nacional, 2004.

Show Graph 2, levels of underground water extraction in Queretaro: This graph shows the depth levels of the water available in the aquifer in the last 60 years, this is the necessary depth you would have to excavate for finding water in a well. ***Show in the graph the following***: In 1940, you could find water at 15 meters of depth. In 1980, you could find water at 65 meters of depth. For 2005, the water is being extracted at 165 meters of depth. There is also a forecast of the water levels for year 2010 if the rate of extraction remains the same. In this graph, it is possible to observe that the water reserves have reduced their levels considerably. If the city keeps extracting water that is located in low depth levels, the costs of extraction will increase considerably and the water from wells might not be adequate for drinking because it could contain harmful substances such as fluoride and arsenic.

Graph 2. Pumping level of underground water in the valley of Queretaro (historic and forecast).



Source: Alfonso Adame Negrete, Diario de Queretaro, 2000.'

38. Suppose that through projects of conservation and recuperation of the aquifer in the Valley of Queretaro, such as infiltration wells, protection of areas of recharge, programs of water savings and development of alternative water sources, it might be possible to preserve this natural resource and that the current depth level of water does not decrease for the next 50 years. In this way, it could be possible to have a reliable source of water. Would you vote for a program that guarantees the water supply for the City of Queretaro through an adequate exploitation of the aquifer if every household like yours had to pay $ |__|___|__| pesos per month for that program if the majority voted for it?

1. Yes
2. No

39. How certain are you that you would actually make this choice today (of voting for a program that preserves the aquifer and that you have to pay the stated amount)? In a scale of 1 to 10 please tell us how certain are you. Number one corresponds to not very certain and number 10 corresponds to very certain.

1	2	3	4	5	6	7	8	9	10
Not very certain									Very certain

FOLLOWING QUESTION ONLY FOR PEOPLE THAT ANSWERED "NO" IN QUESTION 39. For PEOPLE THAT ANSWERED YES PLEASE GO TO QUESTION 41.

40. Please tell us why did you answer "No" to question 38:

1. It is too expensive the amount of willingness to pay for preserving the aquifer of the city of Queretaro.
2. You are not interested in preserving the underground water sources. *GO to question 42.*
3. You feel you do not have enough information to answer yes. *GO to question 42.*
4. You already pay a lot of taxes so that the government preserves the natural resources. *GO to question 42.*
5. You do not believe that is possible to preserve the underground water resources of Queretaro. *GO to question 42.*
6. Other, please specify_________________________________. *GO to question 42.*

41. In which way would you prefer to be charged for the projects of conservation and recuperation of the aquifer?

1. Through a receipt that is sent every month charging for the projects of conservation of the aquifer.
2. Through increases in the taxes paid by each person.
3. Other, please specify ____________________________.

42. Who would you like that manages the works and projects of preservation of the Aquifer of Queretaro?

1. The government of the city.
2. The government of the State of Queretaro (Current manager of the CEA)
3. The Federal Government.
4. A private company.
5. A non-governmental organization dedicated to the environment preservation.
6. A group of professionals and scientists dedicated to the environment preservation.

Section 7. Socio-economic characteristics of the surveyed person and her household

43. Does your household have the following services? ***CHECK every answer.***

Service		
Electricity	1. Yes	2. No
Phone	3. Yes	4. No
Gas/ Natural Gas	5. Yes	6. No
Cable or Satellite T.V.	7. Yes	8. No
Internet	9. Yes	10. No

44. How much do you pay on average every two months for the electricity service?

|__|__|__|__| pesos every two months.

45. What kind of property do you have on your house?

1. Lent or you take care of it (none of the persons living there own the house).
2. Rented.
3. Self-owned and paying a mortgage.
4. Self-owned, totally paid and settled in a self-owned terrain
5. Self-owned in a terrain of irregular settlements.
6. Another kind of property, please specify________________

46. Which is the main material of the walls of your household?

1. Bricks, cement or concrete.
2. Asbestos or metallic sheets.
3. Cardboard sheets.
4. Waste materials.
5. Clay.
6. Other materials.

47. Which is the main material of the ceiling of your household?

5. Bricks, cement or concrete.
6. Asbestos or metallic sheets.
7. Cardboard sheets.
8. Other materials.

48. Which is the main material of the floors?

1. Dirt.
2. Cement.
3. Wood, ceramics or other kind of parquet.

49. Can you tell me please how old are you please:

I___I___I years old.

50. Gender of the interviewed person.

1. Female.
2. Male.

51. ¿In the current moment

1. do you live single?
2. do you live married?
3. do you live in free union?
4. are you divorced?
5. are you separated?
6. Widow.

52. Which is the highest level of education that you have completed?

1. None
2. Kindergarten
3. Elementary
4. Junior High
5. High school
6. Education school
7. Technician or commerce career
8. Undergraduate degree
9. Masters or PhD.

53. How many jobs do you have?

I___I job(s)

54. Which is your main occupation?

1. Wage-earner
2. Household duties
3. Student
4. Retired
5. Boss or employer
6. Labor or non-agricultural employee
7. Self employed (with or without paid workers)
8. Worker without a wage
9. Member of a cooperative association

55. How many people including household heads, that are older than 15 years, work to obtain an income?

I___I___I people.

56. What vehicles are owned by you and the habitants of your household for transportation? ***CHECK every answer.***

Vehicle			How many?
Bicycle	1. Yes	2. No	
Motorcycle	3. Yes	4. No	
Automobile	5. Yes	6. No	
Others Specify_____________	7. Yes	8. No	

57. Which are the domestic appliances that the household has? ***Ask in the following way: Do you have <u>appliance</u>? How many?CHECK every answer.***

Appliance			How many?
Radio	1. Yes	2. No	
Stereo	3. Yes	4. No	
T.V.	5. Yes	6. No	
V.C.R.	7. Yes	8. No	
P.C.	9. Yes	10. No	
Gas stove	11. Yes	12. No	
Stove of another kind	13. Yes	14. No	
Fridge	15. Yes	16. No	
Washer machine	17. Yes	18. No	
Gas water heater	19. Yes	20. No	
Water heater of another kind	21. Yes	22. No	
Microwave	23. Yes	24. No	
Electric iron	25. Yes	26. No	

58. On average, which is your income per month or the monthly income of the people that give money for your household? ***(Show to the participant this page and ask her to point with her finger her level of income or of the people that give money for the household).***

1. From 0 to 1,300 pesos per month
2. From 1,301 pesos to 2,600 pesos per month
3. From 2,601 pesos to 5,000 pesos per month
4. From 5,001 pesos to 6,600 pesos per month
5. From 6,601 pesos to 10,000 pesos per month
6. From 10,001 pesos to 15,000 pesos per month
7. From 15,001 pesos to 20,000 pesos per month
8. From 20,001 pesos to 25,000 pesos per month
9. From 25,001 pesos to 50,000 pesos per month
10. More than 50,000 pesos per month

Appendix D

Script for the Survey, non-connected houses to the water supply system
Spanish Version

Diálogo del encuestador
Al tocar la puerta:

-¿Disculpe se encontrará el señor o la señora de la casa? ***O pedir que si pueden hablar con la persona que vive allí y se encarga de la casa.***

-Buenos días, mi nombre es...y hoy venimos a su domicilio para invitarlo a participar en una encuesta que estamos realizando sobre la demanda de agua en Querétaro. Esta encuesta es parte de un proyecto de investigación realizado por Gustavo Mendoza como parte de sus estudios que está realizando en la Universidad de Alberta en Canadá. Esta persona junto con investigadores de esta universidad, desarrollaron esta encuesta para conocer lo que la gente de Querétaro demanda para mejorar el servicio de agua potable. Participar en esta encuesta es muy fácil, usted solo tiene que contestar algunas preguntas acerca del servicio de provisión de agua para su domicilio y acerca de algunas decisiones que usted podría realizar para que se mejore este servicio. La encuesta no le debe tomar mas de media hora.

Si la persona ACEPTA PARTICIPAR para contestar la encuesta proceda a DARLE LA HOJA INFORMATIVA Y la HOJA DE CONSENTIMIENTO. Si la persona NO ACEPTA PARTICIPAR VAYA A LA SIGUIENTE CASA.

-Ahora permítame pasarle estas hojas que incluyen la información acerca de este estudio y una hoja de consentimiento. Todo lo que yo le explicado es un resumen de lo que está escrito en estas hojas. Sin embargo, la Universidad de Alberta requiere que usted participe voluntariamente y que usted de los propósitos de esta encuesta. Toda la información que usted nos proporcione en sus repuestas es confidencial y no se compartirá con ninguna persona que no sean los investigadores.

-La Universidad de Alberta también requiere que antes de que contestemos la encuesta que le pida su consentimiento por escrito. Para ello, le pido atentamente que conteste las preguntas de consentimiento y que por favor firme la hoja de consentimiento

Nota: Cualquier pregunta o duda de la persona encuestada deberá ser contestada siempre con base en lo aprendido en las sesiones de entrenamiento. EL ENCUESTADOR DEBE ABSTENERSE DE RESPONDER DE CUALQUIER MANERA QUE NO SEA LO QUE SE ACORDÓ EN EL ENTRENAMIENTO.

Después que les den la hoja de consentimiento. *PREGUNTARLES LO SIGUIENTE:*

¿Cómo obtiene la mayor parte del agua para su casa?

- ❑ Agua entubada, su casa está conectada al sistema de abasto de agua de la Comisión Estatal de Aguas (CEAQ). ***Si la persona contesta esta opción, por favor proceda a contestar la encuesta para gente conectada al sistema de abasto de agua.***

- ❑ De otra casa cercana a la suya.
- ❑ De pipa de agua.
- ❑ De una llave pública o hidrante.
- ❑ De un pozo en su propiedad.
- ❑ De un río o arroyo.

Si la persona contesto alguna de estas opciones, por favor proceda a contestar la encuesta para gente no conectada al sistema de abasto de agua.

HOJA INFORMATIVA

La demanda por agua en la Ciudad de Querétaro, México: Un estudio de las preferencias de la gente para mejorar el sistema de abasto de agua y conservar las fuentes de abastecimiento de agua

Querétaro enfrenta una severa restricción del agua disponible para uso doméstico por lo que es necesario realizar inversiones en obras y proyectos que aseguren la disponibilidad de agua para cada habitante.

Propósito de la encuesta: Esta encuesta es parte de una investigación para recolectar información acerca de la demanda por mejoras al servicio de agua potable en su domicilio.

Contexto de la investigación: Los problemas de abasto de agua en Querétaro podrían afectar gravemente el desarrollo de la ciudad. Por lo que una persona originaria de Querétaro junto con investigadores de la Universidad de Alberta decidieron realizar una investigación que permita analizar la demanda de agua.

Métodos: Le vamos a pedir que conteste una serie de preguntas acerca del servicio de agua potable en su domicilio y de algunas decisiones que usted podría realizar para mejorar dicho servicio. El contestar esta encuesta no le debe tomar más de media hora.

Confidencialidad: La información que usted proporcione en esta encuesta es estrictamente confidencial. La encuesta la aplican un grupo de encuestadores formado por ciudadanos de Querétaro. Los encuestadores han firmado un acuerdo en el que se comprometen a guardar en absoluta confidencialidad la información que usted proporcione para esta encuesta. Los encuestadores deberán entregar todas las encuestas y los registros de su participación al investigador principal y sus profesores. El investigador principal y sus profesores serán las únicas personas que tendrán acceso a la información que usted proporcione, sin embargo, sabrán que usted participó pero ellos no podrán conocer cuáles fueron sus respuestas a la encuesta. Los resultados de esta encuesta serán publicados como un resumen total de todas las respuestas de los encuestados pero no habrá alguna forma de identificar sus respuestas a la encuesta.

Beneficios: Con su participación será posible recolectar información acerca de los beneficios económicos que se generarían por mejorar el sistema de abasto de agua. Esta información sería de gran utilidad para promover la realización de proyectos que incrementen la cantidad de agua disponible para la ciudad.

Riesgos: Los investigadores no anticipan ningún riesgo directo para usted si participa en la encuesta. Los resultados de esta encuesta se utilizarán para promover proyectos relacionados con la disponibilidad de agua en Querétaro. Sin embargo, es posible que los proyectos específicos que usted prefiera no se realicen. Esto se podría deber a que sus puntos de vista pueden diferir de los de otros miembros de la comunidad o porque existen otras prioridades en las dependencias pertinentes.

Abstinencia: Usted se puede abstener de participar en esta encuesta antes de contestar alguna pregunta y durante el proceso de respuesta al cuestionario. Después de contestar la encuesta, existe un tiempo límite de 24 hrs. para solicitar que sus respuestas y su registro de participación sean destruidos. Después del tiempo límite de 24hrs., su registro de participación y sus respuestas serán separados y no habrá forma de identificar lo que usted respondió. Por lo tanto, después del tiempo límite no será posible resolver ninguna solicitud de abstinencia de participación. Le pedimos atentamente que comprenda que este proceso garantiza la confidencialidad de todos los participantes y sus respuestas.

Uso de la información: Esta encuesta se realiza como parte de la investigación que Gustavo A. Mendoza realiza en la Universidad de Alberta. Esta investigación no tiene ningún financiamiento por parte del Gobierno del Estado de Querétaro, del Gobierno Municipal de Querétaro o de ningún tipo de empresa o compañía privada. La información que usted provea servirá para entender la demanda y preferencias de la gente por mejorar el servicio de abasto de agua. El reporte final será publicado y estará disponible para cualquier persona o entidad y será presentado ante dependencias tales como la Comisión Estatal de Aguas (CEAQ), el H. Ayuntamiento de Querétaro, la Comisión Nacional del Agua (CNA) y la Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). Le recordamos una vez más, que su registro será confidencial y no habrá manera de identificar sus respuestas a esta encuesta, solamente un resumen de los resultados será incluido en el reporte final.

Si usted tiene cualquier comentario o pregunta no dude en contactar a cualquiera de las siguientes personas:

<u>**Contactos**</u>:

Gustavo A. Mendoza
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Si tiene alguna pregunta o comentario acerca de la forma en que se realiza esta investigación que no pueda resolver con los contactos arriba mencionados por favor contacte a: Georgie Jarvis, Secretaria del Consejo de Ética Humana, 2-14 Agriculture-Forestry Centre, Universidad de Alberta, Edmonton, AB T6G 2P5. Tel. en Canadá: 00-1-780-492-8126.

GRACIAS POR SU PARTICIPACIÓN

Hoja de Consentimiento

Título del proyecto: "La demanda por agua en la Ciudad de Querétaro, México: Un estudio de las preferencias de la gente para mejorar el sistema de abasto de agua y conservar las fuentes de abastecimiento de agua"

Investigadores:

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Consentimiento

Por favor circule sus respuestas:

¿Ud. entiende que se le ha pedido participar en una encuesta sobre la demanda de agua en Querétaro, México?

SÍ NO

¿Ud. entiende que la información recopilada en esta encuesta es parte del proyecto de investigación del estudiante Gustavo A. Mendoza? SÍ NO

¿Entiende los beneficios y riesgos de la realización de este estudio de investigación?

SÍ NO

¿Ha leído y recibido una copia de la Hoja Informativa? SÍ NO

¿Ud. entiende que puede abstenerse de participar en este estudio dentro de un tiempo límite de 24 horas después de contestar la encuesta? En este caso los investigadores no usarán sus respuestas en este estudio y destruirán cualquier registro de participación o de respuestas. SÍ NO

¿Ud. está de acuerdo que después de 24hrs. que Ud. haya contestado la encuesta no será posible pedir que sus respuestas no sean utilizadas en este estudio ya que no se podrá identificar lo que Ud. respondió en la encuesta?

SI NO

¿Ud. entiende que la información que provea será guardada en estricta confidencialidad y que cualquier vínculo entre sus respuestas y su nombre o dirección serán destruidos?

SÍ NO

¿Ud. entiende que los investigadores podrían saber que Ud. participó en este estudio, pero que ellos no podrán saber lo que Ud. respondió?

SÍ NO

¿Ud. conoce que podría contactar al estudiante o los profesores listados en la sección de investigadores si Ud. tiene cualquier pregunta acerca de la investigación o de la encuesta?

SÍ NO

¿Ud. nos otorga permiso para utilizar la información y los datos que proporcionó para los propósitos especificados en la hoja informativa?

SÍ NO

¿Ud. nos otorga permiso para utilizar la información y los datos que proporcionó en esta encuesta para futuras investigaciones y análisis?

SÍ NO

¿Ud. nos otorga permiso para compartir la información y datos que proporcionó con los investigadores listados en esta hoja de consentimiento?

SÍ NO

Este estudio me fue explicado por: ______________________________

Yo acepto tomar parte en este estudio:

______________________	______________________	__________
Nombre del participante	Firma del participante	Fecha

______________________	______________________	__________
Nombre del testigo	Firma del testigo	Fecha

Yo entiendo que la persona que firma esta forma comprende lo que envuelve este estudio y que voluntariamente dicha persona acuerda su participación.

______________________	__________
Firma del Investigador	Fecha

NCH-No._____
Índice_____

UNIVERSITY OF ALBERTA
Departamento de Economía Rural
Faculty of Agriculture, Forestry, and Home Economics

La demanda por agua en Querétaro, México:

Un estudio de las preferencias de la gente por mejoras en el abasto de agua y por conservar las fuentes de abastecimiento de agua

Encuesta
PARTICIPANTES SIN TOMA DE AGUA DOMICILIARIA

Nombre del encuestador:____________________________________.
Colonia:____.
Fecha:____.
Hora en que inició:____.
Hora en que finalizó:____.

Sección 1. Fuentes de abastecimiento de agua

1. ¿Cómo obtiene la mayor parte del agua para su casa? ***Señale la principal fuente de agua para el hogar.***

   1. De pipa de agua de compañía privada o algún particular.
   2. De una llave pública o hidrante.
   3. De pipa de agua de la Comisión Estatal de Aguas.
   4. De otra casa cercana a la suya.
   5. Otra, por favor especifique______________________________.

2. ¿A quién le paga por el agua que recibe en su vivienda? ***Señale a quién se le paga por el agua de la principal fuente para el hogar.***

   1. Al presidente o tesorero de la asociación de su colonia o el encargado de pagar el recibo de las llaves públicas a la CEA.
   2. A una compañía privada o dueño particular de pipas de agua.
   3. Directamente a la Comisión Estatal de Aguas.
   4. Al dueño o casero de la casa que habita (casa rentada o prestada).
   5. A un vecino cercano a su domicilio.
   6. No paga. ***PASE a la pregunta 4.***
   7. Otro, por favor especifique____.

3. ¿Cuánto paga en promedio por mes por el agua para su domicilio?

|__|__|__| pesos por mes.

4. ¿Usualmente de dónde se obtiene el agua para beber en su hogar? ***Señale la principal fuente de agua para beber.***

   1. Compra de garrafones de agua. ***PASE a la pregunta 5.***
   2. Hirviendo el agua. ***PASE a la pregunta 6.***
   3. Usa un filtro para purificar el agua. ***PASE a la pregunta 6.***
   4. Usa sustancias químicas para purificar el agua. ***PASE a la pregunta 6.***
   5. Directamente de la fuente principal (pipa, hidrante o llave pública, etc.), pero sin hervirla o usar sustancias químicas para purificarla. ***PASE a la pregunta 6.***
   6. Otra, por favor especifique____.

5. ¿Cuántos garrafones de agua compra a la semana y cuánto paga por cada uno?

|__|__| garrafones a la semana, |__|__| pesos por cada uno.

Department of Rural Economy

6. Me podría decir por favor el número de personas que viven en el hogar.

I___I___I personas en total.

Sección 2. Disponibilidad de agua para el hogar

7. ¿Qué tipo de contenedor tiene para almacenar la mayor parte del agua para su vivienda?

1. Tinaco en el techo. ***PASE a la pregunta 10.***
2. Pileta. ***PASE a la pregunta 10.***
3. Tambos. ***PASE a la pregunta 10.***
4. Tinaco en el techo de su casa y cisterna en la casa. ***PASE a la pregunta 8.***
5. Otro, por favor especifique________________________________. ***PASE a la pregunta 10.***

8. ¿Qué tipo de sistema tiene para bombear el agua a su casa?

1. Bomba eléctrica. ***PASE a la pregunta 9.***
2. Bomba de gasolina. ***PASE a la pregunta 9.***
3. Bomba hidroneumática. ***PASE a la pregunta 10.***
4. No sabe. ***PASE a la pregunta 10.***
5. Ninguno. Usted saca el agua manualmente. ***PASE a la pregunta 10.***

9. ¿Cuántas veces al mes se utiliza la bomba? ¿Y cuándo lo hace durante cuánto tiempo se prende la bomba?

1. I___I___I veces al mes I___I___I minutos.
2. No sabe.

10. ¿Cuántos días a la semana se abastecen con agua de la fuente principal (hidrante o pipa) para el uso en el hogar (lavar la ropa, baños, etc.)? Si tiene tambos como contenedores principales, ¿cuántos tambos llena con agua a la semana?

I___I días a la semana. I___I tambos a la semana.

11. ¿En una semana normal cuántos días a la semana no se pueden abastecer con agua de la fuente principal y tiene que buscar alguna fuente alterna de agua para su hogar?

1. I___I días a la semana.
2. No les falta el agua ningún día a la semana.

12. ¿En qué meses del año por lo general no tiene agua en lo absoluto y cuándo sucede esto cuántos días dura sin agua?

________________________________. |___|___| días sin agua.

13. ¿Tiene que cargar o traer el agua para su hogar de algún lugar lejano (más de 200 m.)?

1. Sí. ***PASE a la pregunta 14.***
2. No. ***PASE a la pregunta 15.***

14. ¿Cuánto tiempo le lleva cargar el agua cada día de la fuente o de donde obtiene el agua a su hogar?

|___|___| minutos.

15. ¿Tiene usted instalación de agua entubada dentro de su casa, es decir, cuenta con llaves de agua en fregaderos, lavabos, etc.?

1. Sí. ***PASE a la pregunta 16***
2. No. ***PASE a la pregunta 18.***

16. ¿Cuántas llaves de agua tiene en su casa?

|___| llaves de agua.

17. ¿Cuántas regaderas?

|___| regaderas.

18. ¿Su casa tiene drenaje o desagüe de aguas sucias

1. a la red pública (drenaje público)?
2. a una fosa séptica?
3. a otro lado? Por favor especifique adónde se descarga el drenaje o aguas sucias de su hogar________________________________.
4. No tiene drenaje.

19. ¿Con qué tipo de excusado o sanitario cuenta su hogar? Si tiene excusado al que se le pueda echar agua ¿Cuántas tazas de baño tiene su hogar?

1. Tiene excusado o sanitario al que se le puede echar agua. |___|___| tazas de baño.
2. Tiene excusado al que no se le echa agua (letrina o fosa séptica).
3. No cuenta con excusado.

20. ¿Tiene lavadora? Si es así, cuántas cargas de ropa se lavan a la semana.
    1. |__|__| cargas de ropa por semana.
    2. No tiene lavadora.
    3. Sí tiene lavadora pero no sabe cuántas cargas de ropa se lavan a la semana.

21. ¿Tiene jardín o varias macetas con plantas en los patios y azoteas?
    1. Sí. ***PASE a la pregunta 22.***
    2. No. ***PASE a la pregunta 23.***

22. ¿De qué forma riega su jardín?
    1. Con el agua que tiene para su hogar.
    2. Con el agua residual que se desecha en su hogar.
    3. Con el agua para el hogar y el agua residual.
    4. No riega, sus plantas sobreviven sin regarlas (plantas desérticas).

Sección 3. Calidad del agua para la vivienda.

23. ¿Piensa usted que la mayor parte del agua que obtiene para su hogar la fuente principal es lo suficiente buena para tomarla directamente?
    1. Sí es lo suficientemente buena para beber. ***PASE a la pregunta 26.***
    2. No es lo suficientemente buena para beber. ***PASE a la pregunta 24.***
    3. No sabe. ***PASE a la pregunta 26.***

24. ¿Por qué piensa que el agua que recibe del sistema de abasto de agua no es lo suficientemente buena para beber? ***Señale todas las que apliquen para el participante.***
    1. Tiene algún olor que no le gusta,
    2. Tiene algún sabor que no le gusta.
    3. Tiene algún color.
    4. Tiene organismos patógenos.
    5. Se contamina a través del sistema de distribución de agua.
    6. Tiene minerales que podrían ser perjudiciales.
    7. Otra, por favor especifique________________________________.

25. ¿Qué tan a menudo es que el agua que recibe para su hogar (de la pipa o del hidrante) no es lo suficientemente buena para beber directamente?
    1. Siempre.
    2. Algunas veces.
    3. Rara vez (casi nunca).

26. ¿Cree usted que alguien en su hogar se ha enfermado debido al agua que beben?
    1. Sí. ***PASE a la pregunta 27.***
    2. No. ***PASE a la pregunta 28.***

27. ¿Con qué tipo de enfermedad?

Diarrea.	1. Sí	2. No
Cólera.	3. Sí	4. No
Tifoidea.	5. Sí	6. No
Problemas en los riñones.	7. Sí	8. No
Hepatitis	9. Sí	10. No
Otra, por favor especifique____________.		

Sección 4. Nivel de satisfacción del servicio de agua potable actual

28. ¿Qué tan satisfecho está usted con el servicio de agua que tiene actualmente para su hogar?
    1. Muy satisfecho
    2. Satisfecho
    3. Ni satisfecho, ni insatisfecho
    4. Insatisfecho
    5. Muy insatisfecho

¿Por qué?

29. En su opinión, ¿piensa que lo que paga por tener agua en su hogar es caro?
    1. No, yo no pienso que lo pago por tener agua es caro.
    2. Sí, yo pienso que lo pago por tener agua es caro.

Sección 5. Preferencias y disposición a pagar por mejorar el servicio de abasto de agua potable

Querétaro enfrenta restricciones en la cantidad y calidad del agua disponibles para el uso en los hogares. Sin embargo, se podría incrementar la calidad y cantidad del agua en Querétaro con proyectos tales como plantas de tratamiento de aguas residuales, plantas purificadoras de alta tecnología, programas de reducción de fugas de agua y el desarrollo de nuevas fuentes de agua. De esta manera, se podría incorporar al sistema de abasto de agua a los habitantes que aún no cuentan con agua entubada y aumentar la cantidad y calidad del agua disponible para estas personas.

A continuación, se le preguntará a usted si elegiría conectarse al sistema de abasto de agua entubada y contar con mejoras en el servicio de abasto de agua para su hogar. Nosotros le pedimos que señale lo que haría si estos servicios, a los precios descritos, fueran disponibles para usted. Otras investigaciones han mostrado que cuando a la gente se le hacen preguntas hipotéticas como ésta ellos usualmente escogen la mejora aun cuando ésta podría ser cara. Si ellos tuvieran que elegir si gastan el dinero realmente, ellos podrían no aceptar la mejora. Por favor, responda la pregunta como si en realidad usted fuera a pagar por las mejoras descritas.

30. Suponga que se realizarán mejoras significativas al sistema de extracción, purificación, tratamiento y distribución del agua que llega a los hogares de la Cd. de Querétaro. (***Mostrar la tabla de mejoras al servicio de abasto de agua y mientras muestra la tabla señale lo siguiente)*** De modo que esas mejoras permitieran traer agua a su colonia para que su hogar estuviera conectado al sistema de abasto de agua. Además, suponga que esas mejoras permitieran que la disponibilidad del agua en su casa fuera las 24 hrs. al día y que la calidad del agua fuera tal que la pudieran beber directamente de la llave.

Tabla 1. Mejoras al servicio de agua de abasto de agua de su hogar

	De modo que esas mejoras permitieran que:
Conexión de agua	Su casa estuviera CONECTADA al sistema de abasto de agua 
Disponibilidad de agua	24 horas al día 
Calidad del agua	Suficientemente BUENA  Para beber directamente de la llave

¿Estaría usted dispuesto a pagar $|___|___|___| pesos por mes por conectarse al sistema de abasto de agua, por tener agua las 24 horas al día y que pudiera beberla directamente de la llave principal de su hogar?

1. Sí 2. No

31. ¿Qué tan seguro está que usted realizaría esta elección hoy (de pagar o no pagar la cantidad señalada por conectarse y por las mejoras al servicio de abasto de agua para su hogar)? En una escala del 1 al 10, por favor díganos que tan seguro está usted donde el número uno corresponde a no muy seguro y el número 10 corresponde a muy seguro.

1	2	3	4	5	6	7	8	9	10
No muy seguro									Muy seguro

PARA GENTE QUE CONTESTÓ "NO" EN LA PREG. DE DISPOSICIÓN A PAGAR. PASE A LA PREG. 32

PARA GENTE QUE CONTESTÓ "SÍ" EN LA PREG. DE DISPOSICIÓN A PAGAR. PASE A LA PREG. 34

32. ¿Por qué contestó "No" en la pregunta de disposición a pagar por mejoras en el servicio de agua?
   1. Es muy caro el monto de disposición a pagar por mes por conectarse y por el servicio de agua entubada.
   2. Usted siente que no tiene suficiente información para contestar que sí.
   3. Usted ya paga demasiado por el servicio de abasto de agua.
   4. Usted no cree que el agua se pueda proveer con ese nivel de calidad.
   5. Usted no cree que el agua se pueda proveer 24 horas al día.
   6. Otra, por favor especifique______________
   ____

33. ¿Estaría dispuesto a pagar alguna cantidad por conectarse al sistema de abasto de agua y por tener agua las 24 hrs. al día y que se pueda beber directamente de la llave. Si es así, ¿Cuánto?

1. Sí, |___|___|___| pesos por mes. ***PASE a la pregunta 35.***

2. No. ***PASE a Preg. 36.***

34. ¿Estaría dispuesto a pagar más por conectarse y por las mejoras al servicio de abasto de agua? Si es así ¿Cuál es la cantidad máxima al mes que estaría dispuesto a pagar por conectarse a la red de abasto de agua y por el servicio de abasto de agua?
   1. Sí,|___|___|___|___| pesos por mes.
   2. No.

   PASE A LA Preg. 35.

35. ¿De qué forma preferiría que se le cobrarán estas mejoras al servicio de abasto de agua?
   1. Forma actual, a través del recibo del servicio de agua.
   2. A través de incrementos en los impuestos que cada persona paga.
   3. Otra, por favor especifique___________.

PASE a la Preg. 36.

36. ¿Usted cree que la Comisión Estatal de Aguas y el Gobierno del Estado de Querétaro podrán hacer las mejoras necesarias al sistema de abasto de agua para proveer con agua entubada a su colonia, para proveer agua las 24 horas al día y para hacer que el agua sea lo suficientemente buena para beber directamente de la llave?

1. Sí. 2. No. 3. No sabe.

¿Por qué?

37. ¿Quién preferiría que administrara el sistema de abasto de agua de la Ciudad de Querétaro?

1. El gobierno del municipio.
2. El gobierno del Estado de Querétaro.
3. El gobierno Federal.
4. Una compañía privada.
5. No sabe.
6. Otra, por favor especifique

Sección 6. Características socioeconómicas de la persona y su hogar.

38. Número de personas de la familia nuclear (pareja e hijos) que viven en su casa.

I I I personas de la familia nuclear.

39. Número de personas menores de 18 años que viven en el domicilio.

I I I personas menores de 18 años.

40. ¿Cuenta su vivienda con los siguientes servicios?

Servicio		
Teléfono	1. Sí	2. No
Tanques de gas/gas entubado	3. Sí	4. No
Cable o Satélite	5. Sí	6. No
Electricidad	7. Sí. ***PASE a la Preg. 41.***	8. No. ***PASE a la Preg, 42.***

41. ¿Cuánto se paga en promedio cada 2 meses o por bimestre por el servicio de luz?
|__|__|__|__| pesos bimestrales.

42. ¿De qué tipo es la propiedad de su casa?
   1. Propia y totalmente pagada en terreno de asentamiento irregular.
   2. Propia y la están pagando en terreno de asentamiento irregular.
   3. Prestada o la cuidan (ninguna de las personas que vive allí posee la casa).
   4. Rentada o alquilada.
   5. Otro tipo de propiedad, por favor especifique________________.

43. ¿Cuál es el material predominante en los muros de la vivienda?
   1. Tabique, ladrillo, tabicón, cantera, cemento o concreto.
   2. Lámina de asbesto o metálica.
   3. Lámina de cartón.
   4. Materiales de desecho.
   5. Adobe.
   6. Otros materiales.

44. ¿Cuál es el material predominante en los techos de la vivienda?
   1. Losa de concreto, tabique, ladrillo, losa de concreto o techo de cemento.
   2. Lámina de asbesto o metálica.
   3. Lámina de cartón.
   4. Otros materiales.

45. ¿Cuál es el principal material en pisos?
   1. Tierra.
   2. Cemento o firme.
   3. Madera, mosaico u otros recubrimientos.

46. Número de cuartos en el hogar (incluyendo la cocina, la sala y los baños).
|__|__| cuartos en total.

47. Me podría decir su edad por favor:
|__|__| años.

48. Sexo del entrevistado
    1. Femenino
    2. Masculino

49. ¿En el momento actual:
    1. vive soltera (o)?
    2. está casada(o)?
    3. vive en unión libre?
    4. está divorciada (o)?
    5. está separada (o)?
    6. Viudo (a).

50. ¿Cuál es el nivel más alto de educación que usted completó?
    1. Ninguno
    2. Preescolar
    3. Primaria
    4. Secundaria
    5. Preparatoria o bachillerato
    6. Normal
    7. Carrera técnica o comercial
    8. Licenciatura
    9. Maestría o doctorado

51. ¿Cuántos empleos o trabajos tiene usted?

I___I empleo(s)

52. ¿Cuál es su ocupación principal?
    1. Asalariado
    2. Ama de casa
    3. Estudiante
    4. Pensionado o jubilado
    5. Patrón o empleador
    6. Obrero o empleado
    7. Trabajador por cuenta propia (sin trabajadores remunerados)
    8. Trabajador sin remuneración.
    9. Miembro de una cooperativa
    10. Desempleado.

53. ¿Cuántas personas incluyendo a las cabezas o jefes del hogar, que sean mayores de 15 años, trabajan para ganar dinero?

I___I___I personas.

54. ¿Qué vehículos poseen usted y los habitantes de su hogar para transportarse?

Vehículo			¿Cuántos?
Bicicleta	1. Sí	2. No	
Motocicleta o Motoneta	3. Sí	4. No	
Automóvil	5. Sí	6. No	
Otros, especifique___________	7. Sí	8. No	

55. ¿Cuáles son los aparatos domésticos con los que cuenta su hogar? ***Preguntar de la siguiente manera: ¿Tiene aparato? ¿Cuántos?***

Aparato			¿Cuántos?
Radio	1. Sí	2. No	
Grabadora o estéreo	3. Sí	4. No	
Televisión	5. Sí	6. No	
Videograbadora o DVD	7. Sí	8. No	
Computadora	9. Sí	10. No	
Estufa de gas	11. Sí	12. No	
Estufa de otro combustible	13. Sí	14. No	
Refrigerador	15. Sí	16. No	
Lavadora	17. Sí	18. No	
Calentador o boiler de gas	19. Sí	20. No	
Calentador o boiler de otro combustible	21. Sí	22. No	
Horno de microondas	23. Sí	24. No	
Plancha eléctrica	25. Sí	26. No	

56. En promedio, ¿Cuál es el ingreso por mes de usted o de las persona(s) que aportan dinero para el hogar? ***(Mostrar al participante esta página y pedirle que señale con el dedo su nivel de ingreso o de las personas que aportan dinero).***

1. De 0 a 1,300 pesos por mes
2. De 1,301 pesos a 2,000 pesos por mes
3. De 2,001 pesos a 2,600 pesos por mes
4. De 2,601 pesos a 4,000 pesos por mes
5. De 4,001 pesos a 5,300 pesos por mes
6. De 5,301 pesos a 6,600 pesos por mes
7. De 6,601 pesos a 8,000 pesos por mes
8. De 8,001 pesos a 9,250 pesos por mes
9. De 9,251 pesos a 10,600 pesos por mes
10. Más de 10,600 pesos por mes

Script for the Survey, non-connected houses to the water supply system
English Translation

Dialogue for the enumerator

When you knock the door:

-¿Excuse me, is the lord or the lady of the house here? ***Or ask if you could talk with the person that lives there and takes care of the house.***

- Good morning, my name is...and today I came to your home to invite you to participate in a survey that we are doing about the demand for water resources in Queretaro. This survey is part of a research project conducted by Gustavo Mendoza as part of his studies done in the University of Alberta in Canada. This person and other researchers from this University developed this survey to know what Queretaro's people demand for improving the water supply service.

Participating in the survey is very easy, you only have to answer some questions we are going to ask you about the water supply service in your household and about some decisions that you could make to improve that utility service. The survey should not take longer than half an hour.

If the person ACCEPTS TO PARTICIPATE to answer the survey proceed to GIVE HER THE INFORMATION SHEET AND the CONSENT FORM. If the person do NOT ACCEPT TO PARTICIPATE GO TO THE NEXT HOUSE.

-Now let me pass you these sheets that include the information about this study and a consent form. All what I have explained to you is a summary of what is written in these sheets. However, the University of Alberta requires that you participate voluntarily and that you know the purposes of this survey. All the information that you give us in your answers is confidential and it will be not be shared with other people that are not the researchers.

-The University of Alberta also requires that before we conduct this survey that I ask you for written consent. For doing that we kindly ask you to answer the consent questions and to sign the consent form please.

Note: Any question or doubt from the participant must be answered always based in the instructions given to you in the training sessions. THE ENUMERATOR

MUST AVOID OF ANSWERING THE PARTICIPANTS' QUESTIONS IN ANY WAY THAT IT IS NOT WHAT WAS AGREED IN THE TRAINING SESSIONS.

After getting back the consent form. ASK THEM THE FOLLOWING QUESTION.

How do you obtain most of the water for your house?

- ❑ Piped water, your house is connected to the water supply system from the Comision Estatal de Aguas Queretaro (CEAQ). ***If the person answered this, please proceed to answer the survey for people connected to the water supply system.***

- ❑ From other house close to yours.
- ❑ From water truck.
- ❑ From a public tap.
- ❑ From a well in your property.
- ❑ From a river or a creek.

If the person answered any of these options, please proceed to answer the survey for people not connected to the water supply system.

INFORMATION SHEET

Demand for Water in Queretaro, Mexico: A Study of the Preferences for Water Supply Improvements and Water Resources Conservation

Queretaro is facing a severe restriction in the available water for domestic use that makes necessary to realize investments in projects and public works that guarantee the water availability per habitant.

Survey purpose: This survey is part of a research project to collect information about the demand for improvements in the water supply service to your household.

Background: The problems of water supply in Queretaro could severely affect the development of the city. That is why a person native from Queretaro and scientists from the University of Alberta in Canada decided to do a research project that analyzes the demand for fresh water.

Methods: We are going to ask you a series of questions about the water supply service in your household and about some decisions that you could make to improve that utility service. The survey should not take longer than half an hour.

Confidentiality: The information that you provide in this survey is strictly confidential. The survey is conducted by a group of enumerators that is formed by residents of Queretaro. The enumerators have signed an agreement where they commit to keep confidential the information shared by you. The enumerators will give all the answered surveys and the registries of participation to the principal researcher and his professors. The principal researcher and his professors will be the only people with access to the information that you give. Although, the researcher and his professors will know that you participated, they will not be able to know which survey answers were yours. The results of this survey will be published as a total summary of the answers from participants and there will not be a way to identify your answers to the survey.

Benefits: With your participation it will be possible to gather information about the benefits generated by improvements to the water supply system. This information would be very useful to promote the realization of projects that increase the water supply for the city.

Risks: The researchers do not anticipate any direct risks for you by participating in the survey. The results of this survey will be used to promote projects related to the water availability in Queretaro. However, it is possible that specific projects that you prefer might not be implemented. This may be because your views differ from those of others in the community or because of other priorities for the pertinent agencies.

Withdrawal: You can withdraw to participate in this survey before answering any question and while you respond to the questionnaire. After you answer the survey, there is a time limit of 24 hrs. to ask that your answers and your registry of participation are destroyed. After the time limit of 24 hrs, your registry of participation and your answers will be separated and there will not a be way to a identify what you answered in the survey. Therefore, after the time limit it will not be possible to resolve any request of withdrawal from participation in the survey. We kindly ask you to understand that this process guarantees the confidentiality of the participants and their answers.

Use of information: This survey is part of the research of Gustavo A. Mendoza at the University of Alberta. This research does not have any funding coming from the Government of the State of Queretaro, the Municipal Government of Queretaro neither by any company or enterprise. The information that you provide will help to analyze the demand and the preferences for improvements in the water supply system. The final report will be published and will be available for any person or party and it will be presented to agencies such as the Commission of Water in the State of Queretaro (CEAQ), the Municipality of the City of Queretaro, the National Commission of Water (CNA) and the Department of Environment and Natural Resources (SEMARNAT). We remind you one more time, that your registry will be kept confidential and that there will not be a way to identify your answers to the survey, only a summary of the results will be included in the final report.

If you have any questions or comments, please do not hesitate contacting the persons listed below.

Contacts:

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If you have any question or comment with the way the research is being conducted that could be not be resolved with the contacts listed above please contact: Georgie Jarvis, Secretary to the Human Research Ethics Board, 2-14 Agriculture-Forestry Centre, University of Alberta, Edmonton, AB T6G 2P5. Phone in Canada: 00-1-780-492-8126

THANK YOU FOR YOUR PARTICIPATION

CONSENT FORM

Project title: "Demand for Water in Queretaro, Mexico: A Study of the Preferences for Water Supply Improvements and Water Resources Conservation"

Researchers:

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Email: vic.adamowicz@ualberta.ca

Consent:

Please circle your answers:

Do you understand that you have been asked to participate in a survey about the demand for water in Queretaro, Mexico?

YES NO

Do you understand that the information collected in this survey is part of the research project of the student Gustavo A. Mendoza?

YES NO

Do you understand the benefits and risks involved in taking part in this research study?

YES NO

Have you read and received a copy of the attached Information Sheet? YES NO

Do you understand that you can quit taking part of this study within 24 hours after answering the survey? In this case, the researchers will not use your responses in the study and will destroy the records of your responses and participation.

YES NO

Do you agree that 24 hrs after you answered the survey the time limit to withdraw will have expired and it will not be possible to withdraw your participation in this study because your answers will be unidentifiable?

YES NO

Do you understand that the information that you provide will be kept in strict confidentiality and that any link between your answers and your name/address will be destroyed?

YES NO

Do you understand that the researchers may know that you participated in this study, but they will not know what you said?

YES NO

Do you know that you could contact the student or the professors listed above if you have any question about the research or the survey? YES NO

Do you give us permission to use the data and the information that you provided for the purposes specified in the information sheet? YES NO

Do you give us permission to use the data and the information that you provided in this survey for future research and analysis? YES NO

Do you give us permission to share the data and the information that you provided with the researchers listed in this consent form ? YES NO

This study was explained to me by: ______________________________

I agree to take part in this study.:

______________________	______________________	__________
Participant's name	Participant's signature	Date
______________________	______________________	__________
Witness name	Witness Signature	Date

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

______________________	__________
Signature of Investigator	Date

NCH-Number_____
Index_____

UNIVERSITY OF ALBERTA

Department of Rural Economy
Faculty of Agriculture, Forestry, and Home Economics

Demand for Water in Queretaro, Mexico:

A Study of the Preferences for Water Supply Improvements and Water Resources Conservation

Survey
PARTICIPANTS WITHOUT RESIDENTIAL WATER CONNECTION

Enumerator's name:________________________.
Neighbourhood:________________________.
Date:________________________.
Start time: ________________________.
End time:________________________.

Section 1. Household characteristics and sources of water

1. How do you obtain most of the water for your house? ***Check the main source of water for the household.***
    1. From water truck of a private company or a particular person.
    2. From a public tap.
    3. From water truck of the Comision Estatal de Aguas.
    4. From other house close to yours.
    5. Other, please specify_____________________________ .

2. Who do you pay for the water that you receive in your house? ***Check who do they pay for the water from the main source.***
    1. To the president or treasurer of your neighborhood association or to the person in charge of paying the water bill from the public taps to the CEA.
    2. To a private company or a particular person that owns the water truck.
    3. Directly to the Comision Estatal de Aguas (CEA).
    4. To the landlord or owner of the house where you live. (rented or lent house).
    5. To a neighbor close by your house.
    6. Do not pay. ***GO to question 4.***
    7. Other (specify)__________________________________.

3. How much do you pay on average per month for the water of your household?

|__|__|__| pesos per month.

4. Usually, where do you get the water for drinking in your household? ***Check the main source of drinking water.***
    6. Buying bottled water. ***GO to question 5.***
    7. Boiling the water. ***GO to question 6.***
    8. Use a filter to purify the water. ***GO to question 6.***
    9. Use chemical substances to purify the water. ***GO to question 6.***
    10. Directly from the main source (water truck or public tap) without filtering, boiling or using chemical substances to purify the water. ***GO to question 6.***
    11. Other please specify____.

5. How many bottles of water do you buy per week and how much do you pay for each bottle?

|__|__| bottles per week, |__|__| pesos per each bottle.

6. Can you tell me please the number of people that live in the household.

I__I__I people in total.

Section 2. Water reliability for the household

7. What kind of container do you have for storing most of the water for your home?
   1. Water catchment on the ceiling. ***GO to question 10.***
   2. Water sink. ***GO to question 10.***
   3. Barrels. ***GO to question 10.***
   4. Water catchment on the ceiling and a cistern in your home. ***GO to question 8.***
   5. Other, please specify____________________________ ***GO to question 10.***

8. What kind of system do you have for pumping water from the cistern to your house?
   1. Electric pump. ***GO to question 9.***
   2. Gasoline pump. ***GO to question 9.***
   3. Hydropneumatic pump. ***GO to question 10.***
   4. Do not know. ***GO to question 10.***
   5. None. You take out the water manually. ***GO to question 10.***

9. How many times per month do you use the pump? An when you do it how long is the pump on?
   1. I__I__I__I times per month I__I__I__I minutes.
   2. Do not know.

10. How many times per week do you get water (from the water truck or the public tap) for its use in your household (washing clothes, washrooms, etc.)? If you have barrels as the main water containers, how many barrels do you fill with water every week?

I__I times per week. I__I barrels per week.

11. In a normal week, how many days per week you cannot get water from your main source and you need to look for an alternative source of water for your household?
   3. I__I days per week.
   4. Do not lack of water any day per week.

12. In which months of the year do you generally do not have water at all and when this happens how many days do you last without water?

________________________________. I___I days without water.

13. Do you have to carry the water for your household from a distant location (more than 200 mts.)?

1. Yes. ***GO to question 14***
2. No. ***GO to Question 15.***

14. How much time does it take you to carry everyday the water from the source to your household?

I___I___I minutes.

15. Do you have piped water installation in your household, i.e. faucets in sinks, washrooms, etc?

1. Yes. ***GO to question 16.***
2. No. ***GO to question 18.***

16. How many faucets does your house have?

____faucets

17. How many showers?

___showers

18. Does your household have sewage or drainage of waste waters

1. To the public sewage?
2. To a septic cistern?
3. To some other place? Please specify to where to do you discharge the drainage or waste waters____.
4. Do not have sewage.

19. What kind of toilette does your household have? If you have a toilette that you can put water in, how many toilettes does your household have?

1. They have a toilette where they can put water in. I___I___I toilettes.
2. They have a toilette where they cannot put water in (latrine or septic cistern).
3. Do not have toilette.

20. Do you have washer machine? If so, how many loads of laundry are washed in your household per week?

4. |__|__| loads of clothes per week.
5. Do not have a washer.
6. They have washer machine but they do not know how many loads of laundry are washed every week.

21. Do you have a garden or several pots with plants on your yards or ceilings?

1. Yes. ***GO to question 22.***
2. No. ***GO to question 23.***

22. How do you rain your garden?

1. With the water for your home.
2. With the wastewaters that are produced in your home.
3. With the water from your home and the wastewaters.
4. Do not water the garden, your plants survive without irrigation (desert plants).

Section 3. Quality of the water for your household.

23. Do you think that most of the water that you obtain for your home from main source is good enough to drink it directly?

1. Yes it is good enough for drinking. ***GO to question 26.***
2. No, it is not good enough for drinking. ***GO to question 24.***
3. Do not know. ***GO to question 26.***

24. Why do you think that the water that you receive from your current source is not good enough for drinking? ***Check all that apply for the participant.***

1. It has some smell that you do not like.
2. It has some flavor that you do not like.
3. It has some color.
4. It has pathogen organisms (it might make people sick by infectious diseases).
5. It gets polluted through the water distribution system.
6. It has minerals that might be unhealthy.
7. Other, please specify ________________________________.

25. How frequent it is that the water that you receive for your household (from the water truck or the public tap) is not good enough for drinking directly?

1. Always.
2. Sometimes.
3. Seldom (almost never).

26. Do you think that somebody in your household has been sick because of the water that you drink?

1. Yes. ***GO to question 27.***
2. No. ***GO to question 28.***

27. With what kind of disease?

Diarrhea	❑ Yes	❑ No
Cholera	❑ Yes	❑ No
Typhoid	❑ Yes	❑ No
Kidney failure	❑ Yes	❑ No
Hepatitis	❑ Yes	❑ No
Other, please specify		

Section 4. Satisfaction level with the current water supply service

28. How satisfied are you with the water supply service that you currently have for your home?

1. Very satisfied.
2. Satisfied.
3. Neither satisfied, nor satisfied.
4. Unsatisfied.
5. Very unsatisfied.

Why?

29. Do you think that what you pay for having water in your home is expensive?

1. No, I do not think that my payments for the water are expensive.
2. Yes, I think that my payments for the water are expensive.

Section 5. Preferences and willingness to pay for improving the water supply service

Queretaro faces restrictions on the quantity and quality of water available for the households. However, the quality and quantity of water in Queretaro could be increased with projects such as waste water treatment plants, high–tech purifying plants, programs for reducing water leakages and the development of new water sources. In this way, it could be possible to incorporate to the water supply system to the residents that do not have piped water and to increase the water quantity and quality available for this people.

In the following question, you will be asked if you would choose to be connected to the piped water supply system and have improvements in the water supply service for your home. We are asking you to state what you would do if these services, at the described prices, were available to you. Other research has shown that when people are asked hypothetical questions like this they often say that they would choose the improvement even though it may be expensive. If they actually had to choose to spend the money they may choose not to accept the improvement. Please respond the question as if you actually had to pay for the improvement as described.

30. Suppose that significant improvements were done to the city's water system of extraction, purification, treatment and distribution of the water for the households in Queretaro. ***(Show the table of improvements to the water supply service and while you show the table say the following).*** In such a way, that those improvements let to bring water to your neighbourhood so that your home could be connected to the water supply system. Moreover, suppose that those improvements allow that your household has water 24 hours a day and that the water quality is good enough to drink it directly from the tap.

Table 1. Improvements to the water supply service of your home

	Suppose that:
Water Connection	**Your household is CONNECTED to the water supply system.**
Water availability	24 HOURS A DAY
Water quality	GOOD ENOUGH TO DRINK Straight from the tap

Would you be willing to pay |___|___|___| pesos for being connected to the water supply system, for having water 24 hours a day and for being able to drink the water directly from the main faucet of your household?

❑ Yes ❑ No

31. How certain are you that you would actually make this choice today (of paying the stated amount for connecting and for the water supply service improvements for your house)? In a scale of 1 to 10 please tell us how certain are you. Number one corresponds to not very certain and number 10 corresponds to very certain.

1	2	3	4	5	6	7	8	9	10
Not very certain									Very certain

FOR PEOPLE THAT ANSWERED "NO" TO THE WTP QUESTION GO TO QUESTION 32

FOR PEOPLE THAT ANSWERED "YES" TO THE WTP QUESTION GO TO QUESTION 34

32. Why did you answer "No" to the last question?

7. It is too expensive the amount of willingness to pay for connecting to the supply system of piped water.
8. It is too expensive the amount of willingness to pay per month for the water supply service.
9. You do not like or object the way in which the question is made.
10. You feel that you do not have enough information to answer yes.
11. You do not believe that water can be provided with such quality level.
12. You do not believe that water can be provided 24 hours per day.
13. Other, please specify_____________________.

GO to Question 33.

33. World you be willing to pay any amount of money for connecting to the water supply system, for having water 24 hours a day and for being able to drink the water directly from the tap? If so, how much?

1. Sí, |__|__|__| pesos per month. ***GO to question 35.***

2. No. ***GO to question 36.***

34. Would you be willing to pay more for connecting and for the water supply service improvements? If so, which is the maximum amount of money that you would be willing to pay per month for connecting to the network of water supply and for the water supply service improvements?

3. Yes,|__|__|__|__| pesos per month.
4. No.

GO to Question 35.

35. In which way would prefer to be charged for these improvements to the water supply service?

4. Through the bill for the water utility service.
5. Through increases in the taxes paid by each person.
6. Other, please specify

36. Do you think that the Comision Estatal de Aguas and the government of the State of Queretaro can do the necessary improvements to the water supply system to provide piped water to your neighbourhood, to supply water 24 hours a day and to make that water is good for drinking directly from the tap?

1. Yes 2. No 3. Do not know

Why?

37. Who would prefer that manages the water supply system of the City of Queretaro?

1. The Municipal Government.
2. The Government of the State of Queretaro.
3. The Federal Government.
4. A private company.
5. Do not know.
6. Other, please specify________________________________.

Section 7. Socio-economic characteristics of the surveyed person and her household

38. Number of people from the nuclear family (couple and children) that live in your household.

I___I___I people from the nuclear family.

39. Number of people under 18 years old that live in the household.

I___I___I people under 18 years old.

40. Does your household have the following services?

Service		
Phone	1.Yes	2.No
Gas/ Natural Gas	3.Yes	4.No
Cable or Satellite T.V.	5.Yes	6.No
Electricity	7.Yes. ***GO to question 41.***	8.No. ***GO to question 42.***

41. How much do you pay on average every two months for the electricity service?

|__|__|__|__| pesos every two months.

42. What kind of ownership do you have on your house?

1. Self-owned and paying it in a terrain of irregular settlement.
2. Self-owned and totally paid in a terrain of irregular settlement.
3. Borrowed or you take care of it (none of the persons living there own the house).
4. Rented.
5. Another kind of property, please specify________________.

43. Which is the main material of the walls of your household?

1. Bricks, cement or concrete.
2. Asbestos or metallic sheets.
3. Cardboard sheets.
4. Waste materials.
5. Clay.
6. Other materials.

44. Which is the main material of the ceiling of your household?

5. Bricks, cement or concrete.
6. Asbestos or metallic sheets.
7. Cardboard sheets.
8. Other materials.

45. Which is the main material of the floors?

1. Dirt.
2. Cement.
3. Wood, ceramics or other kind of parquet.

46. Number of rooms in the household (including the kitchen, the living room and the bathrooms).

|__|__| rooms in total.

47. Can you tell me please your age:

|__|__| years old.

48. Gender of the interviewed person.
    1. Female.
    2. Male.

49. ¿In the current moment
    1. do you live single?
    2. do you live married?
    3. do you live in free union?
    4. are you divorced?
    5. are you separated?
    6. Widow.

50. Which is the highest level of education that you have completed?
    1. None
    2. Kindergarten
    3. Elementary
    4. Junior High
    5. Highschool
    6. Education school
    7. Technician or commerce career
    8. Undergraduate degree
    9. Masters or PhD.

51. How many jobs do you have?

I___I jobs

52. What is the main occupation of the person?
    1. Wage-earner
    2. Housewive
    3. Student
    4. Retired
    5. Boss or employer
    6. Labor or employee
    7. Self employed (with or without paid workers)
    8. Worker without a wage
    9. Member of a cooperative association
    10. Uemployed

53. How many people including household heads, that are older than 15 years, work to obtain an income?

I__I__I people

54. What vehicles are used by the habitants of the house for transportation?

Vehicle			How many?
Bicycle	❑ Yes	❑ No	
Motorcycle	❑ Yes	❑ No	
Automobile	❑ Yes	❑ No	
Others Specify____________	❑ Yes	❑ No	

55. Which are the domestic appliances that the household has? *Ask in the following way: Do you have appliance? How many?*

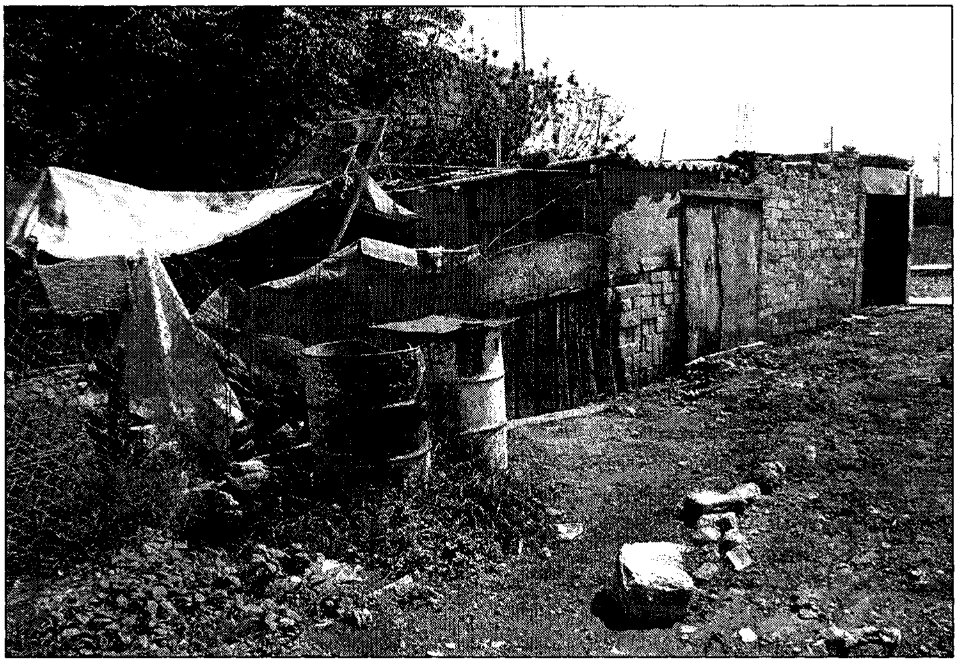
Appliance			How many?
Radio	1. Yes	2. No	
Stereo	3. Yes	4. No	
T.V.	5. Yes	6. No	
V.C.R.	7. Yes	8. No	
P.C.	9. Yes	10. No	
Gas stove	11. Yes	12. No	
Stove of another kind	13. Yes	14. No	
Fridge	15. Yes	16. No	
Washer machine	17. Yes	18. No	
Gas water heater	19. Yes	20. No	
Water heater of another kind	21. Yes	22. No	
Microwave	23. Yes	24. No	
Electric iron	25. Yes	26. No	

56. On average, which is your income per month or the monthly income of the people that give money for your household? ***(Show to the participant this page and ask her to point with her finger her level of income or of the people that give money for the household).***

1. From 0 to 1,300 pesos per month
2. From 1,301 pesos to 2,000 pesos per month
3. From 2,001 pesos to 2,600 pesos per month
4. From 2,601 pesos to 4,000 pesos per month
5. From 4,001 pesos to 5,300 pesos per month
6. From 5,301 pesos to 6,600 pesos per month
7. From 6,601 pesos to 8,000 pesos per month
8. From 8,001 pesos to 9,250 pesos per month
9. From 9,251 pesos to 10,600 pesos per month
10. More than 10,600 pesos per month

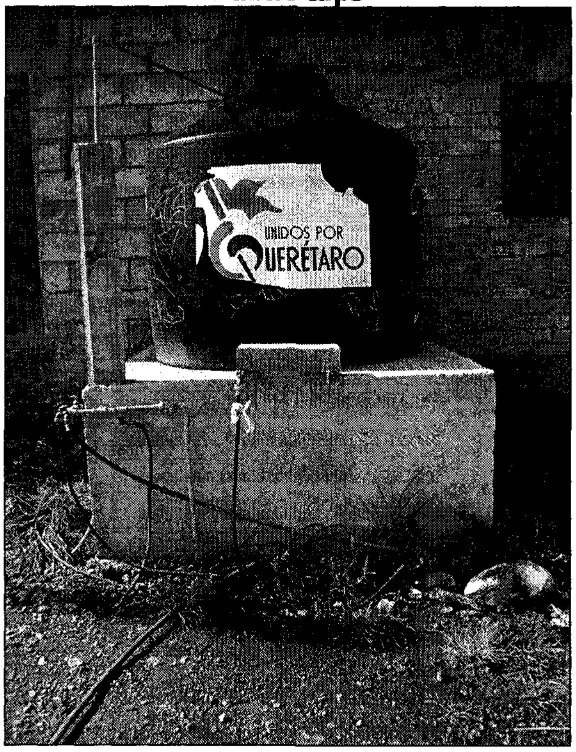
Appendix E
Illustrations of the Informal Settlements

1. Houses in the informal settlements



2. Main sources of water in the informal settlements

Public taps



Water trucks

3. Containers commonly used to store water in the informal settlements

Barrels

Buckets, sinks and various containers

4. Sanitation and hygiene services

Waste waters thrown to the streets