

2014-01-01

# A Comparison Of Water-Related Perceptions And Practices Among Residents Living In Colonias In West Texas And South New Mexico, Relying On Container Or Well Water

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A COMPARISON OF WATER-RELATED PERCEPTIONS AND PRACTICES AMONG  
RESIDENTS LIVING IN COLONIAS IN WEST TEXAS AND SOUTH NEW MEXICO,  
RELYING ON CONTAINER OR WELL WATER

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2014

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THESIS

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF PUBLIC HEALTH

Department of Public Health Sciences

THE UNIVERSITY OF TEXAS AT EL PASO

May 2014

## **ACKNOWLEDGMENTS**

I would like to thank my committee for their support through out this process. My advisor Dr. Sobin, for helping me achieve this goal and for believing in this project. For Dr. Tomaka and the great opportunity he gave two years ago when he invited me to be part of his research team.

Also, I am grateful for Dr. Ibarra for his feedback and support.

I am grateful to my parents and I could never thank them enough for their support during the years. I was blessed since the day I was born to have such supportive parents. I owe them everything I am and everything I have achieved. I am always amazed for their constant efforts and dedication to my brother and I. I am profoundly proud of them. Gracias, los amo!

I would like to thank the people I was able to meet and work with during my experience as a graduate student. To my friend Luisa Garcia for her constant support; to Dr. Holly Mata for being a great example to me as a public health advocate; to my peers and friends from the public health department and college of health sciences. I am grateful I met all of you and I know we will collaborate again in the future as public health professionals.

## ABSTRACT

In the U.S. – Mexico border region, *colonia* residents must cope with the lack of clean water supply and other basic sanitary services. Because of the lack of infrastructure, *colonia* residents rely on alternative water supplies including either private wells or hauled water stored in large above-ground containers. Little is known about residents' perceptions of their water supplies, their use practices, and how water-related use and perceptions might differ between *colonia* residents relying on well water or container water. The purpose of this study was to examine the water-related perceptions and practices of people living in *colonias*, and to compare water-use perceptions and practices, and health conditions among *colonias* using different sources of unregulated water (well water vs. container water). This study included a total of 46 residents (24 from west Texas and 22 from New Mexico). This study analyzed data collected during a water treatment sustainability and feasibility project in the Colonias. Residents completed a descriptive survey that included items pertaining to water use perceptions, practices, quality, and perceived health outcomes. Results showed that over ninety-percent of these very low-income participants purchased additional water for drinking purposes (bottled water or from watermills). Approximately seventy percent of participants had negative perceptions of their water supplies with regard to water safety, taste, and smell. Furthermore, forty-four percent of participants were concerned about having experienced waterborne illness from their water source. Overall, water treatment and testing were not practiced among *colonia* residents. Groups did not differ on factors such as water purchased; water related-illness; and perceived water quality. Secondary exploratory analyses suggested that even though participants had significant concerns about the quality and safety of their water source many consumed the water for cooking or making

beverages. Water source did not influence these discrepancies between perception and practice. The results from this study suggested that well-water and container water are equally poor substitutes for a regulated water supply. Discrepancies between perceptions and practice indicated that their water situations seriously decreased quality of life for residents. This study added to the small literature on this topic by examining current water use practices among residents living in the colonias along the U.S./Mexico border region. The results suggested the need to further examine water-related perceptions and practices of people living in *colonias* using unregulated water sources. The results could be used to promote critical practices such as improved water treatment practices. This study has implications for public health practice in providing information regarding the conditions in which colonia residents are living. Increased awareness of these conditions by the general public may eventually lead to new solutions for supporting the wellness of this population along the border region.

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## CHAPTER I: INTRODUCTION

From California to Texas, it is common to find people living on the outskirts of cities. In the U.S.-Mexico border region, these settlements are known as *colonias*. The word *colonias* translates from Spanish into neighborhood but in the border region, the word has a deeper meaning. *Colonias* is often used to describe rural substandard settlements that share many specific characteristics such as extreme poverty, unreliable potable water supply, and inadequate basic sanitation (Ward, 1999; Sumaya et al., 2006; (The New Mexico Center on Law and Poverty, 2010); Donelson & Esparza, 2010). Since the 1990's, *colonias* located along the U.S. – Mexico border have become a major public health concern because they lack clean water and sewer systems. The lack of affordable housing with rapid population growth in the border region has expanded and increased the number of *colonias* significantly, putting more people at risk of diseases (Ward, 1999; The Senate Interim Committee on Natural Resources, 2002; Olmstead, 2004). There are approximately 2,500 designated *colonias* along the US-Mexico border with more than 1,000,000 residents, mostly located in Texas and New Mexico (Donelson & Esparza, 2010).

### **What Defines the *Colonias*?**

There are several working definitions of *colonias* and different government agencies have defined *colonias* in different ways. How *colonias* are defined has an impact on the amount and type of public funds available to them. Some definitions have focused on physical characteristics, such as whether houses are self-constructed over an extended period of time (Ward, 1999). Others have emphasized the social characteristics of *colonias* such as poverty rates, language isolation and demographics (The New Mexico Center on Law and Poverty, 2010;

Mukhija & Monkkonen, 2007); or their location in relation to the border (Donelson & Esparza, 2010; Mukhija & Monkkonen, 2007).

Consistent within the definitions of *colonias* however are the very poor living conditions and the associated problems their residents face. The living conditions in *colonias* are often compared to those in third-world countries because most *colonias* lack infrastructure and basic services. For instance, most residents do not have access to clean water or sanitation facilities (Ward, 1999; Carter & Ortolano, 2004; The New Mexico Center on Law and Poverty, 2010). The main reason for this is that most *colonias* are unincorporated which means they are not part of a local, state or federal government and therefore it is not clear who is responsible for providing services to these communities (Donelson & Esparza, 2010). Additionally, the infrastructure and services needed in *colonias* is often considered too expensive for local governments to provide (Parcher & Humberson, 2009).

Location is one of the most important criteria for defining a colonia. The term colonia is used specifically to address low-income rural communities located ‘near’ the international border with Mexico (Carter & Ortolano, 2004). The definition of ‘near’ however is often debated. Usually, the definition of colonias specifies a limit of 150 miles from the U.S.-Mexico border; however, the literature has shown that *colonias* have been identified outside that specific area (Mukhija & Monkkonen, 2007). For example, Pajarito Mesa is a community located 200 miles away from the border, but meets all of the other criteria for consideration as a colonia (The New Mexico Center on Law and Poverty, 2010).

While location is usually the feature that qualifies a *colonia* to receive federal funding for services, it has been suggested that criteria other than the distance from the border should also be

used to help communities that face the same or greater challenges. Expanded criteria could improve the allocation of resources to the poorest communities (Donelson & Esparza, 2010).

### **Colonias demographics**

Most census data for *colonias* are incomplete because reaching all of residents living in the remote communities is difficult, if not impossible. The literature suggests that there are more than 2,500 settlements designated as *colonias* along the U.S.-Mexico border, with a population including over 1,000,000 people (Donelson & Esparza, 2010). From the four Border States, Texas has both the largest number of *colonias* of 2,200, and the largest number of people living in *colonias*, with an estimated population of more than 400,000 (Donelson & Esparza, 2010). New Mexico is the second largest in number and population size, with 141 *colonias* and an estimated population of 135,000 (The New Mexico Center on Law and Poverty, 2010).

In general, *colonia* residents are of Mexican origin, have lived in the U. S. for more than 50 years, and travel often across the border. About 65% of people living in the *colonias* have United States citizenship (Parcher & Humberson, 2009). In addition, *colonias* residents speak primarily Spanish, have limited education, low income and high unemployment rates, and lack basic health care services (Ward, 1999; Parcher & Humberson, 2009; Donelson & Esparza, 2010). A recent study of a colonia of El Paso County, Texas found that the average annual income was \$17,757 (Anders et al., 2010).

### **Colonias History**

The development of *colonias* began in the 1950's in response to the increased need for affordable housing along the border, especially by low-income immigrant populations (Ward, 1999). Developers took advantage of the lack of specific laws to subdivide and sell small lots of land without the proper infrastructure, sometimes with a false promise of later services (Federal

Reserve of Dallas, n.d.; Ward, 1999; The New Mexico Center on Law and Poverty, 2010).

Immigrant farm workers, who came to the U.S. for employment opportunities, were easily lured into buying these properties due to the low cost, easy financing terms, low or no down payment, and the possibility of building their houses over time without the restrictions of local building ordinances (Donelson & Esparza, 2010). However, lots in *colonias* were inexpensive only because of the lack of infrastructure and utilities typically found in subdivisions (Parcher & Humberson, 2009). Once purchased, residents of *colonias* struggle to get help in securing safe water and proper sanitation for their communities.

Many of the buyers became landholders through a contract for deed arrangement with the landowner, also known as real estate contracts (Ward, 1999; The New Mexico Center on Law and Poverty, 2010). They occupied the land with an obligation to make regular payments and would not receive the deed until the entire obligation was paid. Unfortunately, many of the occupants were unable to meet their payment obligation – sometimes only a single payment – and lost their property rights in this unregulated environment (The New Mexico Center on Law and Poverty, 2010).

*Colonias* have grown significantly because nobody was paying attention to them. It wasn't until 30 years after *colonias* began, in the 1980's, that they began to receive attention from the local and national media, mainly because of concerns for public health created by continually-growing neighborhoods with unsanitary living conditions (Mukhija & Monkkonen, 2007; Parcher & Humberson, 2009).

### **Colonia efforts in Texas and New Mexico**

*Colonias* exist along the U.S. -Mexico border from California to Texas, as well as in the Mexican border states of Baja California, Sonora, Chihuahua, Coahuila, Nuevo Leon and Tamaulipas. However, they are mostly concentrated in Texas and New Mexico. In Texas, the State government, pressured by the media and non-governmental organizations who became alarmed in the 1980's by the unsafe living conditions in these communities, enacted several Bills to address the issues. One of the most important of these was Senate Bill 2, passed during the 71<sup>st</sup> Texas Legislature in 1989. The primary focus of Senate Bill 2 was to control the development of more *colonias* and to create programs to provide funds for water and sewer system projects to ensure safe water and sanitation services (Texas Secretary of State, n.d.). This legislation however did not address the underlying problem that caused the development of *colonias* in the first place, that is, insufficient affordable housing on the border for low-income populations (Parcher & Humberson, 2009).

One of the programs developed for *colonias* by Senate Bill 2 was the Economically Distressed Areas Program (EDAP), which was implemented through the Texas Water Development Board (TWDB) in 1989. The EDAP grants were available for communities without clean water and adequate sewer systems, specifically for those located in poor counties where the per capita income was 25 percent below the state average (Parcher & Humberson, 2009). Although research suggests that the program did not achieve the results expected during the first decade, the progress of the projects in *colonias* funded through the EDAP increased significantly after 1997 (Carter & Ortolano, 2004). Carter and Ortolano (2004) analyzed the EDAP's performance from 1989 to 2002. They reported that before 1997 only nine of EDAP's projects were completed and benefited 22,000 residents. In contrast, 30 projects serving a total of 75,000 residents were finished from 1998 to 2002. Furthermore, Senate Bill 2 approached

another important issue in *colonias*, that is, the subdivision of land. Under the legislation, the Model Subdivision Rules (MRS) were enforced. By applying the MRS, subdivisions divided into 5 acres or less were required to provide the needed adequate water and sewer infrastructure (Parcher & Humberson, 2009).

The 76<sup>th</sup> Texas Legislature enacted Senate Bill 1421 in 1999. The Bill was passed to further administrate colonia infrastructure priorities for water and wastewater services. One of the primary functions of this Bill was to create positions for a Director of Colonia Initiatives Program and ombudspersons who will focus on the border counties with the most populated *colonias* – including El Paso County (Texas Secretary of State, n.d.).

The 77<sup>th</sup> Texas Legislature enacted Senate Bill 312 in 2001. The Bill provided funds for the development of the Colonia water and wastewater Self-Help Program (CSHP). The purpose of the CSHP was to foster collaboration of non-profit organizations with colonia residents to work together to develop the infrastructure needed in their communities (The Senate Interim Committee on Natural Resources, 2002). The premise was that non-profit organizations would be able to collaborate with residents to develop more water and wastewater self-help projects if they had the access to funds and grants. Furthermore, with Senate Bill 312, residents were required to participate actively by either providing a percentage of the cost of the projects constructed in their communities or by providing sweat equity or labor (Texas Secretary of State, n.d.).

The 79<sup>th</sup> Texas Legislature enacted Senate Bill 827 in 2005. SB 827 required establishing a colonia identification system to track the progress of *colonias* projects funded by the state. As a result, the Colonia Initiative Program adopted a colonia identification system developed by the TWDB. In this system, *colonias* were classified by health risks based on their infrastructure status (See Table 1).

Table 1 – Classification criteria for *colonias*\*.

Degree of Health Risk	Color classification	Criteria:
High health risk	Red	1. Inadequate wastewater disposal (cesspools). 2. Lack of potable water supply 3. Not platted.
Medium health risk	Yellow	1. Some lots lack solid water disposal (trash collection). 2. Lack drainage. 3. Not all roads are paved.
Low health risk	Green	1. Platted. 2. Have a potable water supply. 3. Have adequate wastewater disposal. 4. Have solid waste disposal. 5. All roads are paved.

\* Tabled Information taken from (The Colonia Initiatives Program of the Office of Texas Secretary of State, 2006).

In 2006, The SB 827 final report revealed that using the classification criteria above, from the 1,786 *colonias* designated in Texas, 442 *colonias* with an estimated population of 62,675 were classified as red. In contrast, 636 *colonias* with an estimated population of 145,408 were classified as green. However, 312 *colonias* were classified as unknown. (The Colonia Initiatives Program of the Office of Texas Secretary of State, 2006).

Several other initiatives have enhanced efforts to build capacity and community self-development such as educational and professional development, job networking, and health and human services in *colonias*. For instance, one of the *Colonias* Programs projects is the TAMU water project. The TAMU water project or TAMU Proyecto de Agua is a community-based initiative dedicated to the production, distribution, and research of affordable, appropriate technology such as point-of-use ceramic water filters, for residents in the Texas *Colonias* and other rural communities.

Conditions differ in Texas and New Mexico. For example, currently in New Mexico, there are no regulations governing contracts for deed. The growth of *colonias* is likely to

continue in the absence of legislation that protects low-income residents in the border (The New Mexico Center on Law and Poverty, 2010). At the same time, the illegal subdivision of land has been addressed in the state legislature. The New Mexico Subdivision Act was passed by the state in 1995. The main purpose of the act was to control the subdivision of land through the then existing loopholes in the law (The New Mexico Center on Law and Poverty, 2010). Under this act, sellers were required to inform buyers about legal issues with the lands. Other programs and organizations involved in *colonias* in New Mexico include the Colonias Development Council (CDC), which advocates for colonia residents rights, specifically on social, environmental, and economic issues (The New Mexico Center on Law and Poverty, 2010). The Department of Housing and Urban Development (HUD) through the HUD's Colonias Initiative Program works with local, state and federal partners to improve the quality of life of colonia residents. The program aims to address *colonias* issues such as safe housing, and environmental, socioeconomic, and community development. Also of note, New Mexico State funds the Colonias Initiative. The initiative was developed in 2005 and was designed to support infrastructure development in colonia communities.

### **Research in Colonias**

In a comprehensive review of the literature it was found that nine studies had been completed on health or health-related issues in the *colonias*. For example, in 2000, the Office of Border Health (OBH), through the Texas Department of health, conducted a study on the health and environmental conditions of Texas border counties and *colonias*. The study provided the first population-based data on the health status in the Texas-Mexico border area. Although its focus was not specific to *colonias*, it provided some preliminary data on the living conditions of the residents in *colonias* and non-*colonias* areas in the border region (Dutton et al., 2000). The study

suggested that, during the time of the study, there was a higher incidence of diarrhea episodes in children living in *colonias*; specifically, *colonia* children one year to five years old were much more likely than non-colonia children to have had diarrhea in the past two weeks. (Dutton et al., 2000).

Leach and colleagues (2000) investigated the prevalence of Cryptosporidiosis infection, caused by the intestinal parasite *Cryptosporidium parvum*, in children living in rural and urban communities in south Texas. The study compared the virus prevalence among 285 children living in *colonias*, urban border communities, and urban non-border communities. The study suggested children living in *colonias* (89%) and living in urban border communities (82%) were more prone to having the C. Virus than those living in non-border communities (46%). Also, the study suggested that some of the risk factors associated with the infection in colonia children were age, income and water source. In the study, children were more likely to get the infection if they drank municipal water, had a lower income, and their age increased.

Anders and colleagues (2010) conducted a health survey of a colonia located in west Texas. The study aimed to assess the functional health status and the general health perceptions of 216 residents of a community located in El Paso, Texas. The study suggested that *colonia* residents were more prone to experience health disparities than the general populations of El Paso or Texas. Some of the health issues self-reported in the study included binge drinking or problems related to alcohol, smoking, diabetes, depression, and other mental disorders such as anxiety. Furthermore, participants' perceptions of general health showed that diabetes and access to health care were the greatest concerns in this population.

There has been some research regarding the cost of providing municipal water supply to *colonias*. For example, Martinez et al. (2010) conducted an economic analysis of decentralized

options for providing water service to low-income settlements (*colonias*) in El Paso, Texas. The authors suggested that while the cost of providing piped-in water supply for *colonias* could be more than \$119,000 per lot, the solution for these communities could be the construction of community wells (serving, for example, four families). The cost of building a well for a colonia could be about \$13,980 for the initial investment with a \$113 annual fee for maintenance and operation (Martinez et al., 2010).

Other studies have looked further into the reasons for the absence of services in *colonias*, especially regarding water and wastewater systems (Olmstead, 2004). Some studies suggested that *colonias* have been neglected because residents do not represent a strong market for private sector investment. Others suggested that local governments were not able to afford the costly infrastructure for the services needed. It has also been noted that weak political influence accounts for the lack of services in *colonia* communities (Olmstead, 2004).

Percher and Humberson (2009) analyzed the use of the U.S. Geological Survey (USGS) Geographic Information System (GIS) to improve the information gathered on the physical conditions, infrastructure and health needs in *colonias*. This research was developed to comply with the Texas Senate Bill 827 and found that these methods significantly improved the tracking of *colonias* being served by state-funded projects.

Recent research in *colonias* also included the Korc and Ford (2013) analysis of the application of the Water Poverty Index (WPI) to *colonias*. The WPI is a measure used to study water scarcity. This measure links household income and wealth with water availability. In their study, Korc and Ford suggested that the WPI can be an effective tool in integrating physical, social, economic and environmental information and for determining priorities associated with the water situation in *colonias*.

## **Colonia Access to Drinking Water and Health Implications**

One of the most pervasive and problematic issues for residents of the *colonias* is access to safe drinking water. Because infrastructure for water is absent, residents of *colonias* must use alternative ways of obtaining water for household/cleaning and drinking purposes. Alternative water sources can include hiring water haulers or digging their own wells for household/cleaning purposes, or filtering water or buying bottled water for drinking and cooking. Some of these alternative sources may expose them to health risks such as water-borne illnesses, contamination, and diseases such as diarrhea and cholera (Korc, 2011; Maier et al., 2008).

Residents of *colonias* in Texas rely primarily on hauled water as an alternative supply and spend a significant amount of money on water. One study found that the water costs in *colonias* exceeded \$808 per year per household, and that people from one *colonia* paid from \$25 to \$40 per load of water delivered to their homes every two or three weeks (Martinez et al., 2010). Thus, for people with very little income, the cost of water can require a significant proportion of a family's yearly income and create great economic burden. Another problem encountered is when residents refuse to use hauled water for drinking because they believe it to be unsafe. Consequently, they may purchase additional water for drinking from stores or from vending machines, which is a major economic burden for families who are already living on very little income.

Also important to consider, the storage of hauled water can create serious health risks for people in *colonias*. Many families use large containers to store large amounts of drinking water. Figure 1 below shows a typical container used by a colonia family. Sometimes people are not aware of the proper cleaning practices needed for these large containers, so they either do not clean them or use inadequate or excessive amounts of chlorine. For example, the Texas

Department of Health (2000) reported that the residual chlorine levels were inadequate (too low) in almost all *colonias* that store drinking water in large containers (Dutton et al., 2000). Also, people do not use the recommended containers to store their water. For example, it is advised to use black tanks to store drinking water to prevent algae growth (the absence of light limits algae growth) (Maier et al., 2008), but few families follow this recommendation.



Figure 1 – A typical container used by a colonia family in West Texas



Figure 2 – Private wells commonly found in *colonias* in New Mexico

Although *colonias* have similar water accessibility issues, the details of their situations differ. In New Mexico, *colonia* residents use primarily well water as shown in Figure 2. Well water often represents a public health concern for reasons that differ from those in *colonias* using hauled container water. The main concerns regarding well water are related to the fact that these wells are unregulated. Residents often dig their own wells and then install septic tanks nearby. In these cases, the digging is not supervised by professionals and the well water is not certified as safe for public consumption. As a result, the contamination of groundwater by naturally occurring or manmade contaminants poses a threat for the people.

### **The Purchase of Drinking Water in Colonias**

Residents of *colonias* often purchase additional water specifically for drinking purposes, regardless of the quality of their home water supply (e.g., container, or well water). Bottled water is popular and its nationwide use has increased significantly over the past decades. In 2009, sales

exceeded eight thousand millions of gallons and accounted for more than 10 thousand million dollars in revenue in the U.S. alone (Rodwan, 2010). For this reason, researchers have been studying the factors that influence drinking water purchase in general, and bottled water purchase in particular. This research suggested that some of the factors for acquiring additional water specifically for drinking purposes included taste, perceived quality, and health concerns. Implications of choosing alternative drinking water sources included additional cost, health consequences, and environmental concerns (Doria, et al., 2009; Gorelick, et al., 2011; Hobson, et al., 2007).

Most published research on the purchase of drinking water focused on communities with access to safe municipal water sources. The issue of purchasing drinking water, however, has many different implications for residents of communities, such as those living in *colonias*, for whom the purchase of water is not an alternative but the only way to ensure health and avoid disease.

The majority of studies examined people with access to safe water, and there are far fewer studies examining the purchase of drinking water among residents of communities without access to a municipal water supply. For example, Jones et al. (2005) studied the perception of drinking water in rural areas of Hamilton, Ontario, Canada by people who relied on water from private wells. They conducted a series of focus groups to characterize this population's perception of drinking water from private water supplies. They identified key concerns shared by 15 participants. Most participants trusted the quality of water from private supplies. They believed the taste was better than municipal water systems or even bottled water. Participants showed a negative response to bottled water because of the perceived poor taste and the unknown source of the water.

At the same time, researchers noticed that the residents wanted to be informed about the measured quality of their water supply. For example, residents were concerned about bacterial and chemical contamination. The study also suggested that testing was a common issue among participants. Residents could not afford the cost of testing their personal water supply and did not feel that they were given enough specific information about it. Following this study, Jones et al. (2006) conducted a cross-sectional study of 246 residents relying on private water supplies (i.e. private wells and/or cisterns) in the same community of Hamilton, Ontario. The study assessed water quality perceptions, water testing behaviors and self-reported desire for information regarding their water source. Similar to the findings from the focus groups, most participants were concerned about bacterial and chemical contamination. Participants in the second study, contrary to the previous study, had more favorable views regarding bottled water. Also, they reported using some type of water treatment; however, researchers concluded that the use of treatments were mainly to improve the taste and to reduce the hardness of the water supply. From the study the researchers concluded that residents' perceptions of their water supply, including the taste and odor of tap water, and the perceived quality, were key determinants leading people to avoid tap water for drinking purposes. However, the study also showed that participants used treatment systems because they perceived them to be helpful in reducing bacterial, metal, and chemical contaminants from their water supplies.

As suggested by the research above, health concerns influenced people's decisions regarding seeking alternative water sources. No other studies have examined these types of perceptions and associations of perceptions with behavior (i.e., water purchasing) in underserved communities.

A lack of safe drinking water, whether attributable to unsafe conditions caused by container or well water, can contribute to several adverse health outcomes including but not limited to diarrhea, Hepatitis A, Salmonella, Cryptosporidiosis, Shigella Dysentery (Gundry, Wright & Conroy, 2004; Korc, 2011; Leach et al., 2000). Among colonia inhabitants, children are at high risk because their developing digestive systems are more susceptible to stomach diseases such as diarrhea (Dutton et al., 2000). Especially in developing countries, diarrhea is one of the top leading causes of death in children. There are reports that estimate 1.5 million children die each year from diarrhea, a disease that is preventable and could be avoided with clean drinking water sources and sanitation (UNICEF/WHO, 2009).

Diarrhea is of particular concern in the *colonias*. In 2000, the Texas Department of Health (TDH) reported a 2-week diarrhea prevalence of 20% in children under one year of age in *colonias* of Texas (Dutton et al., 2000). Also, the rates of Shigella Dysentery and Hepatitis A were found to be four times higher along the U.S.-Mexico border than the national average (Carter & Ortolano, 2004).

To summarize, although there have been efforts to develop water and sanitation projects in *colonias* (Texas Secretary of State, 2010) the problem remains unsolved. Despite federal recognition of this dire public health problem, relatively little research has been conducted to better understand the characteristics of those living in *colonias* and thus their possible needs. One of the greatest sources of health threats in *colonias* is the lack of access to clean drinking water. Residents of these communities often rely on alternative water supplies such as hauled water, which is kept in containers, and/or uncertified private wells that may be dug close to septic tanks.

Research is needed to examine factors that contribute to how residents perceive and respond to unsafe water conditions. Understanding what drives residents' decisions and behaviors can guide the development of interventions and programs to improve basic practices in the *colonias*.

Very little research has been done to describe the characteristics and practices of people who must cope with living with unsafe, expensive, or no sources of clean water. Regional differences with regard to the primary water source, i.e., container water versus well water, might impact the types of water-related problems that residents experience and their perceptions of their water supply. Knowing the characteristics and practices of people who must deal with potentially unsafe containers or well water, and characterizing the possible outcomes of conditions related to water from containers or “homemade” wells, could help increase awareness of this often-ignored population and guide targeted interventions, thereby improving the efficient use of available funds.

### **Healthy People 2020**

Healthy People is a U.S. federal initiative which develops 10-year national health objectives for the entire country. Healthy People 2020 provides an update on previous goals and objectives and expand to current health issues. In the initiative's environmental health topic, there are several objectives regarding environmental issues including water quality. The two objectives for water quality include extending the service of safe water systems to more people and reducing the number of waterborne disease outbreaks related to drinking water. This project aligns with both of the objectives set up for water quality by raising awareness about the lack of safe water issues in *colonias* and documenting the great need these communities have for getting

access to safe drinking water. At the same time it will help raise awareness also about waterborne diseases.

### **Rationale and Purpose**

Most people living in the U.S. are unaware of the problems that *colonia* residents face. Surprisingly little data is available regarding the basic water practices and perceptions of water conditions by *colonia* residents. There is only general acknowledgement that the current conditions are unacceptable. This study contributes to the small but growing literature on *colonias* that provides much needed information about how its residents live and cope with the lack of potable water. By characterizing in greater detail the perceptions and behaviors of people in the *colonia* communities with regard to their water sources, this study could aid in raising awareness among the public and public officials who are in a position to take action.

This study examined responses from *colonia* residents living in two distinct areas near the U.S.-Mexico border, west Texas and New Mexico. *Colonia* residents living in west Texas rely on transported container-stored water; while residents living New Mexico rely primarily on unregulated wells. The goal of this study was to provide a more detailed description of conditions in *colonias* and more specifically, to compare water-use perceptions and practices, and health conditions among *colonias* using different sources of unregulated water. A total of 47 residents (23 from west Texas and 24 from New Mexico) participated in focus groups and completed a survey regarding their water source and water-use perceptions and practices as well as their perceived water quality.

This study had three hypotheses:

- 1) We predicted that water source would be associated with water purchase; specifically, that more residents using container water purchased water than residents using well water.

2) We predicted that water source would be associated with water-related illnesses; specifically, more residents using container water reported more water-related illnesses than residents using water from private wells.

3) We predicted that water source would be associated with perceived water quality; specifically, residents using container water perceived water quality as being lower than did people using water from private wells.

## CHAPTER 2: METHODS

### Overview

Data for the present study were part of a larger Environmental Protection Agency funded study, which examined the feasibility and sustainability of Point of Use water treatment systems in *Colonias* of the Paso del Norte region. The purpose of the larger ongoing study is to investigate the feasibility and sustainability of POU water treatment technologies in *Colonias*; and also to demonstrate implementation of POU water treatment systems for migrating environmental, social, and economic challenges faced by *Colonias* due to unsanitary drinking water and violations of environmental justice. The larger project has four phases and is currently in Phase 3.

Participants were eligible to participate if they were: (1) adult heads of households; (2) without access to municipal water; and (3) are concerned about their water quality. The UTEP Institutional Review Board approved this study. Informed consents were obtained by all participants.

### Design

The study design was cross-sectional and analyzed data collected as part of an ongoing Point of Use (POU) water quality treatment systems and environmental justice project among *colonia* residents living in Paso del Norte region. The data was collected as part of Phase 1 of the Water Quality Evaluation and Community Assessment phase of the project from December 2012 to March 2013 at 3 locations: Hueco Tanks, Texas; Hillcrest Estates, Texas; and Mesquite, New Mexico.

This study used a community assessment survey, which consisted of three sections: water source, water quality and demographics. The survey characterized *colonia* residents' sources of

water, possible health conditions, water quality perceptions (i.e. taste, and smell), and concerns about contaminants.

## **Setting**

El Paso County is located on the western tip of Texas along the border of Mexico by the Rio Grande River. There are approximately 350 *colonias* in El Paso County, Texas where more than 3,500 residents have no potable water services (Martinez, 2010). Similarly Dona Ana County is located on the southern edge of New Mexico, along the Rio Grande River. There are 141 designated *colonias* in New Mexico with more than 135,000 residents most of whom rely on private or shared wells (*Colonias issues in New Mexico*, 2010). For the purpose of the larger project, three *colonias* were selected to participate in the study. The *colonias* chosen were: Hueco Tanks, Texas; Mesquite, New Mexico; and Hillcrest Estates, Texas.

## **Participants**

Participants for the analysis included 47 *colonia* residents residing in Hueco Tanks, Texas; Mesquite, New Mexico; and Hillcrest Estates, Texas. All 47 completed a water quality evaluation/community assessment survey, which was administered by research assistants. The present study received UTEP Institutional Review Board exemption and all *colonia* residents participated voluntarily.

## **Procedure**

Each study participant participated in a two-hour focus group. Each focus group consisted of 5 - 10 persons. During the focus groups participants signed an informed consent and completed the survey regarding their water source and water quality perceptions about their water. After *colonia* residents' completed the survey and participated in the focus group, the moderator asked them to talk more about their current water source. All participants were asked

to talk about their specific water source - either a well or water not from a well (usually hauled and container-stored water) - and to express their concerns and issues with that specific water. Later, participants were presented with different water filters and were asked to discuss their perceptions about each one including what advantages and disadvantages they saw in each, and which they preferred most.

Each participant received a meal and an incentive in form of a prepaid gift card of \$30 for participating in the study. The focus groups took place in community centers and churches. In Hueco Tanks, the focus group was held in a church "El Linaje Escogido"; in Mesquite, the focus groups were held in a the community center "Del Cerro Community Center"; and in Hillcrest Estates, the focus groups were held in a Christian church.

### ***Water Quality Evaluation/Community Assessment***

The research team developed a survey based on previous research on water quality. The survey was available in Spanish or English to match participants' language preference. It contained 46 items and it was divided into three sections.

**Section I- Water Source.** This section assessed participants' current sources for drinking water, water purchasing and water use patterns (i.e., drinking, household cleaning). Some examples of the items of this section were; "what is your household's main source of water for the kitchen, bathroom, and laundry", "is this your household's main source of drinking water, on an average day", how much potable water does your family consume. Items 1, 3, 4, 8, and 12 comprised this section. For the analysis of question 1, the variable was recoded into a binary variable with the values of: 1 – well water and 2 – not well water, (people with municipal water were not included in the analysis). (*See appendix A.*)

**Section II- Water Quality.** This section included questions on perceptions of water quality from a primary source on multiple dimensions (taste, smell, and perceived safety). Also, this section assessed the level of concern about the overall safety of the water from primary source and level of concern from contaminants. Items for section included 21, 22, 23, and 36. Items 21-23 were recoded as “disagree”, “neither disagree or agree”, and “agree”. (*See appendix A for additional detail*).

**Section III-Demographics.** This section included questions on age, gender, ethnicity, education, time living at current home, number of persons living in the same house, and household income. Household income was recoded into a binary variable with two levels, “at or below poverty level” and “above poverty level” using the U.S. poverty level for a family of four as a cut point.

### **Data Processing and Analysis**

Prior to data entry, survey forms were checked for accuracy and completeness and all data were entered into an SPSS database and double-checked for accuracy. During this process missing data was discovered and participants were approached again to offer them the opportunity to complete the survey. From this effort we were able to recover data from 12 participants. The rest of the participants were not located either because they did not give contact information while responding to the survey; or their numbers were changed or disconnected. Thus the percents of the results were based on reported information.

Descriptive and inferential analyses were conducted using SPSS 20. Descriptive statistics were used to describe the sample including means and/or frequencies for all variables included in the analysis. Inferential statistics (e.g., chi-square tests as appropriate) were used to evaluate whether differences exist between residents whose main water source is container water versus

well water. Demographic variables included gender, age, income, level of education, years living in current home, and number of persons living in the same household. The primary independent variables were type of water used (well water or container water) and the primary dependent variables were amount of water purchased, self-reported water-related disease, and perceived water quality.

### CHAPTER 3: RESULTS

Data from 47 participants were collected; 46 met the inclusion criteria (one participant was excluded because the participant reported not living in *colonias* permanently). Data were collected over the course of a 6-month period by a team including investigators from the University of Texas at El Paso (UTEP) and New Mexico State University (NMSU). Survey data were collected at the beginning of focus groups including 5–10 participants. A total of 6 focus groups were held. The identity of subjects was protected through the use of an anonymous subject code.

Prior to data entry, survey forms were checked for accuracy and completeness and all data were entered into an SPSS database and double-checked for accuracy. Prior to the analysis of data, all variables were checked for distribution properties. Variables for years lived at home, the amount of water consumed for drinking and the amount used for cooking were recoded into a new dichotomous categorical variable after finding out they were not normally distributed. The hypotheses to be tested included:

This study had three hypotheses:

- 1) We predicted that water source would be associated with water purchase; specifically, that more residents using container water purchased water than residents using well water.
- 2) We predicted that water source would be associated with water-related illnesses; specifically, more residents using container water reported more water-related illnesses than residents using water from private wells.
- 3) We predicted that water source would be associated with perceived water quality; specifically, residents using container water perceived water quality as being lower than did people using water from private wells.

The analyses included three stages. Demographic characteristics of the sample were first summarized and compared by group to identify characteristics that would need to be controlled for in the main group comparisons of differences by water source; next descriptive statistics of water use practices and perceptions were summarized; lastly, group differences were compared statistically to determine whether observed differences were significant.

### **Demographic Characteristics of Participants**

Table 2 shows the demographic characteristics for the total sample and for the identified comparison groups (participants with well-water versus container water). The distributions for each of the variables are shown Figures 3 – 23.

Possible differences in demographic variables by comparison group were tested with either chi-square or t-test. As indicated in Table 2, age was the only variable that differed significantly between groups ( $t = 2.071$ ,  $p = .045$ ). All subjects provided demographic characteristics with the exception of 18 subjects who did not report income, and 4 subjects who did not report ethnicity. The sample was fifty-six percent female with a mean age of 47.98 years. Of the subjects willing to report ethnicity, all were self-identified as Hispanics. Thirty-five percent of subjects reported income consistent with living below the federal poverty level for a family of four (\$23, 550 annually). Forty-eight percent of the participants used well water while fifty-two percent of participants used above-ground storage container water.

### **Descriptive Summary of Water-Use Practices and Health Outcomes**

Participants were asked to identify the specific water-use practices for their primary water source. Table 3 shows the results of these questions. More than half of the participants used the water to brush their teeth (65.1%) and about a third of the participants (26.7%) used their water source for cooking. When comparing groups descriptively, thirty-six percent of the participants

using private wells reported cooking with the water while about seventeen percent of the people using container water use the water for cooking. Further, no participants in the container water group indicated using their water to prepare coffee or tea, while approximately thirty-six of the participants using private wells indicated using their water for coffee or tea. Chi-square was used to test whether the observed group differences were statistically significant. As shown in Table 3, the only significant difference found was with regard to use of water source for making coffee and/or tea. Those participants using private wells were significantly more likely to use their water for making coffee and/or tea.

Based on data collected in this study, ninety-one percent of the participants using private wells purchased additional water for drinking purposes, while ninety-two percent of the participants using container water purchased drinking water. Because the percentages were so similar, a test of significant difference was not performed. Based on these data, it was concluded that there were no differences in drinking water purchased between participants using private wells and participants using container water. Colonia residents using private wells purchased water for drinking purposes in the same proportion as colonia residents using container water.

Based on data collected in this study, forty-six percent of the participants using private wells reported having experienced water-related illness in the six-months previous to the survey, versus forty-two percent of participants using container water. Using chi-square, the small difference between groups was determined not to be significant ( $\chi^2 = .067$ ,  $p = .515$ ). Based on these data, it was concluded that there were no differences in having experienced water-related illness between participants using private wells and participants using container water. In both groups, nearly half of subjects experienced water-related illness.

#### **Water-Use Perceptions in Participants with Well-Water as Compared with Participants with above-the-ground container Water**

Participants were asked to rate their water source's quality based on characteristics such as perceived safety, taste, and smell. Table 3 shows the results of these questions. Overall, a majority of respondents (66.7%) perceived their water as not safe to drink. When comparing groups, more people using private wells (81.8%) were concerned about using their water for cleaning purposes than people using container water (62.5%). Chi-square was used to test possible group differences; no differences were found.

As shown in Table 4, sixty-nine percent of the participants using private wells perceived water as being not safe to drink; seventy-seven percent perceived taste as unacceptable; and sixty-eight percent perceived smell as being unacceptable. In contrast, sixty-five percent of the participants using container perceived water as not safe to drink; sixty-seven percent perceived taste as unacceptable and sixty-one percent perceived smell as unacceptable.

Chi-square was used to test possible group difference only for taste. The difference of eleven percent was determined not to be significant ( $\chi^2 = .763$ ,  $p = 0.521$ ). Based on these data, it was concluded that there were no differences in water quality perceptions based on perceived water safety, taste and smell between participants using private wells and participants using container water.

#### **Water-Use Practices compared to Water-Use Perceptions in Participants with Well-Water as Compared to Participants with above-ground container Water**

Based on the results from Table 3 and Table 4, we used secondary exploratory to examine inconsistencies in perceptions vs. practices. As shown in Table 5, we examined the number of people in our sample whose daily practices are not consistent with their perceptions of water and water quality, an index that may be used as a measure of reduced quality of life.

As shown in Table 5, when comparing participants' reported practices with perceptions, there were some interesting findings. For instance, seventy-three percent of the participants using private wells were concerned about using their water for cleaning purposes; still participants reported using the water for washing dishes. In contrast, forty-six percent of participants using container water reported washing dishes with their water although they were concerned with the quality of the water for cleaning purposes. Also, nearly seventeen percent of participants using container water were perceived their water was not safe to drink but used the water for cooking. In contrast, only nine percent of participants using private wells perceived their water was not safe to drink but used the water for cooking.

Chi-square was used to test possible group differences. As shown in Table 5, those participants using well water were significantly more likely to perceive water taste as unacceptable and to use the water to make coffee and/or tea ( $\chi^2=6.120$ ,  $p= 0.019$ ). Also, those participants using private wells were more likely to being concerned about chemical contaminants and to use the water to make coffee and/or tea ( $\chi^2= 6.120$ ,  $p= 0.019$ ). Those participants using private wells were more likely to report experienced illness and to use the water to make coffee and/or tea ( $\chi^2= 4.779$ ,  $p= 0.045$ ).

We also examined the number of people who did not regularly treat or test their water source, and were using water for some form of consumption. Chi-square was used to test possible group differences. As shown in Table 6, those participants using private wells were more likely to not treating water for drinking purposes and to use the water to brush teeth ( $\chi^2= 4.330$ ,  $p= 0.045$ ). Also, those participants using private wells were more likely to not treating their water and to use it to make coffee and/or tea ( $\chi^2= 9.007$ ,  $p= 0.003$ ). Another difference was found when comparing never testing water source versus using water to make coffee and/or tea.

Those participants using private wells were more likely to have never tested the water and to use it to make coffee and/or tea ( $\chi^2= 9.007, 0.003$ ). The goal of this is to determine whether one of the groups has greater reduction of quality of life as indicated by contradictions in their perceptions versus their practices.

## CHAPTER 4: DISCUSSION

### Overview

People living in *colonias* lack many of the basic living necessities required for a safe and healthy life, including infrastructure that provides safe drinking water. For this reason, residents use possibly inferior alternative water sources that may endanger their health and the development of their children. The primary alternative water sources used by people included in this study were private wells or water stored in above-ground containers. The purpose of this study was to describe the water use perceptions and practices of people living in *colonias* in west Texas and south New Mexico who are using water from private wells or above-ground container, and to compare the water-related use and practices among residents living in *colonias* relying on container water and private wells.

### Summary of Results

Data from 46 *colonia* residents were analyzed. Forty-eight percent of the participants used well water while fifty-two percent of participants used above-ground storage container water. The sample was approximately fifty-seven percent female with a mean age of 47.98 years. Results showed ages were significantly different; however, this variable was not included as a control factor because the group mean ages were not old enough for their ages to compromise perceptions of water aesthetics such as taste or smell. Thirty-five percent of subjects reported income consistent with living below the federal poverty level for a family of four (\$23, 550 annually). Approximately, thirty-six percent of the participants had an education of less than high school.

## **Water Use Practices**

Based on data collected in this study (Table 3), for all but one water-use practice, residents using well-water or container water did not differ with regard to water use practices. Residents reported consuming approximately the same amounts of water for drinking and cooking purposes (less than 5 gallons). Approximately ninety percent purchased bottled water; ninety-five percent do nothing to treat their water; ninety-percent have never had their water tested; only thirty-percent use their water for cooking; and sixty-five percent use their water for brushing their teeth. Residents using well or container water differed in one way and that is, no one on container storage used their water to make coffee or tea while thirty-six percent of those using well-water used their water for making coffee and tea. With regard to water-use practices, there appeared to be no advantage for either type of water source. Furthermore, it appeared that residents using well-water may be putting themselves at significant health risk by using unsafe water for making their daily coffees and teas.

## **Perceptions of Water by Residents of the Colonias**

Based on data collected in this study (Table 4), a majority of residents of the colonias perceived their water supplies as unacceptable for several reasons. This was true of residents regardless of their alternative water source (residents using well-water or container water did not differ in their perceptions). Approximately sixty-five percent perceived their water as unsafe to drink; approximately seventy percent said the taste of their water was unacceptable; approximately sixty-five percent said the smell of their water was unacceptable; approximately seventy-percent were concerned about chemical contaminants in their water; approximately seventy-percent were concerned about using their water for cleaning; and approximately forty-

five percent of residents reported experiencing acute intestinal illnesses that they believed were the result of bad water. With regard to water-use perceptions, the majority of participants had negative perceptions of their water and had several concerns about using this water. Also, participants perceived the water is affecting their health by making them suffer from intestinal illness.

Thus, while some may suggest that well-water may be a higher quality alternative water source, these findings suggest that well-water and container water are equally poor substitutes for a regulated water supply. The findings also showed specific ways in which the quality of life for residents is seriously diminished by having to use alternative water sources, whether the water was from private wells or from make-shift container systems.

A few of the descriptive findings are especially important to emphasize. As described above, the vast majority of participants did not treat their alternative water supplies to improve water safety, and the vast majority did not test their water for contaminants. This is unacceptable from a public health perspective because the lack of treating and testing greatly increases the chances for water-borne illnesses.

### **Study Hypotheses**

The first hypothesis that this study investigated was that we predicted that water source would be associated with water purchased; specifically, that more residents using container water purchased water than residents using well water. Overall, this study found that the majority of participants purchased water specifically for drinking purposes regardless of the water source. Water purchased was not found to be significantly different between study groups.

The second hypothesis was that we predicted that water source would be associated with water-related illnesses; specifically, more residents using container water reported more water-

related illnesses than residents using water from private wells. This study found that less than half of the sample reported experienced water-related illness in the past six months. However, water-related illness was not found to be significantly different between study groups.

The third hypothesis was that we predicted that water source would be associated with perceived water quality; specifically, residents using container water perceived water quality as being lower than did people using water from private wells. Water quality was based on perceived water taste, smell and safety. As described above, this study found that overall participants reported their water was not safe to drink and its taste and smell were unacceptable, no statistical differences were found between study groups.

### **Exploratory Comparisons of Perceptions vs. Practices**

Given the descriptive findings, we conducted additional exploratory analyses to determine whether participants' perceptions differed from their practices. If people perceived their water as smelling bad, tasting bad and/or likely to be dangerous, but used the water anyway for cooking, drinking and/or cleaning, this would be another important indication of reduced quality of life because residents were not able to use their perceptions to guide their practices.

In fact, we found that even though participants had concerns about the quality and safety of their water source many still consumed the water for cooking or making beverages and the water source did not influence discrepancies between perception and practice (groups did not differ) (Table 5).

With regard to water safety perception and water-use, thirteen percent perceived water was not safe to drink, but used it for cooking; nearly forty percent perceived water was not safe to drink but used it to brush teeth; approximately seven percent perceived water was not safe to drink, but said they used the water for preparing coffee or tea.

Similar numbers were found when comparing the perceived smell and water use. Thirteen percent perceived water's smell was unacceptable, but used the water for cooking; nearly forty percent perceived smell was unacceptable, but used the water to brush teeth; and approximately nine percent perceived smell was unacceptable, but used the water to make coffee or tea.

With regard to taste, fifteen percent perceived taste was unacceptable, but used the water for cooking; nearly forty-six percent perceived water taste as unacceptable, but used the water to brush teeth; approximately eleven percent perceived taste was unacceptable, but used water to make coffee or tea.

When comparing the well-water to container groups with regard to these discrepancies, the only statistically significant differences were found in the numbers of people in each group who perceived water smell and taste as bad and used the water anyway to prepare coffee or tea. In fact, none of the participants using container water reported using their water for coffee or tea. It is very important to note that a vast majority of participants were concerned about chemical contaminants and also reported experiencing water-related illness.

Thus, several findings suggested that quality of life is reduced by deficiencies in the water supplies of people living in the colonias. In addition to the negative perceptions of their water supply, the very low-income residents studied reported frequent purchase of relatively expensive water for drinking and cooking, and this likely created a financial burden for families. This is another way in which inadequate water of *colonia* residents' reduced quality of life. Surprisingly, despite negative perceptions of their water, many residents reported often using their well or container water for cooking, brushing teeth or preparing beverages. These

discrepancies between perceptions and practices could add additional stress to participants' everyday lives because of the pressure to consume water they perceived as unsafe.

## **Limitations**

There are several limitations associated with this study that are noteworthy. This study was primarily limited by the small sample size (46). Related to this issue, the Chi-square results need to be interpreted with caution because some of the cells contained less than five observations. Given the small sample size and that several Chi-square cells contained less than five observations; further research should be conducted with a larger sample to test for differences between residents living in colonias using private wells and container water. Another limitation of this study was external validity, or the generalizability of the study. Participants were not randomly selected and represented residents from three *colonias* in the border region (Hueco Tanks, TX; Hill Crest Estates, TX; and Mesquite, NM), which might not be representative of the entire *colonia* population. Also, results were based on self-reported responses and may have been less than accurate or biased. For example, the recall of participants with regard to having experienced illness could be flawed, or participants could have failed to attribute illness to water consumption. However, this study has several strengths despite its limitations. Albeit limited in scope, we strongly believe this study adds valuable descriptive information to the literature on *colonias*. The current literature on this population is very limited and this study provides a description of the situation many people in these communities face every day. Future research could use the information presented in this study as a starting point from which to explore in further detail water-related issues in *colonias*.

## Recommendations for future research

The findings of this study suggested that the quality of life in *colonias* is affected by the lack of safe water. Future research is needed to further explore factors that contribute to how residents perceive and respond to unsafe water conditions. Understanding in better detail what drives residents' decisions and behaviors could guide the development of interventions and programs to improve basic water practices in the *colonias*.

This study used a survey instrument that has not been used previously. Through the process of data analysis and considering the results obtained, ways in which the instrument could be changed to improve the information collected were noticed. Appendix A shows the original survey and Appendix B includes a modification version of the original survey. Several changes are suggested and explained below. These could be used to improve the instrument for future use. The suggestions are based on questions and concerns expressed by participants while answering the survey, and from our own experience during data analysis.

### *Section I, Water Source, Question 3*

*“Is this your household’s main source of drinking water?”*

Nearly one-hundred percent of participants answered “yes” to this question, even though most of them reported purchasing drinking water. This suggested to us that the participants did not understand the intention of the original question, which was to determine whether or not they used their tap water as their main water source.

This question could be re-phrased to avoid confusion, for example, by asking, “In regard to your main source of household water (well-water or container water), do you drink this water?” and provide the following answer possibilities: no, sometimes, usually, always. In addition, an additional open-ended question could be added, such as, “If you do not drink the

water from your main water source, what is your source of drinking water?” In addition, these modified questions could be moved to the “Water Use and Practices” section to further clarify the intention of the questions.

Furthermore, it is suggested that three additional questions be added to Section I, “Water Source,” to describe the conditions of the private wells, such as how deep are the wells and how far wells are placed from the septic tank. These questions would provide a more detailed description of the water source.

Similarly, it is also suggested that five additional questions be added to the Section I., Water Source, with regard to characteristics of the container water. These questions would pertain to how the water was hauled to the homes, where the water was purchased from, how often water was purchased, amount of water purchased per occasion, and how much was paid per occasion for the water purchased.

#### *Section II Water-use and Practices*

These questions pertained to how the well or container water was used. Specifically, the questions asked if residents used the water for drinking and/or for other purposes, and included questions regarding water treatment use and water testing. These questions however included no follow-up questions regarding these practices.

It is suggested that an additional follow-up question be added if participants respond that they do not treat their water, such as, “If you do not treat your water, why not?” This additional question would identify the reasons that deter *colonia* residents from using water treatment and for testing their water. This could help identify gaps in knowledge that could be addressed with public health interventions. It is also suggested that a question be added that asks whether the participant would like to receive information on treatment options.

Other questions suggested for this section were with regard to the barriers of cleaning the water tanks (“If you do not clean your water tank, what are some of the reasons why?”) and if they would like to receive information on how to clean the tanks properly.

### *Section III Water Quality*

During the administration of the survey, many participants expressed confusion with regards to the type of water been assessed. For this reason, statements in the survey questions related to the water source were modified to specify that we were evaluating their *well-water or container water*.

For example, the statement “*my water is safe enough to drink*” was changed to “*my well-container water is safe enough to drink.*” The same format was used for all statements.

Also, we added color to the evaluation of the characteristics of the water. We believe that color could be an important characteristic that could deter participants from using their water or change their perception of quality.

For the question on perceived health outcomes caused by consuming the water, we added the option “skin rashes” because several participants expressed verbally, during the survey distribution, their concerns about effects on their skin.

### *Section IV Demographics*

Children are more susceptible to suffer water borne illness. It is particularly important to know if they are children living in the house since this could change the water-related use, specifically water purchased. In the original instrument, there were no questions regarding children in the households. We added one question asking whether children are living in the home, and an additional question to specify the age group (months to 5; 6 – 10; and 11- 17 years old) of children identified.

## Conclusion

Despite regional recognition of the situation, many *colonia* residents are still living in deplorable conditions. This study found that it is the perception of a majority of colonia residents that their water is of very low quality and approximately one-half of residents believed they experienced illness due to poor quality water. It was also found that a majority of colonia residents purchased drinking water, which further depletes the financial resources of this very low-income population. In addition, discrepancies between perception and practice were found that further suggested a lowered quality of life for these residents. These findings add to a small but growing literature that is attempting to bring awareness to the unacceptable living conditions in the colonias. The obvious long-term solution for these people is to get safe public water to these communities. However, it will take many years to achieve this goal. Short-term solutions to prevent the spread of water-related illness could be to develop interventions to educate residents on the various methods to improve water quality, such as water treatment practices (e.g., filtering water, boiling water, chlorine use, and solar water disinfection) as well as to promote frequent water testing.

While participants had several concerns about the quality and safety of their water source, several used the water for cooking and brushing teeth. In addition, water treatment and water testing were not commonly practiced. Therefore, efforts to develop interventions to increase treatment of water and promote water testing are recommended.

Importantly, the results from this study suggested that well-water and container water are equally poor substitutes for a regulated water supply. The quality of life for residents using both types of alternative water sources (well-water or container-water) was seriously diminished as

indicated by their negative perceptions of their available water and by discrepancies between their perceptions and practices.

This study has implications for public health practice. The information provided by this study could inform tailored interventions such as the promotion of water treatment practices. Also, this study suggested colonias residents are being exposed to poor water sources and are at a disadvantage with regard to standards and regulations on water safety that exist for other communities in the United States. Raising awareness of the situation in colonias and increasing access to safe and affordable water sources is a public health imperative, and calls for collaboration among stakeholders and policymakers across multiple sectors including government agencies, community-based organizations, and the public health workforce.

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**Table 2*****Demographic Characteristics among colonias residents (n=46)***

	Mean (SD) or %			
	Total (N=46)	Well water (n=22/47.8)	Container Water (n=24/52.2%)	t- test or $\chi^2$
Age	47.98 (15.56)	52.76(15.81)	43.19(14.08)	t= 2.071*
10 years or less lived in current home	53.5%	45.5%	61.9%	$\chi^2 = 1.169$
Female	56.5%	59.1%	54.2%	
Income below poverty level	34.9%	54.5%	33.3%	$\chi^2 = 4.778$
Less than High School	36.4%	31.8%	38.1%	
People living in same household	4(1.42)	4(1.66)	4(1.42)	

\*Note: p<0.05.

**Table 3*****Water-Use Practices (N=46)***

	(n) %			$\chi^2$
	Total (N=46)	Well water (n=22)	Container water (n=24)	
Consumed 5 or less water gallons daily for drinking	(32) 80%	(16) 88.9%	(16) 72.7%	1.616
Consumed 5 or less water gallons daily for cooking	(37) 94.9%	(18) 94.7%	(19) 95%	.001
Purchased drinking water	(42) 91.3%	(20) 90.9%	(22) 91.7%	
Don't treat water for drinking purposes	(40) 95.2%	(20) 95.2%	(20) 95.2%	
Never tested water source	(42) 91.3%	(19) 86.4%	(23) 95.8%	1.296
Used well/container water for cooking	(12) 26.7%	(8) 36.4%	(4) 17.4%	2.070
Used well/container water to brush teeth	(28) 65.1%	(16) 76.2%	(12) 54.5%	2.216
Used well/container water to prepare coffee or tea	(8) 17.8%	(8) 36.4%	(0) 0%	10.172*

\*Note:  $p < 0.05$ .

**Table 4*****Perceptions of Water and Water Use Outcomes (N=46)***

	(n) %			
	Total (N=46)	Well water (n=22)	Container Water (n=24)	$\chi^2$
Water is not safe to drink	(30) 66.7%	(15) 68.2%	(15) 65.2%	
Taste is unacceptable	(33) 71.7%	(17) 77.3%	(16) 66.7%	.763
Smell is unacceptable	(29) 64.4%	(15) 68.2%	(14) 60.9%	
Concerned about chemical contaminants in water	(32) 72.7%	(15) 68.2%	(17) 77.3%	2.125
Concerned about using water for cleaning purposes	(33) 71.7%	(18) 81.8%	(15) 62.5%	2.142
Experienced intestinal acute illness from water use	(20) 43.5%	(10) 45.5%	(10) 41.7%	.067

**Table 5**  
***Discrepancies between practices to perceptions***

	(n) %			$\chi^2$
	Total (N= 46)	Well water (n=22)	Container Water (n=24)	
<b>Water is not safe to drink vs.</b>				
Used water for cooking	(6) 13.04%	(2) 9.1%	(4) 16.7%	.581
Used water to brush teeth	(18) 39.13%	(10) 45.5%	(8) 33.3%	.708
Used water to make coffee/tea	(3) 6.52%	(3) 13.6%	(0) 0%	3.501
<b>Smell is unacceptable vs.</b>				
Used water for cooking	(6) 13.04%	(3) 13.6%	(3) 12.5%	.013
Used water to brush teeth	(17) 39.95%	(10) 45.5%	(7) 29.2%	1.307
Used water to make coffee/tea	(4) 8.69%	(4) 18.2%	(0) 0%	4.779*
<b>Taste is unacceptable vs.</b>				
Used water for cooking	(7) 15.21%	(4) 18.2%	(3) 12.5%	.287
Used water to brush teeth	(21) 45.65%	(12) 54.5%	(9) 37.5%	1.344
Used water to make coffee/tea	(5) 10.89%	(5) 22.7%	(0) 0%	6.120*
<b>Concerned about chemical contaminants vs.</b>				
Used water for cooking	(7) 15.21%	(5) 22.7%	(2) 8.3%	1.843
Used water to brush teeth	(17) 39.95%	(10) 45.5%	(7) 29.2%	1.307
Used water to make coffee/tea	(5) 10.89%	(5) 22.7%	(0) 0%	6.120*
<b>Experienced water-related illness vs.</b>				
Used water for cooking	(7) 15.21%	(4) 18.2%	(3) 12.5%	.287
Used water to brush teeth	(15) 32.60%	(8) 36.4%	(7) 29.2%	.271
Used water to make coffee/tea	(4) 8.69%	(4) 18.2%	(0) 0%	4.779*

\*Note:  $p < 0.05$ .

**Table 6**

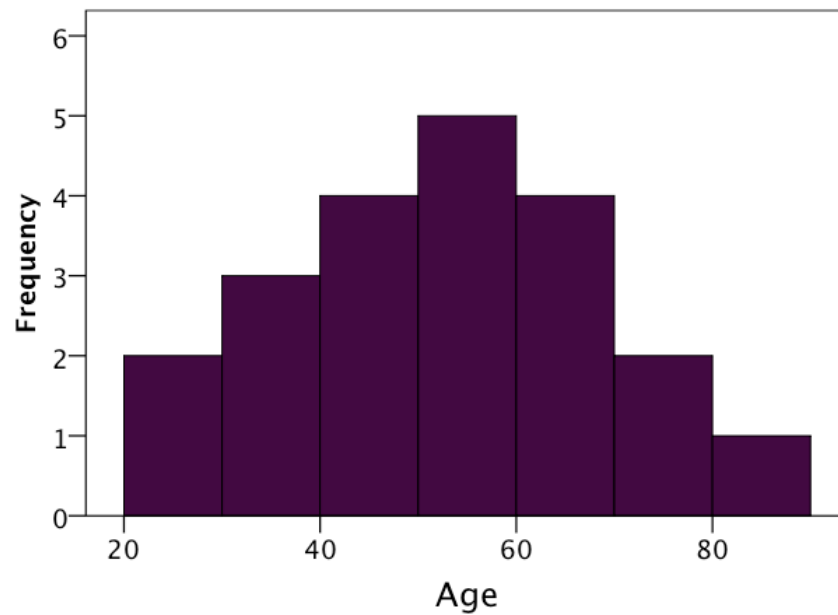
***Discrepancies between water treatment/testing and practices***

	(n) %			
	Total (N= 46)	Well water (n=22)	Container Water (n=24)	$\chi^2$
<b>Does not treat water for consumption vs.</b>				
Used water for cooking	(11) 23.91%	(7) 31.8%	(4) 16.7%	1.448
Used water to brush teeth	(24) 52.17%	(15) 68.2%	(9) 37.5%	4.330*
Used water to make coffee/tea	(7) 15.21%	(7) 31.8%	(0) 0%	9.007*
<b>Never tested water for consumption vs.</b>				
Used water for cooking	(11) 23.91%	(7) 31.8%	(4) 16.7%	1.448
Used water to brush teeth	(25) 52.17%	(14) 63.6%	(11) 45.8%	1.466
Used water to make coffee/tea	(7) 15.21%	(7) 31.8%	(0) 0%	9.007*

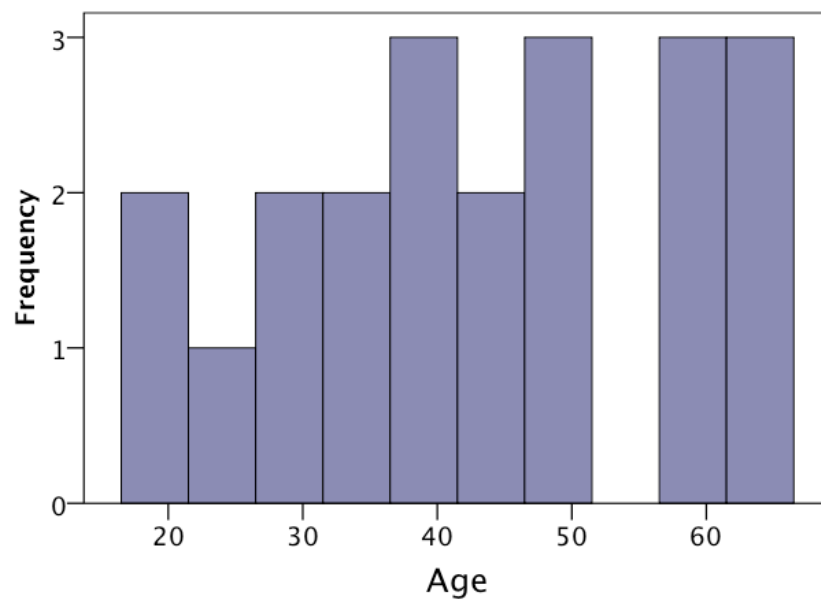
\*Note:  $p < 0.05$ .

## Demographics:

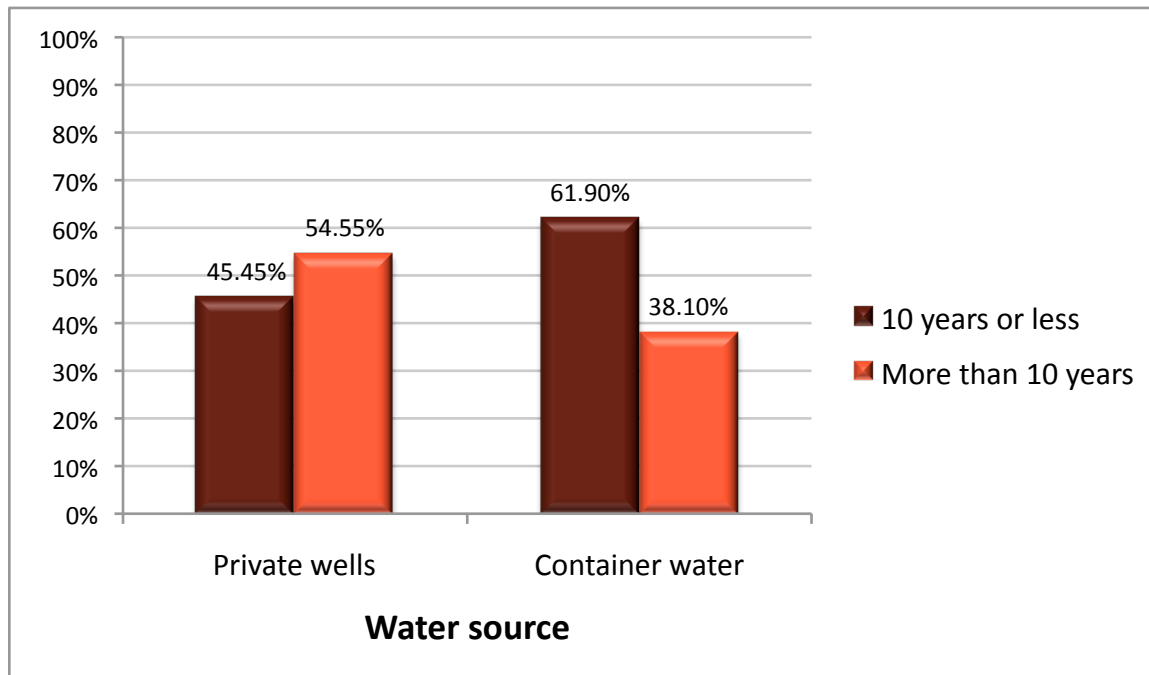
**Figure 3. Age distribution of participants using well water**



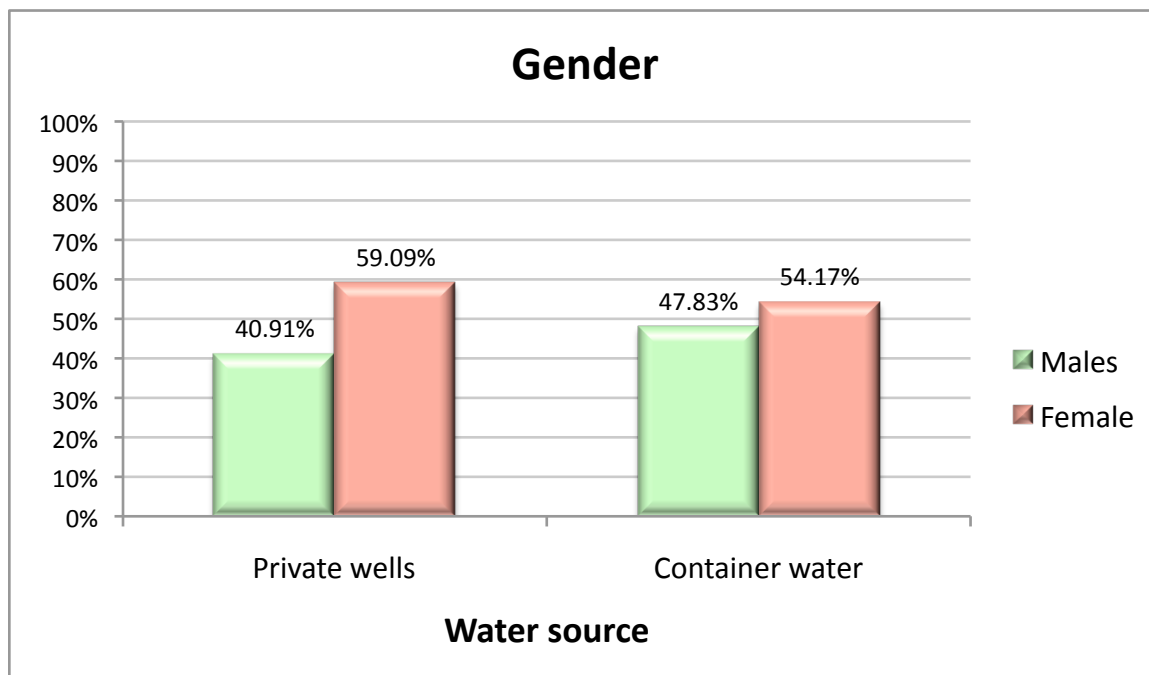
**Figure 4. Age distribution of participants using container water**



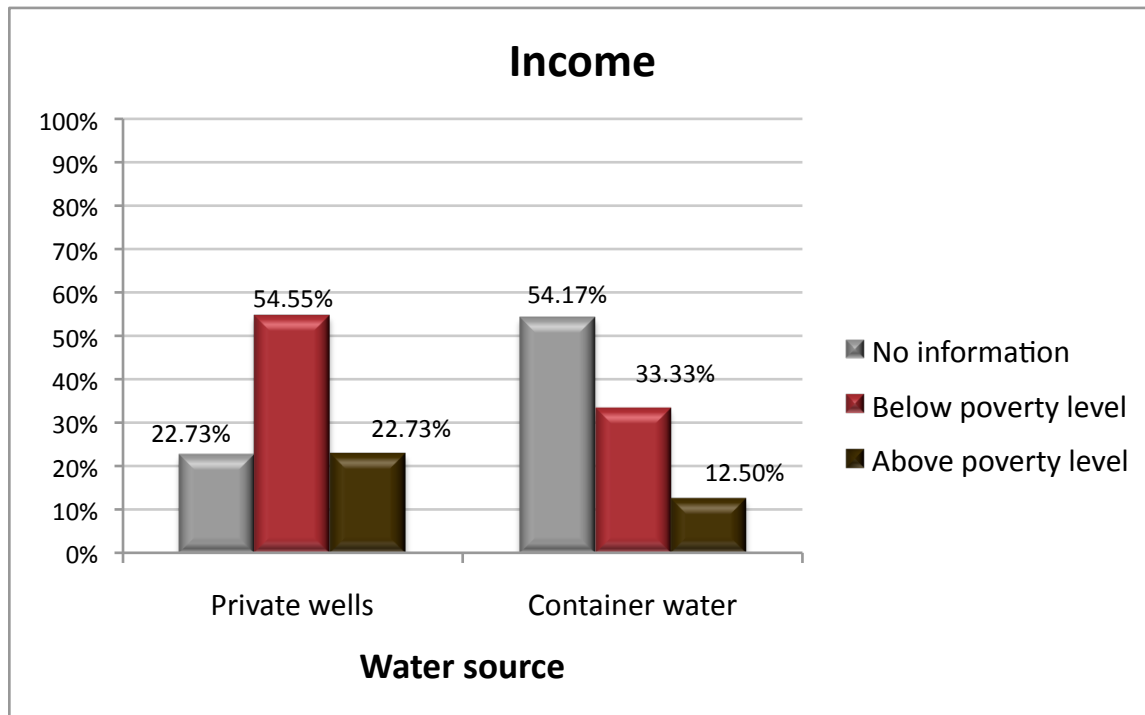
**Figure 5. Percentage of years living in current home by water source**



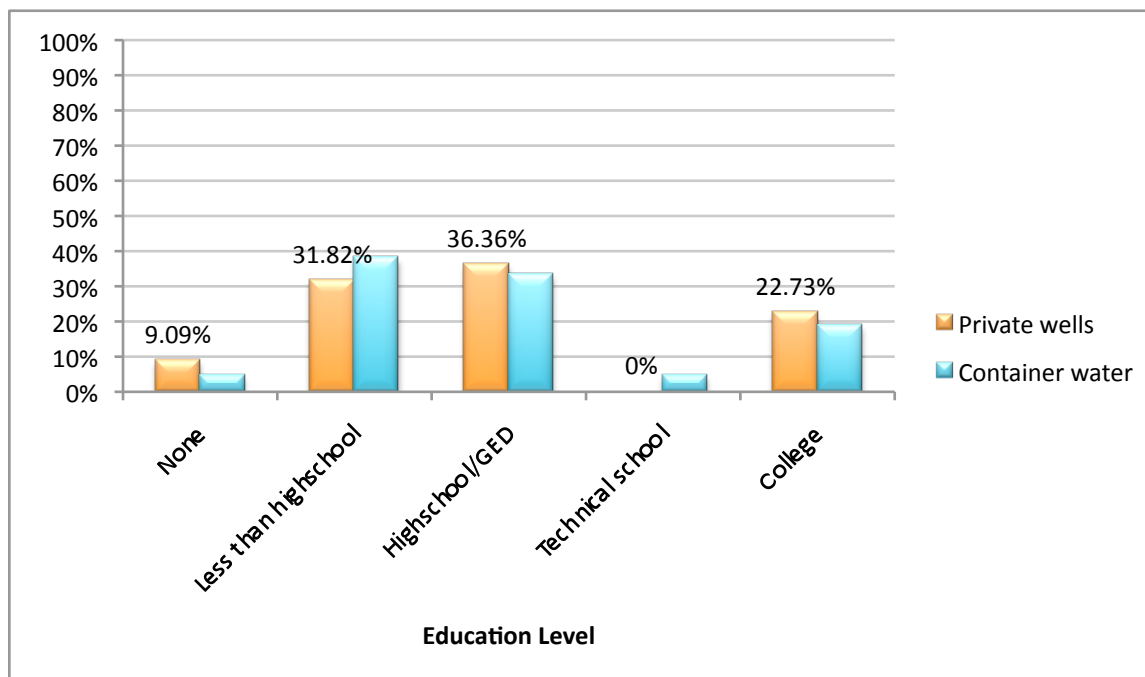
**Figure 6. Gender distribution by water source:**



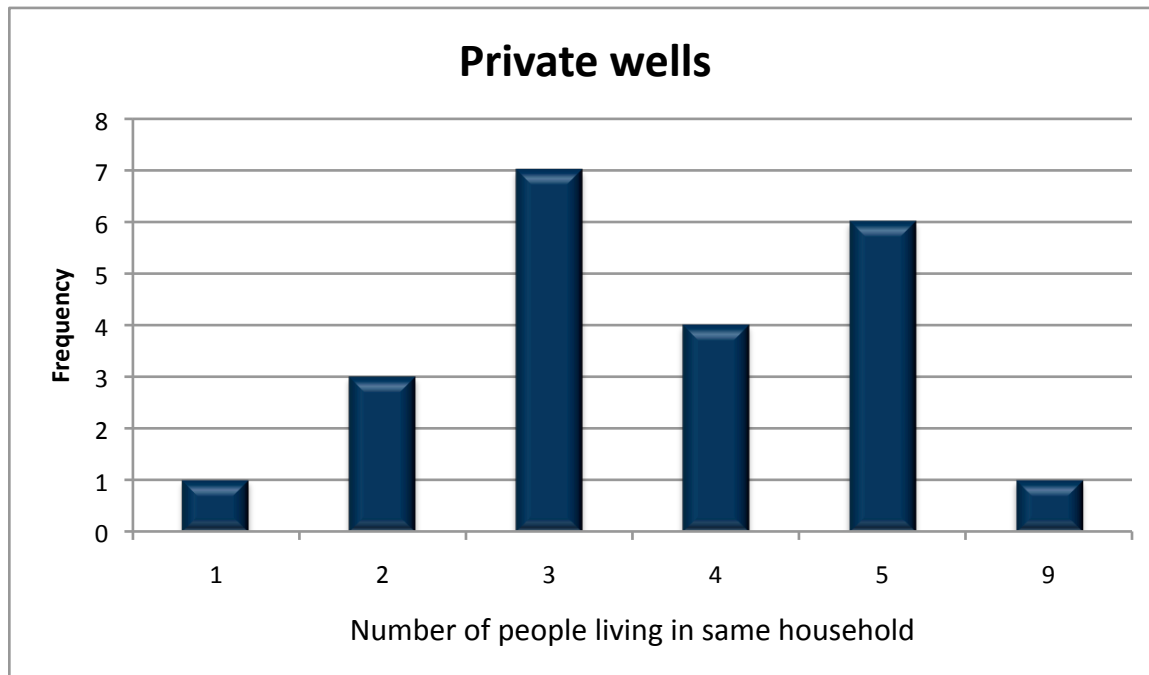
**Figure 7. Income distribution by water source**



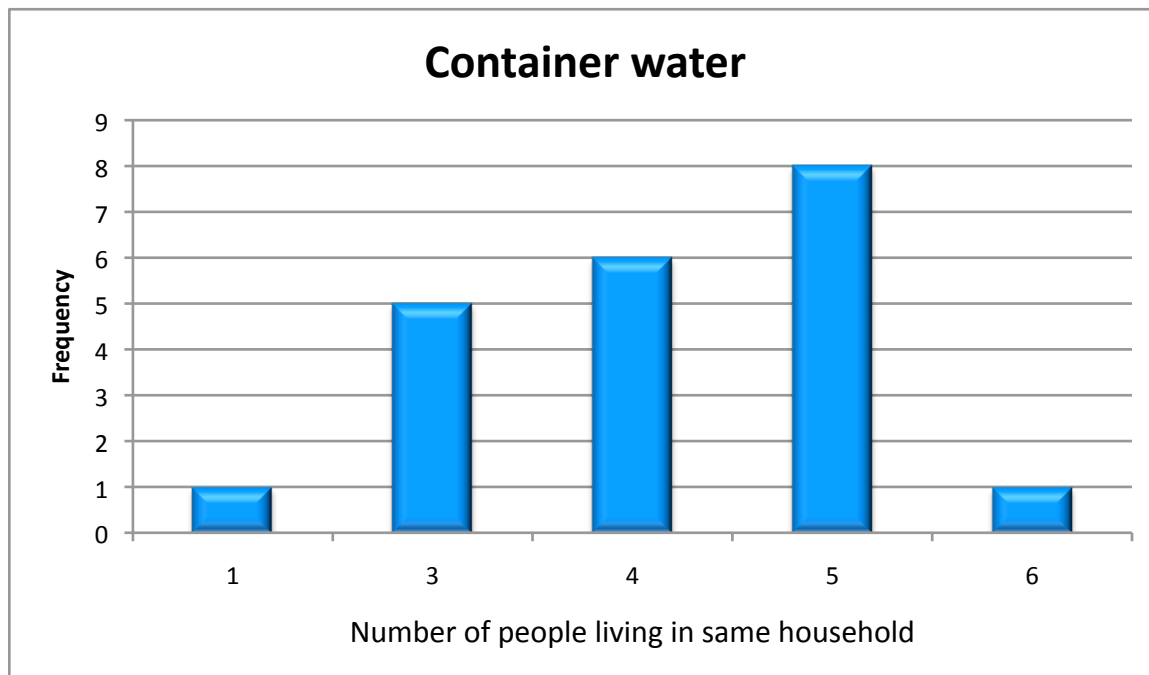
**Figure 8. Education distribution by water source**



**Figure 9. Frequency of number of people living in same household in participants using well water**

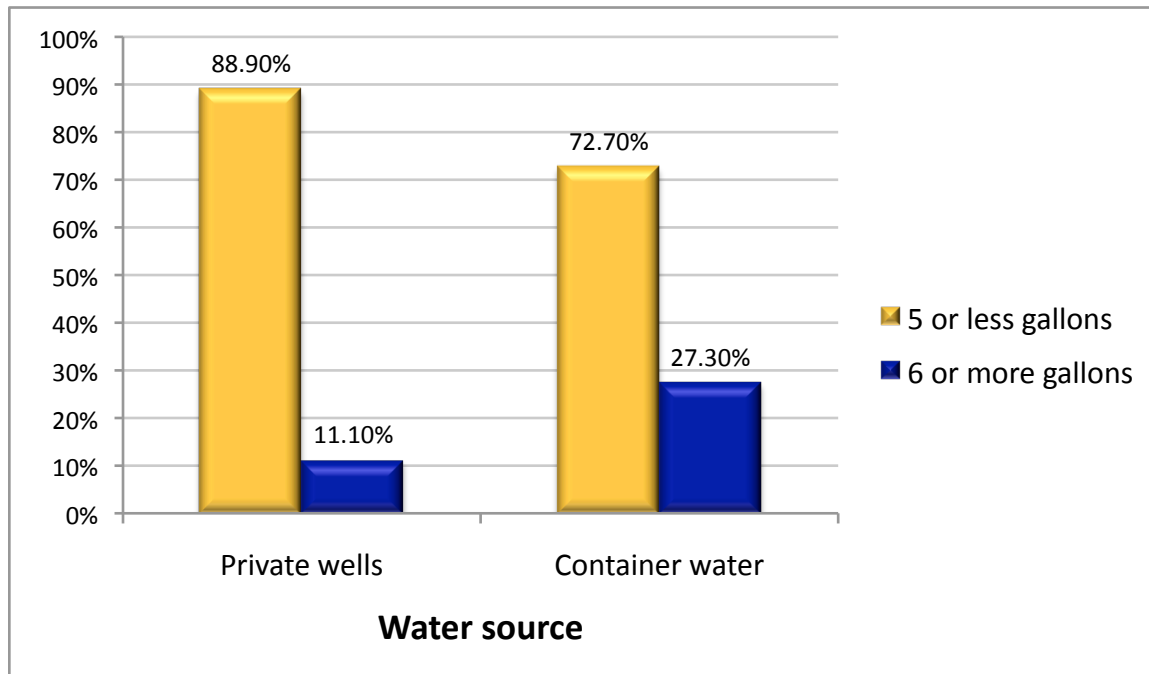


**Figure 10. Frequency of number of people living in same household in participants using container water**

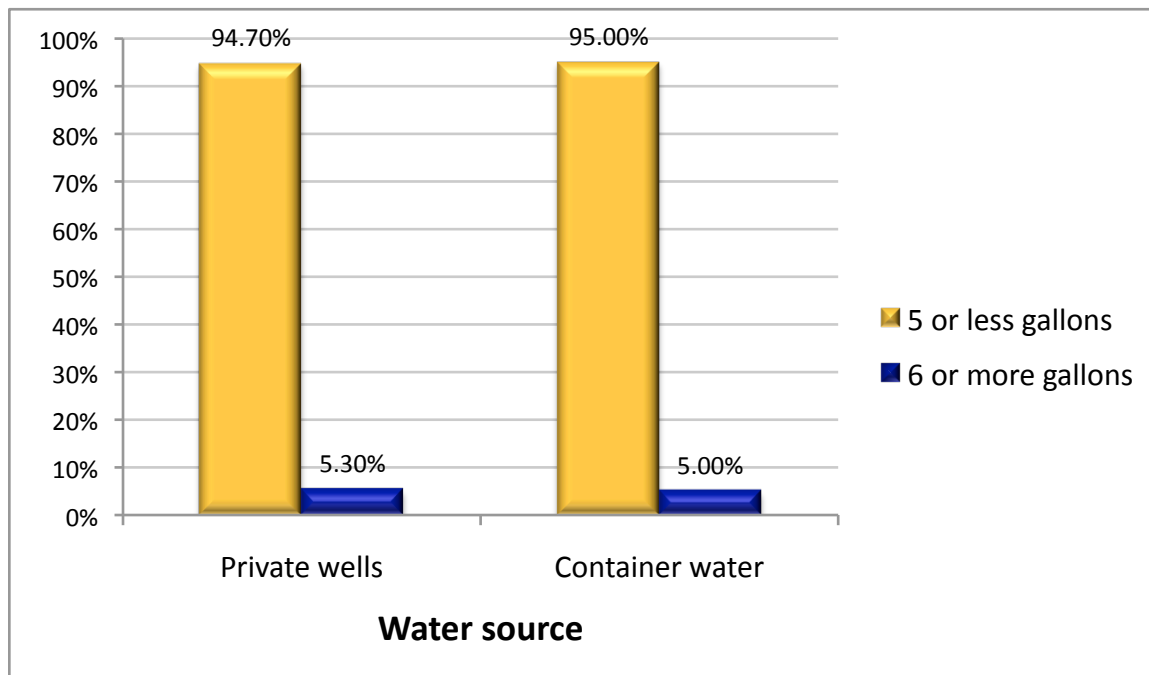


## Distributions of water-use and practices:

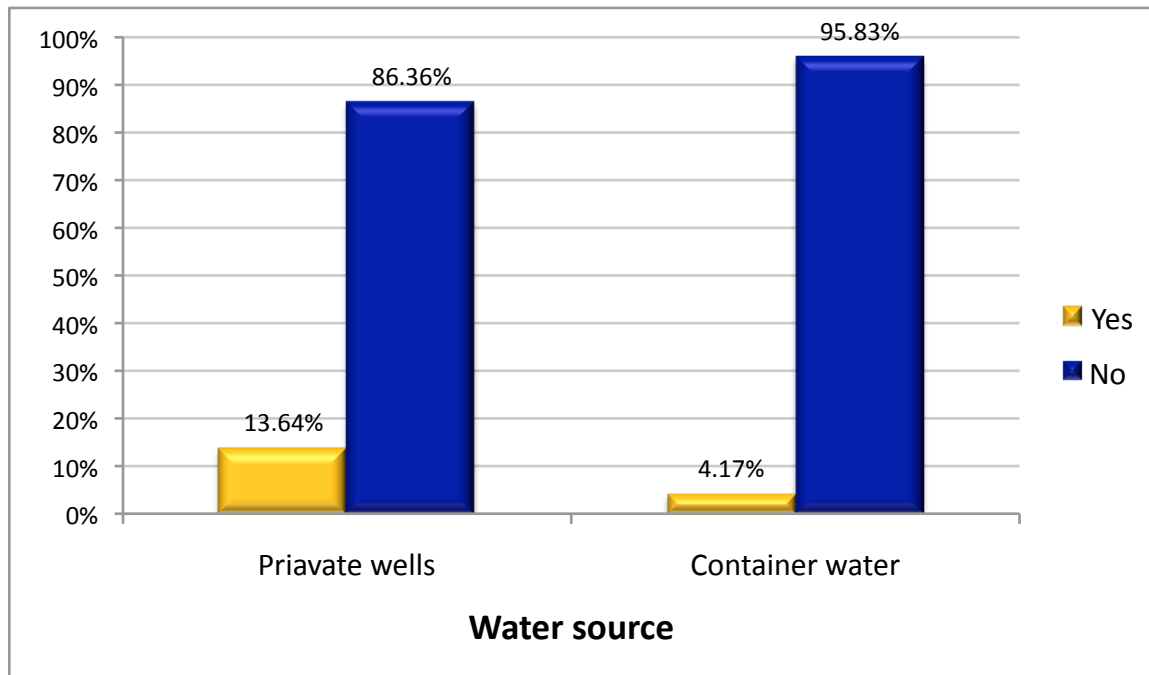
**Figure 11. Drinking water consumed in gallons by water source**



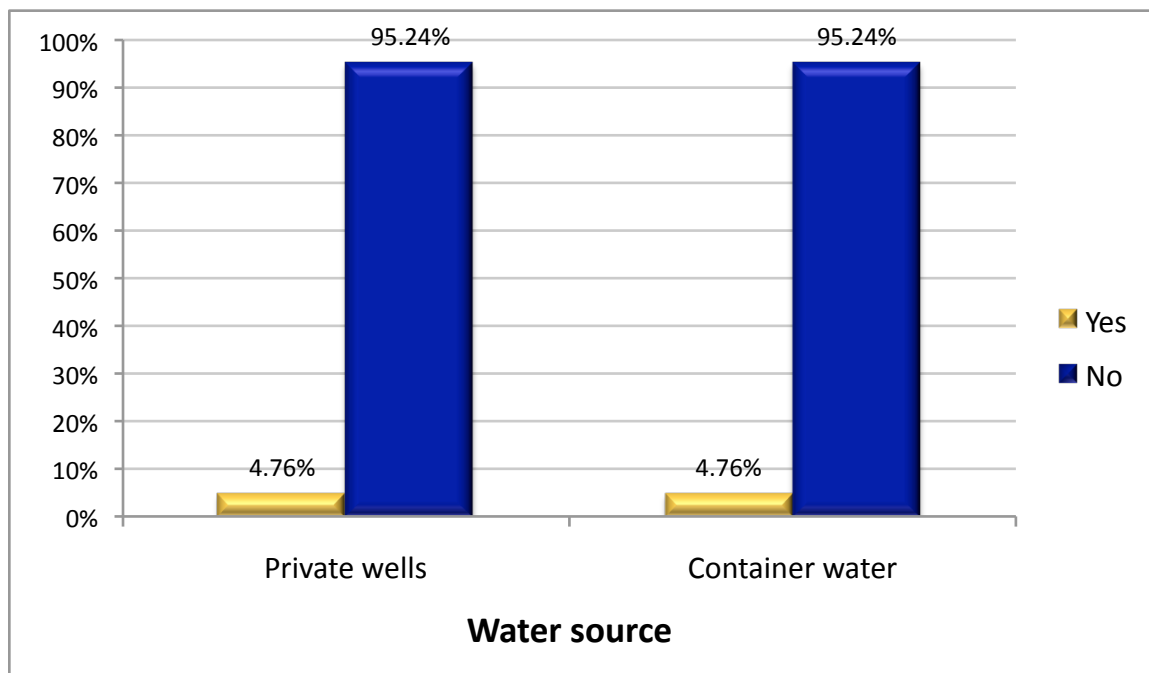
**Figure 12. Drinking water used for cooking in gallons by water source**



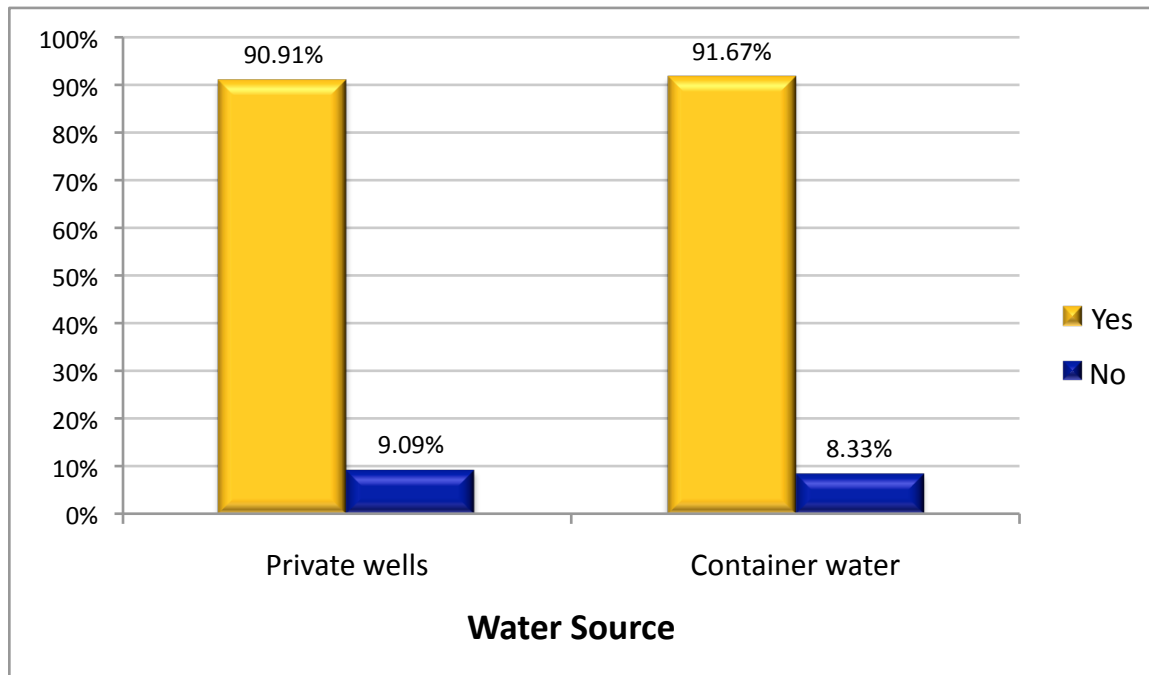
**Figure 13. Percentage of participants conducting water testing by water source**



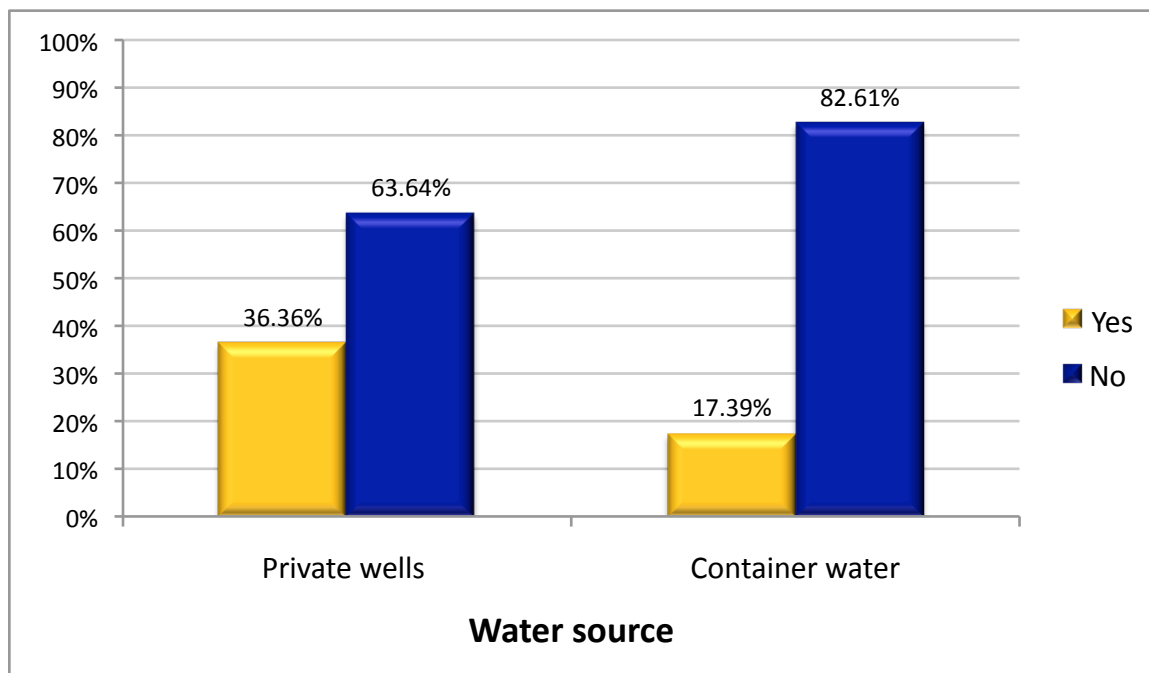
**Figure 14. Percentage of participants treating the water by water source**



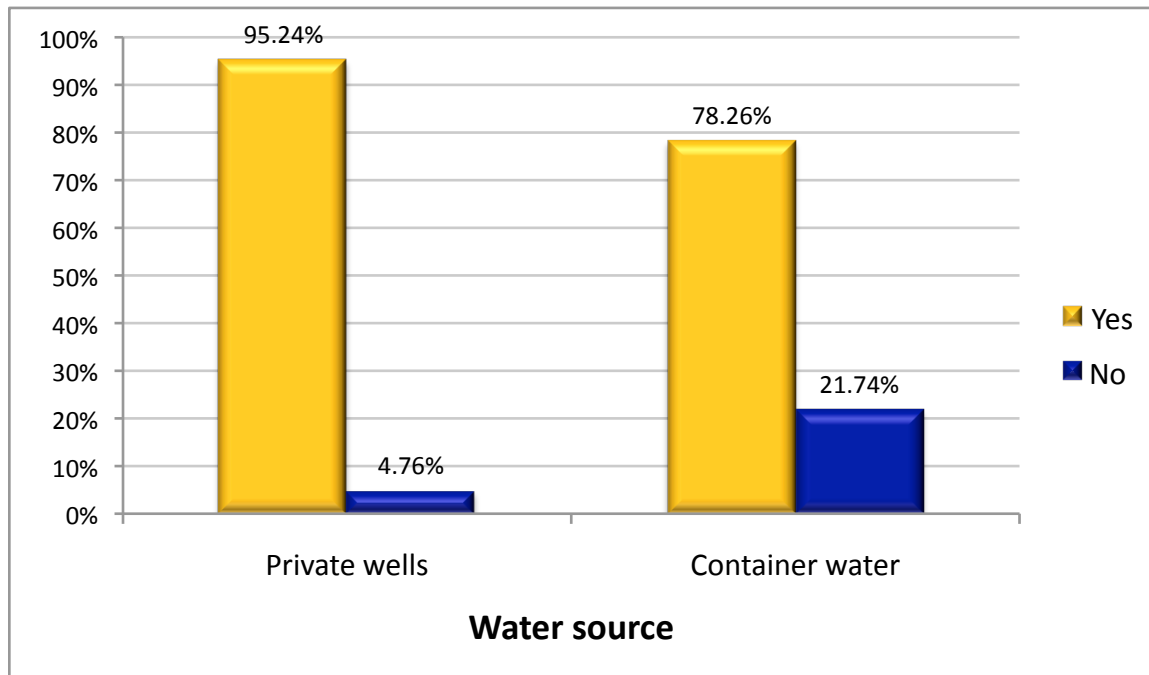
**Figure 15. Percentage of participants purchasing additional drinking water by water source**



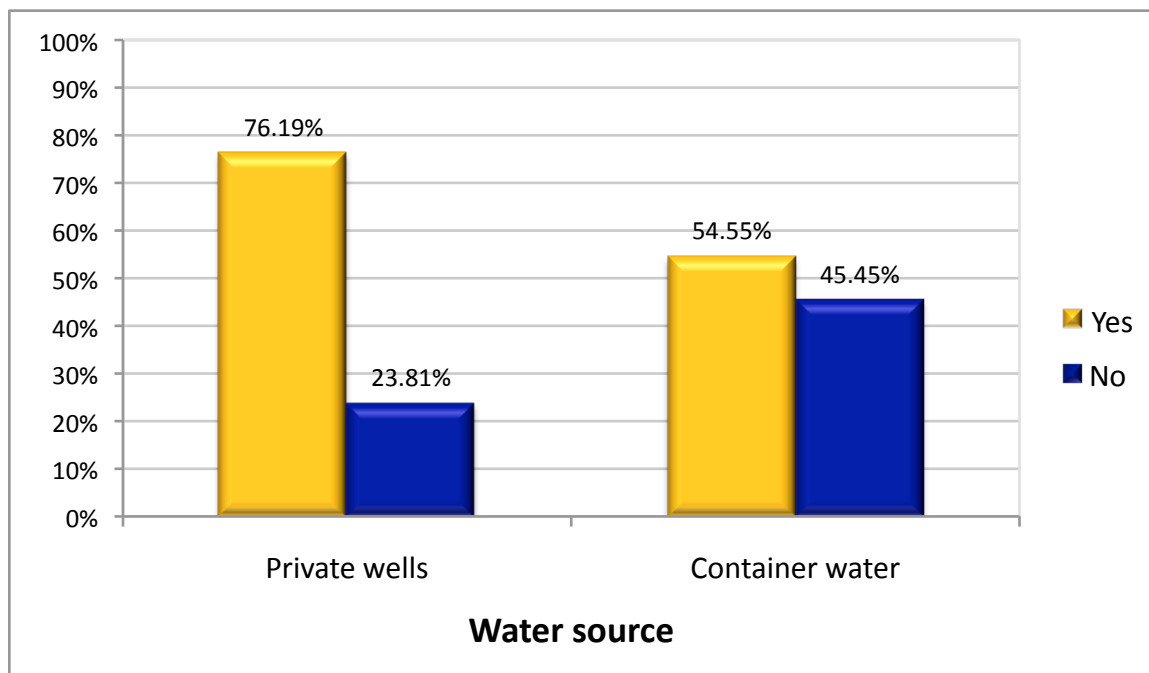
**Figure 16. Percentage of participants using well or container water for cooking by water source**



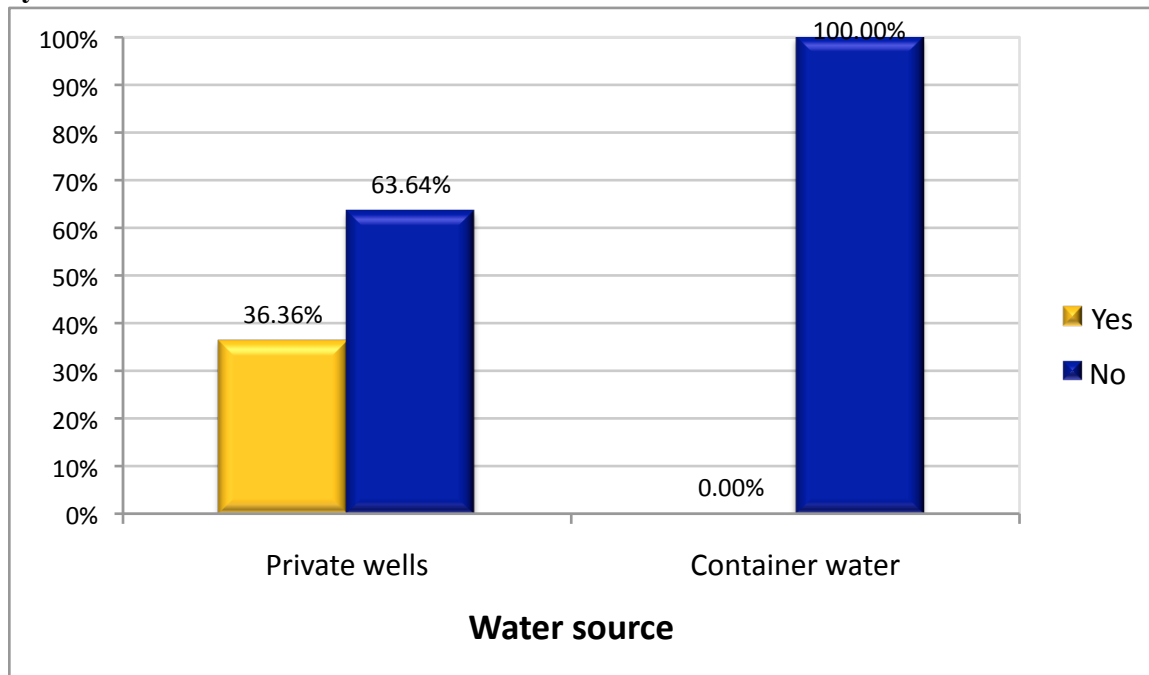
**Figure 17. Percentage of participants using well or container water for washing dishes by water source**



**Figure 18. Percentage of participants using well or container water to brush teeth by water source**

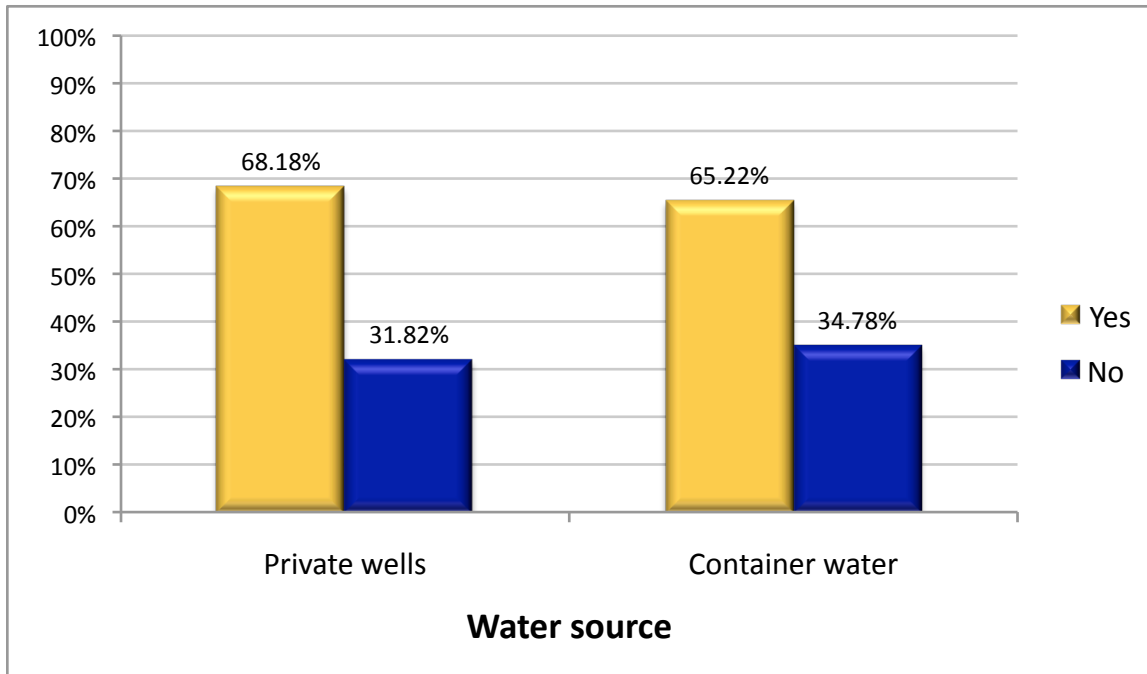


**Figure 19. Percentage of participants using well or container water to prepare coffee or tea by water source**

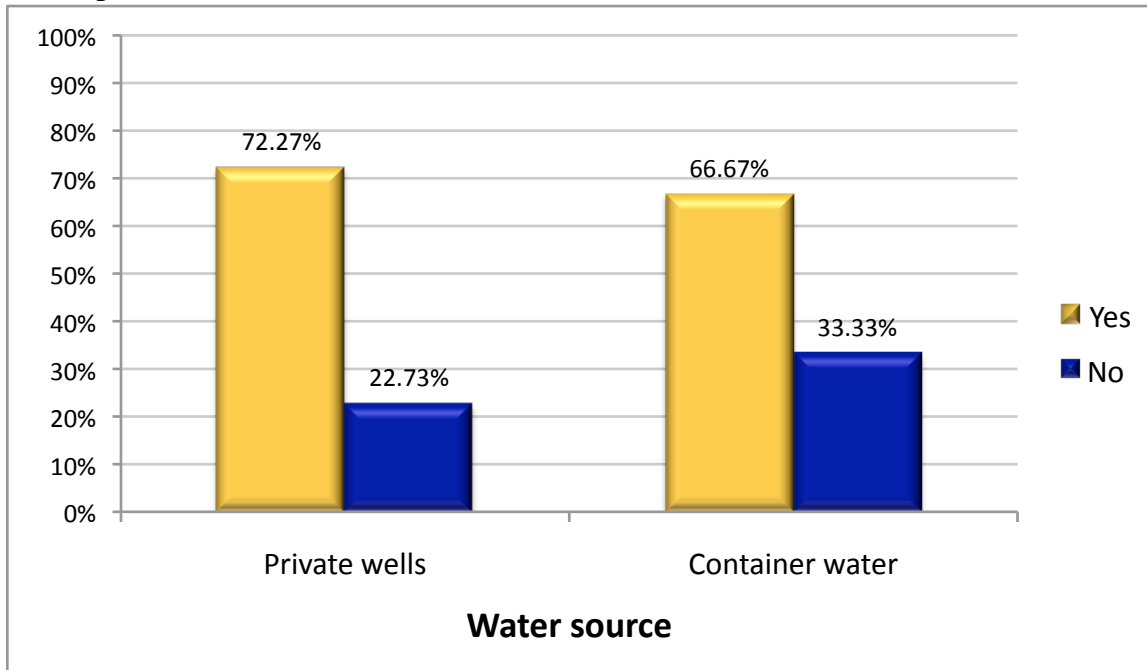


**Distributions of perceptions:**

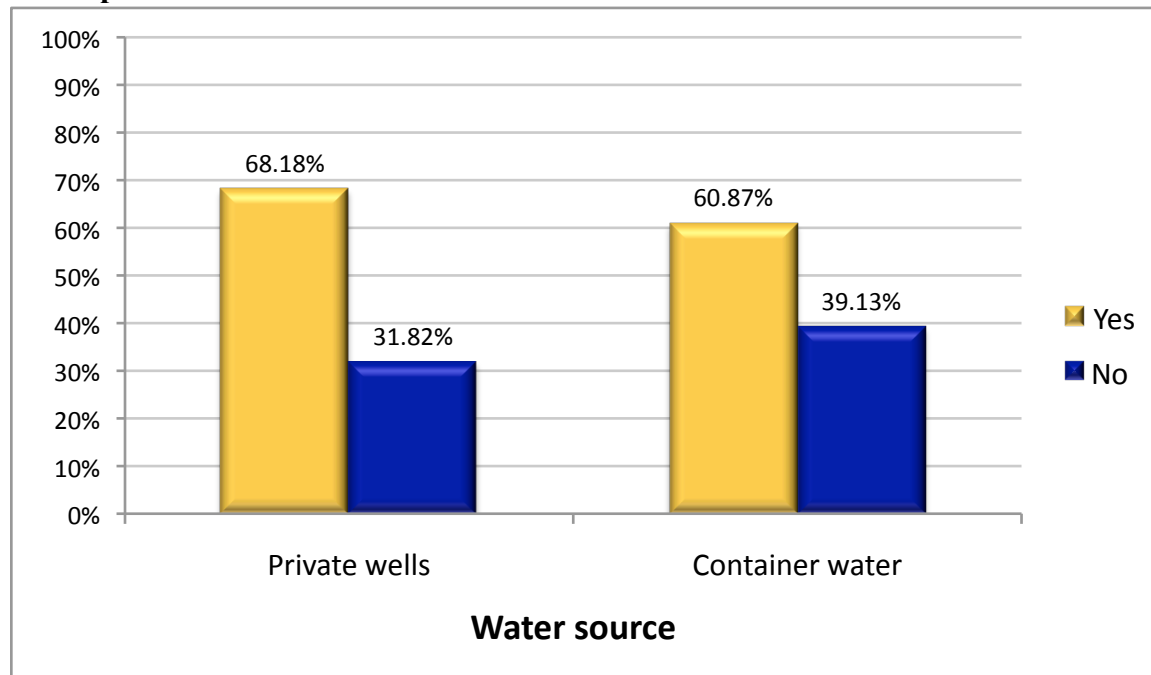
**Figure 20. Percentage of participants perceiving well or container water as not safe to drink**



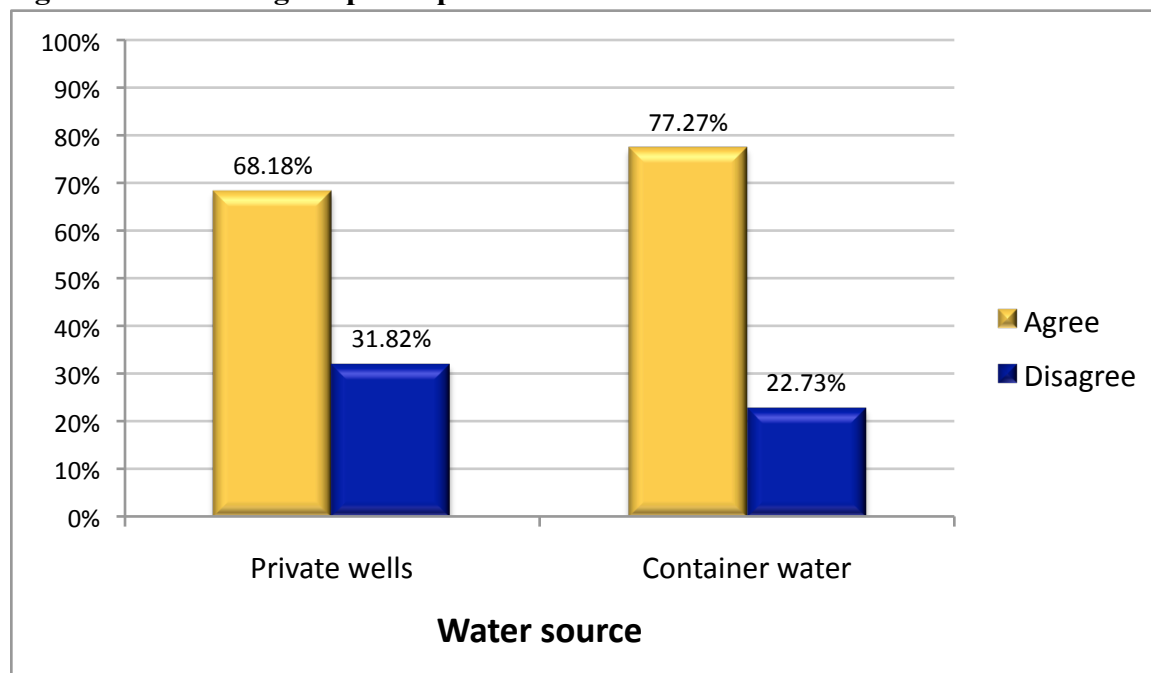
**Figure 21. Percentage of participants perceiving well or container water taste as unacceptable**



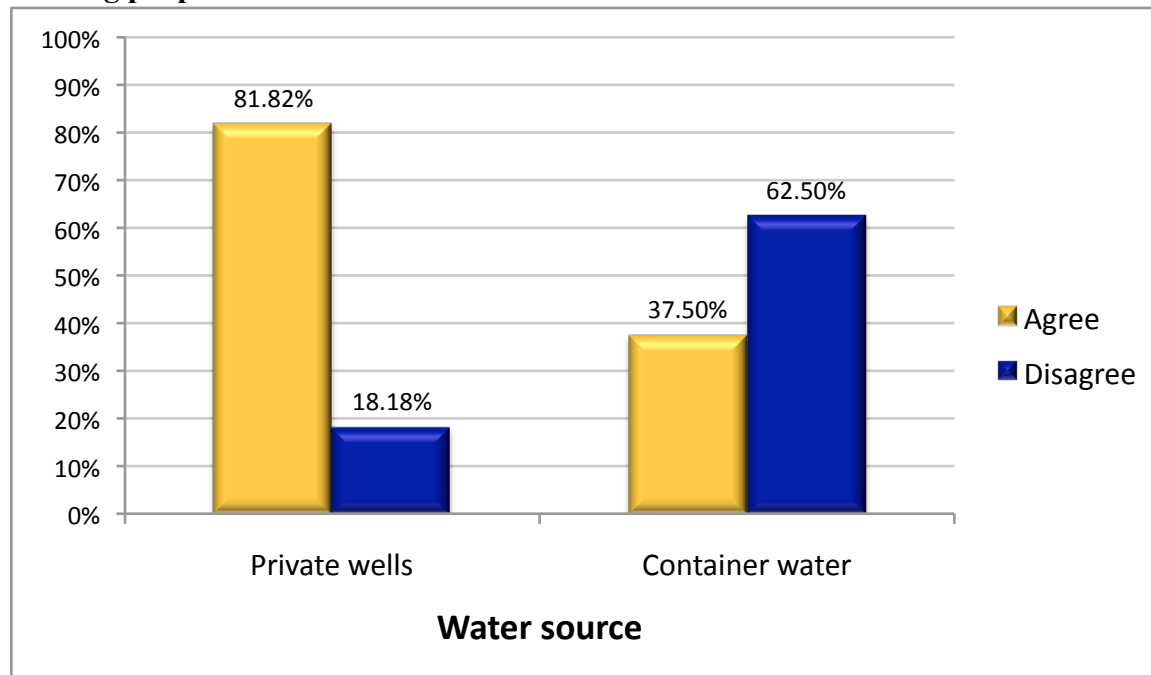
**Figure 22. Percentage of participants perceiving well or container water smell as unacceptable**



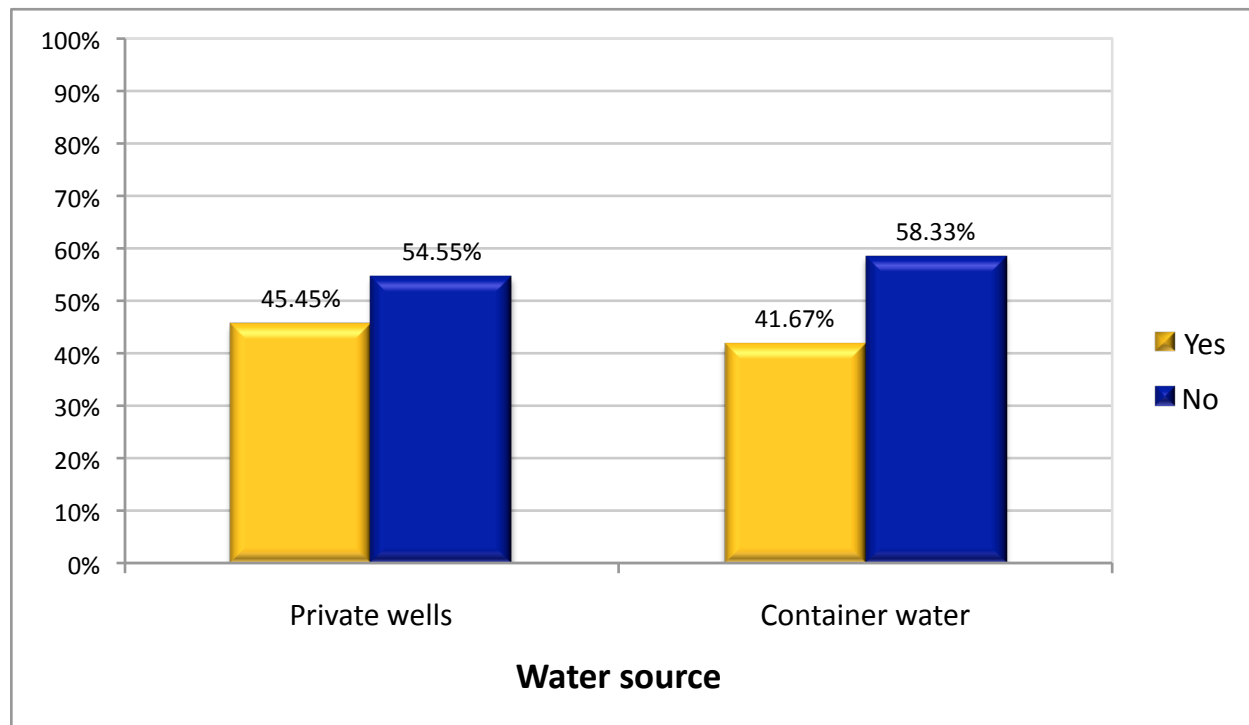
**Figure 23. Percentage of participants concerned about chemical contamination**



**Figure 24. Percentage of participants concerned about the quality of their water for cleaning purposes**



**Figure 25. Percentage of participants who perceived having experienced intestinal acute illness from water use**



## APPENDIX

### Appendix A: Instrument used for this study

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#### SECTION I: Water Source

Q1. What is your household's main source of water for the kitchen, bathroom, and laundry?

- ☐ Municipal water from a water district or local public water company
- ☐ Water hauled/delivered by others, like a water/pipe truck
- ☐ Water hauled by self
- ☐ Well
- ☐ Other: \_\_\_\_\_  
(specify)

Q2. Does this water come into your home from a faucet?

- ☐ Yes
- ☐ No

Q3. Is this your household's main source of drinking water?

- ☐ Yes
- ☐ No

**If no, what is your main source of drinking water?** \_\_\_\_\_

Q4. On an average day, how much potable water does your family consume?

Drinking water: # \_\_\_\_\_ gallons

Water for cooking: # \_\_\_\_\_ gallons

The following questions are about water treatment:

Q5. Do you treat this water in any way before drinking it?

- ☐ Yes, always
- ☐ Yes, usually
- ☐ Yes, sometimes
- ☐ No, never

Q6. If yes, how do you treat your drinking water? (**check all that apply**)

- ☐ I do not treat my water
- ☐ Boil the water
- ☐ Chlorine tablets or drops
- ☐ Iodine tablets or drops
- ☐ Pitcher filter, such as Brita
- ☐ Filter at kitchen tap/faucet

- ☐ Sun (containers in the sun)
- ☐ Other: \_\_\_\_\_ (specify)

Q7. If you treat your drinking water, to which household members do you provide treated water for drinking? (*check all that apply*)

- ☐ I do not treat my water
- ☐ All members
- ☐ None of the members
- ☐ Children under 5 years of age
- ☐ Members over 65 years of age
- ☐ Pregnant members
- ☐ Only if family member are sick

The following questions are about water purchases:

Q8. Does your household purchase drinking water from a source such as a grocery store or water mill? (DO NOT include water purchased from the local public water company or water hauled for an outdoor tank.)

- ☐ Yes, always
- ☐ Yes, usually
- ☐ Yes, sometimes
- ☐ No, never

Q9. If yes, where do you purchase the drinking water for your household? (*check all that apply*)

- ☐ I do not purchase additional drinking water.
- ☐ From a supermarket or wholesale store (Wal-Mart; Sam's club, etc.)
- ☐ From machines, such as watermills
- ☐ Other: \_\_\_\_\_  
(specify)

Q10. Why is the primary reason you choose to get water from this place?

- ☐ I do not purchase additional drinking water.
- ☐ Proximity (it is close to my home)
- ☐ Cost (it is inexpensive)
- ☐ There is no other source
- ☐ High Quality

Q11. How far do you travel to purchase water?

- ☐ I do not travel to purchase water

# \_\_\_\_\_ miles

Q12. How much water do you buy on each occasion?

☐ I do not purchase additional drinking water.

\_\_\_\_\_ gallons  
or  
\_\_\_\_\_ Cases of 24 bottles

Q13. How much do you pay on each occasion you buy water?

☐ I do not purchase additional drinking water.

\$\_\_\_\_\_ per occasion

The following questions are about water use:

Q14. To which household members do you provide bottled and/or water from machines for drinking? (**check all that apply**)

- ☐ I do not use purchased bottled water
- ☐ All members
- ☐ Children under 5 years of age
- ☐ Members over 65 years of age
- ☐ Pregnant members
- ☐ Only if family member are sick

Q15. Which of the following things have you done in the past month? (**check all that apply**)

	Tap water	Filtered water	Bottled water
Mixed infant formula with	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cooked with	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mixed powdered drink (e.g. kool-aid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Washed dishes with	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brushed your teeth with	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Made coffee or tea with	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The following questions are about water storage:

Q16. If you store drinking water, where do you store it?

- ☐ I do not store drinking water
- ☐ Outside the home
- ☐ Inside the home

Q17. What size container do you use to store your drinking water?

- ☐ I do not store drinking water
- ☐ Smaller than 5 gallons
- ☐ 3 to 5 gallon containers from water mill
- ☐ Greater than 5 gallon containers, such as drums or tanks

Q18. What material is your water storage container made of?

- ☐ I do not store drinking water
- ☐ Metal
- ☐ Glass

Q19. Is your stored water covered or sealed?

- ☐ I do not store drinking water.
- ☐ Yes
- ☐ No

Q20. Do you have a water tank in use?

- ☐ Yes
- ☐ No

Q20a. What do you use to clean your tank?

- ☐ I do not use a tank for storing drinking water.
- ☐ I do not clean my tank
- ☐ Bleach
- ☐ Chlorine
- ☐ Detergent/soap
- ☐ Other \_\_\_\_\_ ( specify product)

Q20b. How often do you clean your tank in a year?

- ☐ I do not use a tank for storing drinking water.
- ☐ Never
- ☐ One time per year
- ☐ Two times per year
- ☐ Three times per year
- ☐ Four times per year
- ☐ Once every two months
- ☐ Once a month
- ☐ More than once a month

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## SECTION II Water Quality

Please tell me whether you “**Agree**”, “**Disagree**”, or “Have **no strong feelings** either way” concerning the following statements.

	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
Q21. My drinking water is safe enough to drink	1	2	3	4	5
Q22. I am concerned about <b>chemical</b> contaminants in my drinking water	1	2	3	4	5
Q23. I am satisfied with the quality of my drinking water	1	2	3	4	5
Q24. The taste of my drinking water is acceptable	1	2	3	4	5
Q25. The smell of my drinking water is acceptable	1	2	3	4	5
Q26. I have been informed about the quality of my drinking water	1	2	3	4	5
Q27. I am knowledgeable about ways to improve the quality of drinking my water	1	2	3	4	5
Q28. I am concerned about <b>microbes</b> in my drinking water	1	2	3	4	5

Q29. I can trust my water supplier to provide me with a safe supply of drinking water	1	2	3	4	5
Q30. I am concerned about the quality of my water supplier	1	2	3	4	5
Q31. In general, the quality of my non-drinking water is good	1	2	3	4	5
Q32. I am concerned about the quality of the water I use for cleaning purposes	1	2	3	4	5

Q33. In the last year, have you or any member of your family taken specific action to improve the quality of your water?

- ☐ Yes \_\_\_\_\_ (specify)  
☐ No

Q34. Has your household water at home ever been tested for quality and/or contaminants?

- ☐ Yes \_\_\_\_\_ How long ago?  
☐ No

Q35. **IF yes**, about how long has it been since it was tested?

- ☐ Never tested  
☐ Within the last 3 years  
☐ 4 to 5 years ago  
☐ 6 to 10 years ago  
☐ Over 10 years

Q36. Have you or any other member in your home experienced any of the following conditions from your drinking water in the past six-months? (check all that apply)

- ☐ Diarrhea  
☐ Vomiting  
☐ Nausea  
☐ Stomach pain  
☐ Other water-borne illness: \_\_\_\_\_ (specify)  
☐ None

Q37. Do you have any comments that you would like to share with us regarding the quality of your drinking water?

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### SECTION III: Demographics

Q38. What is your age? \_\_\_\_\_ Yrs.

Q39. What is your gender?

☐ Male

☐ Female

Q40. What is your race or ethnicity?

☐ Black

☐ White/Non-Hispanic

☐ White/Hispanic

☐ Asian/Pacific Islander

☐ Native American Indian

☐ Other: \_\_\_\_\_

Q41. Do you consider yourself Hispanic or Latino?

☐ Yes

☐ No

Q42. What is your highest educational degree obtained?

☐ Less than HS

☐ GED

☐ High school

☐ Technical school

☐ College (Associates, Bachelor's)

☐ Graduate School (Master's, PhD)

☐ None

Q43. How many years have you lived in your current home? \_\_\_\_\_ Years

Q44. How many years have you lived in your current community?

\_\_\_\_\_ Name of Community \_\_\_\_\_ Years

Q45. Including yourself, how many people currently live in your household? \_\_\_\_\_ Persons

Q46. Which of the following best describes your household income from all sources?

☐ Less than 5,000 per year

☐ 5,000 to less than 10,000 per year

☐ 10,000 to less than 15,000 per year

☐ 15,000 to less than 20,000 per year

☐ 20,000 to less than 25,000 per year

☐ 25,000 to less than 35,000 per year

☐ 35,000 to less than 50,000 per year

- ☐ 50,000 to less than 75,000 per year
- ☐ 75,000 to less than 100,000 per year
- ☐ 100,000 or more per year
- ☐ Don't know
- ☐ Refused to answer

That is the end of the survey. Thank you for participating in our study.

## Appendix B: Instrument with suggestions

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### SECTION I: Water Source

Q1. What type of water do you usually use around the house? (e.g. kitchen, bathroom, and laundry)

- ☐ Hauled water
- ☐ Well water
- ☐ Other (please specify): \_\_\_\_\_

Q2. Does this water come into your home from a faucet?

- ☐ Yes
- ☐ No

Q3. If you have a well, when was your well built?

- ☐ I do not use well water
- ☐ Less than 5 years ago
- ☐ 5 – less than 10 years ago
- ☐ 10 – less than 15 years ago
- ☐ 15 – less than 20 years ago
- ☐ More than 20 years ago
- ☐ I don't know

Q3a. If you have a well, how deep is your water well?

- ☐ I do not use well water
- ☐ Less than 60 feet deep
- ☐ 60 – less than 90 feet deep
- ☐ 90 – less than 120 feet deep
- ☐ Deeper than 120 feet
- ☐ I don't know

Q3b. If you have a well, how far is your well placed from your septic tank?

- ☐ I do not use well water

- ☐ Less than 10 feet
- ☐ 10 – less than 20 feet
- ☐ 20 – less than 30
- ☐ 30 – 40 feet
- ☐ More than 40 feet
- ☐ I don't know
- ☐ Other (please specify): \_\_\_\_\_

Q4. If you use hauled water, how do you get the water delivered to you home?

- ☐ I do not use hauled water
- ☐ I haul the water myself
- ☐ I hire water haulers

Q4a. If you haul water yourself, where do you get the water?

- ☐ I do not use hauled water
- ☐ Private company
- ☐ From a relative's house
- ☐ Private wells
- Other: \_\_\_\_\_

Q4b. If you use hauled water, how often do you get hauled water to your house?

- ☐ I do not use hauled water
- ☐ Weekly
- ☐ Biweekly
- ☐ Monthly
- ☐ Other (please specify): \_\_\_\_\_

Q4c. If you use hauled water, how much water do you get per occasion?

- ☐ I do not use hauled water

\_\_\_\_\_ gallons

Q4d. If you get hauled water, how much do you pay per occasion?

☐ I do not use hauled water

\$ \_\_\_\_\_ per delivery

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## SECTION II: Water-use and Practices

Q5. In regards to your main source of household water (private well, hauled water), do you drink this water?

☐ Yes, always

☐ Yes, usually

☐ Yes, sometimes

☐ No, never

If you **do not** drink this water, what is your main source of drinking water? \_\_\_\_\_

Q4. On an average day, how much potable water does your family consume?

Drinking water: # \_\_\_\_\_ gallons

Water for cooking: # \_\_\_\_\_ gallons

Q19. Identify the type of water you would typically use for the following activities (**check all that apply**)

	Well/container water	Filtered water	Bottled water
Preparing infant formula	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cooking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Preparing powdered drinks (e.g. kool-aid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Making coffee or tea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Showering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brushing teeth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Washing dishes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Cleaning the house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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The following questions are about water treatment for your drinking water:

Q6. Do you treat this water in any way before using it?

- ☐ Yes, always
- ☐ Yes, usually
- ☐ Yes, sometimes
- ☐ No, never

Q7. If yes, how do you treat your drinking water? ***(check all that apply)***

- ☐ I do not treat my water
- ☐ Boil the water
- ☐ Chlorine tablets or drops
- ☐ Iodine tablets or drops
- ☐ Pitcher filter, such as Brita
- ☐ Filter at kitchen tap/faucet
- ☐ Sun (containers in the sun)
- ☐ Other (please specify): \_\_\_\_\_  
(specify)

Q8. If you treat your drinking water, to which household members do you provide treated water for drinking? ***(check all that apply)***

- ☐ I do not treat my water
- ☐ All members
- ☐ None of the members
- ☐ Children under 5 years of age
- ☐ Members over 65 years of age
- ☐ Pregnant members
- ☐ Only if family member are sick

Q9. If you do not treat your drinking water, explain your reasons for not doing it?

Q10. Would you like to receive information on water treatment options?

☐ Yes

☐ No

The following questions are about water purchasing specifically for drinking purposes:

Q11. Does your household purchase drinking water from a source such as a grocery store or water mill? (DO NOT include water purchased from the local public water company or water hauled for an outdoor tank.)

☐ Yes, always

☐ Yes, usually

☐ Yes, sometimes

☐ No, never

Q12. If yes, where do you purchase the drinking water for your household? (***check all that apply***)

☐ I do not purchase additional drinking water.

☐ From a supermarket or wholesale store (Wal-Mart; Sam's club, etc.)

☐ From machines, such as watermills

☐ Other (please specify): \_\_\_\_\_

Q13. If you purchase drinking water, what is the primary reason you choose to get water from this place?

☐ I do not purchase additional drinking water.

☐ Proximity (it is close to my home)

☐ Cost (it is inexpensive)

☐ There is no other source

☐ High Quality

Q14. If you purchase drinking water, how far do you travel to purchase water?

☐ I do not travel to purchase water

#\_\_\_\_\_ miles

Q15. If you purchase drinking water, how often do you purchase drinking water?

- ☐ Weekly
- ☐ Biweekly
- ☐ Monthly
- ☐ Other (please specify): \_\_\_\_\_

Q16. If you purchase drinking water, how much water do you buy on each occasion?

- ☐ I do not purchase additional drinking water.

\_\_\_\_\_ gallons  
or  
\_\_\_\_\_ Cases of 24 bottles

Q17. If you purchase drinking water, how much do you pay on each occasion you buy water?

- ☐ I do not purchase additional drinking water.

\$\_\_\_\_\_ per occasion

Q18. If you purchase drinking water, to which household members do you provide bottled and/or water from machines for drinking? (*check all that apply*)

- ☐ I do not use purchased bottled water
- ☐ All members
- ☐ Children under 5 years of age
- ☐ Members over 65 years of age
- ☐ Pregnant members
- ☐ Only if family member are sick

The following questions are about water storage:

Q20. If you store drinking water, where do you store it?

- ☐ I do not store drinking water
- ☐ Outside the home
- ☐ Inside the home

Q21. What size container do you use to store your drinking water?

- ☐ I do not store drinking water
- ☐ Smaller than 5 gallons
- ☐ 3 to 5 gallon containers from water mill
- ☐ Greater than 5 gallon containers, such as drums or tanks

Q22. What material is your water storage container made of?

- ☐ I do not store drinking water
- ☐ Metal
- ☐ Glass
- ☐ Plastic
- ☐ Other\_\_\_\_\_ (specify product)

Q23. Is your stored water covered or sealed?

- ☐ I do not store drinking water.
- ☐ Yes
- ☐ No

Q24. Do you have a water tank in use?

- ☐ Yes
- ☐ No

Q24a. What do you use to clean your tank?

- ☐ I do not use a tank for storing drinking water.
- ☐ I do not clean my tank
- ☐ Bleach
- ☐ Chlorine
- ☐ Detergent/soap
- ☐ Other\_\_\_\_\_ (specify product)

Q24b. How often do you clean your tank in a year?

☐ I do not use a tank for storing drinking water.

☐ Never

☐ One time per year

☐ Two times per year

☐ Three times per year

☐ Four times per year

☐ Once every two months

☐ Once a month

☐ More than once a month

Q24c. If you do not clean your tank, what are some of the reasons?

☐ It is hard for me to do it and I do not have the help to do it

☐ I do not know how to properly clean my tank

☐ I think it is dangerous

☐ Other \_\_\_\_\_ (specify product)

Q25d. Would you like to receive information on how to clean large water tanks?

☐ Yes

☐ No

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### SECTION III Water Quality

Please tell me whether you “**Agree**”, “**Disagree**”, or “**Have no strong feelings** either way” concerning the following statements related to your primary water source.

	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
Q26. My <b>well/container</b> water is safe enough to drink	1	2	3	4	5
Q27. I am concerned about <b>chemical</b> contaminants in my <b>well/container</b> water	1	2	3	4	5
Q28. I am satisfied with the quality of my <b>well/container</b> water	1	2	3	4	5

Q29. The taste of my <b>well/container</b> water is acceptable	1	2	3	4	5
Q30. The smell of my <b>well/container</b> water is acceptable	1	2	3	4	5
Q31. The color of my <b>well/container</b> water is acceptable	1	2	3	4	5
Q32. I have been informed about the quality of my <b>well/container</b> water	1	2	3	4	5
Q33. I am knowledgeable about ways to improve the quality of my <b>well/container</b> water	1	2	3	4	5
Q34. I am concerned about <b>microbes</b> in my <b>well/container</b> water	1	2	3	4	5
Q35. I am concerned about the quality of my <b>well/container</b> water supplier	1	2	3	4	5
Q36. I am concerned about the quality of my <b>well/container</b> I use for cleaning purposes	3	2	3	4	5

Q37. In the last year, have you or any member of your family taken specific action to improve the quality of your water?

- ☐ Yes \_\_\_\_\_ (specify)  
☐ No

Q38. Has your household water at home ever been tested for quality and/or contaminants?

- ☐ Yes \_\_\_\_\_ How long ago?  
☐ No

Q39. **IF yes**, about how long has it been since it was tested?

- ☐ Never tested  
☐ Within the last 3 years  
☐ 4 to 5 years ago  
☐ 6 to 10 years ago  
☐ Over 10 years

Q40. Have you or any other member in your home experienced any of the following conditions from your primary water source in the past six-months? (check all that apply)

- ☐ Diarrhea  
☐ Vomiting

- ☐ Nausea
- ☐ Stomach pain
- ☐ Skin rashes
- ☐ Other water-borne illness: \_\_\_\_\_ (specify)
- ☐ None

Q41. Do you have any comments that you would like to share with us regarding the quality of your primary water source (well/tank water)?

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**SECTION IV: Demographics**

Q42. What is your age? \_\_\_\_\_ Yrs.

Q43. What is your gender?

- ☐ Male
- ☐ Female

Q40. What is your race or ethnicity?

- ☐ Black
- ☐ White/Non-Hispanic
- ☐ White/Hispanic
- ☐ Asian/Pacific Islander
- ☐ Native American Indian
- ☐ Other: \_\_\_\_\_

Q44. Do you consider yourself Hispanic/Latino?

- ☐ Yes
- ☐ No

Q45. What is your highest educational degree obtained?

- ☐ None
- ☐ Less than HS
- ☐ GED/High school
- ☐ Technical school
- ☐ College (Associates, Bachelor's)
- ☐ Graduate School (Master's, PhD)

Q46. How many years have you lived in your current home? \_\_\_\_\_ Years

Q47. How many years have you lived in your current community?

\_\_\_\_\_ Name of Community \_\_\_\_\_ Years

Q48. Including yourself, how many people currently live in your household? \_\_\_\_\_ Persons

- Q48a. How many of those people are 11 - 17 years old? \_\_\_\_\_ Persons  
Q48b. How many of those people are 6 - 10 years old? \_\_\_\_\_ Persons  
Q48c. How many of those people are under 5 years old? \_\_\_\_\_ Persons

Q49. Which of the following best describes your household income from all sources?

- ☐ Less than 5,000 per year
- ☐ 5,000 to less than 10,000 per year
- ☐ 10,000 to less than 15,000 per year
- ☐ 15,000 to less than 20,000 per year
- ☐ 20,000 to less than 25,000 per year
- ☐ 25,000 to less than 35,000 per year
- ☐ 35,000 to less than 50,000 per year
- ☐ 50,000 to less than 75,000 per year
- ☐ 75,000 to less than 100,000 per year
- ☐ 100,000 or more per year
- ☐ Refused to answer

**That is the end of the survey. Thank you for participating in our study.**

## **CURRICULUM VITA**

Lydia Berenice Garcia Cobos was born and raised in Chihuahua, Mexico. She graduated from Colegio de Bachilleres de Chihuahua Plantel 4 in 2006. She graduated with a Bachelors of Arts degree in Electronic Media with a double major in Organizational and Corporate Communications from the University of Texas at El Paso with the honors of Cum Laude in Spring 2011. In the same year, she entered the Master of Public Health program at UTEP. Since 2012, Ms. Garcia has worked as a research assistant in an Environmental Protection Agency' granted project. In 2013, Ms. Garcia was accepted to the Directors of Health Promotion and Education summer internship and collaborated with the Hispanic Health Disparities Research Center. She was part of a team whose work on smoke-free policy in public housing was presented at regional and national conferences this year. Also, she has interned with the City of El Paso Department of Public Health. All this opportunities have let Ms. Garcia to experience hands on the work in public health. She has especially enjoyed working with such a diverse group of community partners throughout her time at UTEP. She is particularly interested in health communications and environmental health and she is very enthusiastic about her career as a public health professional.