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Small Water Enterprises: A Cross-Sectional Study of Bottled Water Consumption in the Yucatan Peninsula

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Abstract

Small Water Enterprises: A Cross-Sectional Study of Bottled Water Consumption in the Yucatan Peninsula, Mexico

By Joanna Galvez

Background: Each year there are millions of cases of diarrhea worldwide because of lack of access to safe water. Interventions that seek to increase safe access to water vary both in method and effectiveness. Local small water enterprises (SWEs) can better respond to a community's need for safe water. Living Waters for the World (LWW) is a global non-profit that aids members of local communities to set up SWEs that purify and sell bottled water. There is a dearth of research on communities' views regarding safe water interventions like LWW and SWEs in general.

Objective: This thesis explores the differences between LWW consumers and non-consumers in the Yucatan Peninsula.

Methods: 300 household surveys were conducted in two urban and three rural communities throughout the Yucatan Peninsula. There was an LWW water plant in all these communities and all inhabitants had access to their bottled water. Data were then analyzed focusing on differences in bottled water consumption, health and hygiene knowledge and attitudes and beliefs with regards to bottled water.

Results: Bottled water was the primary source of drinking water for almost all households. LWW consumers paid less significantly less for bottle water and purchased more bottled water per week than non-consumers. LWW consumers were more likely than non-consumers to cite price as a reason they preferred a specific brand of bottled water. LWW consumers were also more likely to use bottled water for other purposes besides drinking, namely, cooking, preparing food, and brushing their teeth compared to non-consumers.

Discussion: Overall, there were some interesting findings but due to the small sample it was difficult to perform further analyses. Further study is needed with a larger, randomized sample. Qualitative studies can explore more in depth the reasons LWW consumers prefer to drink their water. The findings from this research can be used to scale up similar interventions, and set up SWEs that fit with the community consumption practices. New LWW sites, particularly those

outside the Yucatan Peninsula should conduct baseline research to determine community attitudes and practices before installing new systems.

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Acronym List

CWU	Clean Water U
FBO	Faith Based Organization
IP	Initiating Partners
LWW	Living Waters for the World
MDG	Millennium Development Goals
NGO	Non Governmental Organization
OP	Operating Partner
PET	Polyethilene terephthalate
POU	Operating Partners
SES	Socioeconomic Status
SWE	Small Water Enterprise
SODIS	Solar Water Disinfection
SWS	Safe Water System
SWTP	Small Water Treatment Plants
SSS	Small Scale System
ROS	Reverse Osmosis and Softening
RO	Reverse Osmosis
UNICEF	United Nations Children's Fund
UV	Ultra Violet
WB	World Bank
WHO	World Health Organization

Chapter 1: Introduction

This chapter is an introduction to the problem this thesis is studying. The first section provides the background information necessary to understand the study. The second section problematizes the issue. This is followed by the purpose statement, research question, and significance statement. Finally terms used throughout this thesis are defined.

1.1 Background

Waterborne illness is the second highest cause of childhood mortality(World Health Organizatio United Nation's Children's Fund, 2006). An estimated 1.6 million children die every year from diarrhea, which is transmitted primarily through contaminated water (World Bank, n.d.; World Health Organization United Nation's Children's Fund, 2006) There are approximately 1.1 billion people that do not have access to an improved water source, and even those with access to an improved source (World Health Organizatio United Nation's Children's Fund, 2006).are still exposed to water that can be contaminated either during collection, transport, or storage (Kosek, Bern, & Guerrant; Parashar, JS, & Glass, 2003; WHO/UNICEF, 2006).

Studies have continually shown the harmful consequences of inadequate access to safe water (Andrade, Queiroz, Cabral, Lieberman, & Jeronimo, 2009; Checkley et al., 2004). Access to water is an important determinant of nutritional status, and consequently impacts stunting and wasting (Checkley, et al., 2004) . Because of the impact of early childhood nutrition on long-term health status,

malnutrition can lead to cognitive problems, decreased work and social mobility later in life, and lower economic status (Checkley, et al., 2004). Other factors that impact morbidity and mortality due to diarrhea and other parasitic infections, especially in children, are parents' literacy rates, maternal education, increased buying power, proper water storage, and exposure to health education campaigns (Andrade, et al., 2009; Checkley, et al., 2004; Quihui, Valencia, Crompton, & Phillips, 2006).

The economic cost of diarrhea and other water related illnesses include health services costs, such as treatment and hospitalization, indirect costs incurred by patients and their families, and lost days of work and school. Lack of access to safe water perpetuates a cycle of human suffering. This can have long term health and social effects for children by negatively impacting their nutritional status, weakening their immune system and effecting their cognitive abilities (Checkley, et al., 2004).

People lack access to safe water in Mexico with 15% of the rural population lacking access to improved drinking water sources (Organization). Even in places where piped water is available, service is not reliable and the water is not safe to drink (INEGI, 2006). This implies a need for alternative sources of drinking water. Mexico is the second largest consumer of bottled water in the world, where bottled water is a staple (Diaz, Ortiz, Schettino, Vega, & Gutierrez, 2009). It follows that those families who cannot afford bottled water,

must either drink the tap water or find a more affordable way to purify their drinking water.

Many faith-based organizations (FBOs) dedicate themselves to improving communities' access to safe water throughout the world. One such organization is Living Waters for the World (LWW), a global faith based organization, which aids communities around the globe to set up water treatment systems within communities in need of safe water. LWW trains mission teams to install and operate water treatment systems and to build partnerships with local community leaders. They also provide a health education curriculum and training to the mission teams. The mission teams, in turn, trains and equips members of local communities to install and operate treatment plants, and to teach health education to others in the community.

Health interventions often fail in the long term because of a lack of training and funding. It is difficult to sustain the benefits of infrastructures, such as latrines or water treatment plants due to such factors(Breslin, n.d.). LWW addresses the issue of sustainability through a model of "training the trainer"(LWW; LWW Our Mission, n.d.). Mission teams from various Presbyterian congregations in the US attend training seminars, run by LWW staff and held multiple times per year. The mission teams are made up of congregants who volunteer their time to travel to communities with poor access to safe water and assist and train members of the local community in building and operating water treatment plants. LWW does this by building partnerships with local

community leaders. Often, community leaders are members of the local Presbyterian congregation. Water treatment systems are set up in churches, schools or clinics. These treatment plants are set up as a Small Water Enterprise (SWE), which purify, bottle, and deliver treated water in five-gallon containers. LWW water is comparable to other bottled water brands consumed in Mexico. However, LWW is able to sell their bottled water at half the cost, making their product more affordable and accessible than others. The LWW model, has the potential to increase access to safe water in underserved populations and hard to reach communities throughout the world(LWW Facts, n.d.; LWW Health Education, 2009).

1.2 Statement of the Problem

The success of public health interventions is dependent on the number of people that benefit from them and the sustainability of that benefit in the long run. There are many interventions that seek to increase access to safe water in low and middle-income countries (J. Brown, et al., 2009; Meierhofer & Landolt, 2009; Preston, et al., 2010) There are multiple water treatment techniques that reduce water contaminants, theoretically lowering exposure to unsafe water (Peter-Varbanets, Zurbrugg, Swartz, & Pronk, 2009; Potgieter, Becker, & Ehlers, 2009; Yayemain et al., 2009). However, many interventions do not take into account community knowledge and preferences with regards to treated water, and are therefore unsuccessful in decreasing exposure to contaminated water . There is a need to better understand consumers of treated water to determine the

success of interventions such as the LWW model. The conceptual model below by Kolb Dewilde illustrates the causal pathway by which interventions that increase access to safe water can reduce exposure to enteric pathogens thereby decreasing morbidity (see Figure 1) (Dewilde, et al., 2008).

Figure 1. Causal pathway through which safe water programs can reduce population exposure to enteric pathogens and deliver a beneficial health impact (Dewilde, et al., 2008).

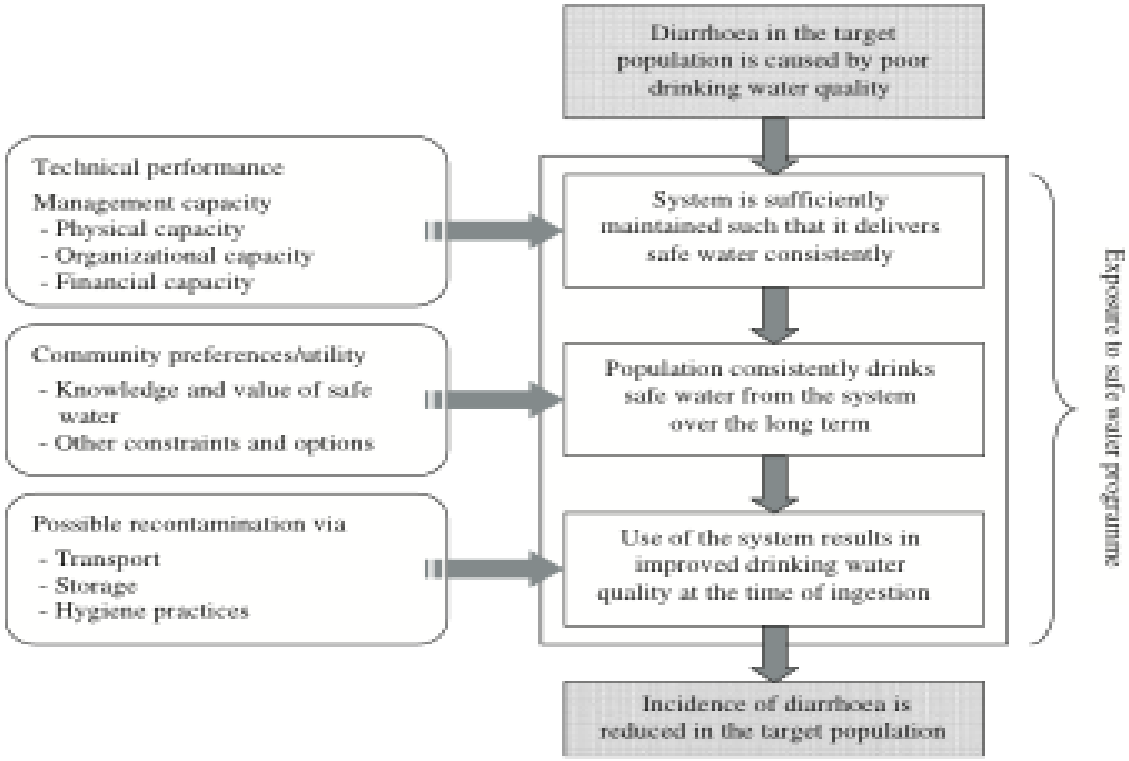

Figure 1 Impact model illustrating causal pathway through which safe water programmes can reduce population exposure to enteric pathogens and deliver a beneficial health impact

The model above identifies barriers to successful interventions such as transport and hygiene practices, and takes into account community preference for an intervention as a mediating factor for success (Dewilde, et al., 2008). By understanding consumer knowledge and preferences, interventions can be better targeted, and reach a larger percentage of the population. In order to know what makes a safe water intervention successful, it is necessary to first understand consumers of treated water, why and how they consume it, and moreover, to assess their health and hygiene knowledge and attitudes towards treated water.

1.3 Purpose Statement

The purpose of this thesis is to assess consumer preference, knowledge and attitudes with regards to purified water for LWW consumers and non-consumers. The study compares the demographic characteristics, factors that affect purchasing decisions, uses, practices, and beliefs regarding treated water, and satisfaction with the taste and quality of the purified water of LWW consumers and non-consumers.

1.4 Research Question

In what ways do consumers of LWW water differ from non-consumers in preferences, practices, and attitudes toward treated water, in particular bottled water?

1.5 Significance Statement

Studies on the effectiveness of SWEs are sparse. This study investigates consumer preferences and behaviors with regards to bottled water consumption in Mexico. Within this study the author specifically examines the SWE model of LWW. Learning more about the consumers of bottled water may aid LWW in improving their operations, marketing strategy and product quality. Since tap water is not considered safe for human consumption in Mexico, bottled water is a staple throughout the country. Understanding consumer needs can maximize the success and impact of interventions (Dewilde, et al., 2008). In this case, if bottled water is already widely consumed and accepted in the Yucatan Peninsula, then interventions that use bottled water as a way to increase access to safe water in the community are more likely to be successful, meaning that bottled water is more likely to be consumed. This thesis will provide pertinent data on factors that contribute to the success and sustainability of small water enterprises. An important factor of sustainability is consumer use. Understanding consumer preference, knowledge and attitudes with regards to purified water can help determine use. Lastly this information may help improve the business model of other SWEs, and potentially increase the number

of sustainable water treatment systems in Mexico and across the developing world.

1.6 Definition of terms

LWW Consumers: Users of LWW bottled water that are loyal to the brand.

Non-consumers: Users of brands of bottled water other than LWW.

Community: Delivery area of the LWW plant, entire town in rural areas, and surrounding districts in urban areas.

Sustainable: An intervention that is used by many over long periods of time.

Bottled Water: A five gallon bottle of water.

Success: The number of people that benefit from a health intervention and the sustainability of that benefit in the long run.

Improved water source: A source likely to provide safe water. (World Health Organizatio United Nation's Children's Fund, 2006).

Irradiation: A technology for pasteurizing fresh produce.

Chapter 2: Literature Review

This chapter is a review of the current literature on the different elements of Living Water for the World (LWW). There are a total of seven sections in this chapter. The first relates to LWW's mission and the problem of lack of access to safe water that the organization is trying to address. The second section examines LWW's presence in Mexico and in the Yucatan Peninsula in particular. It also examines national and state level health indicators in Mexico. The next section reviews various methods of water purification and the effectiveness of using these in health interventions both at point of use (POU) and at the source. It compares these interventions to the method used by LWW. Section four reviews the literature on Faith Based Organizations (FBOs). Additionally it examines health interventions focusing on the intersection of faith and health in LWW interventions. This is followed by section five, an introduction to the LWW model and the characteristics of the Small Water Enterprises (SWEs) they help to set up. This section also discusses the current literature on SWEs and how LWW's model compares to other SWEs. It addresses the rationale for the types of SWEs that are set up in the Yucatan Peninsula. The last section of this chapter looks at the current literature on consumer use and preferences and how these relate to sustainable interventions. The chapter concludes with a summary of findings based on the review of the literature.

2.1. The Problem

LWW is a FBO that exponentially builds capacity by training mission teams who in turn train members of local communities throughout the world. LWW's mission is to enable individuals, church teams, and other organizational groups to share clean water with partners in need (LWW Our Mission, n.d.).As mentioned in the previous chapter, over a billion people suffer from lack of access to an improved water source. Among those that have access to an improved source, many are still at risk of consuming contaminated water (Kosek, et al.; Parashar, et al., 2003; WHO/UNICEF, 2006). LWW addresses this issue by providing safe water in sealed containers to avoid recontamination, and health education programs that teach people what they can do to avoid consuming contaminated water (LWW Facts, n.d.; LWW Health Education, 2009)The consumption of contaminated water has many detrimental health risks (Checkley, et al., 2004). Tap water may be subject to recontamination either because of a lack of residual chlorination or improper storage practices (Corella-Barud, Mena, Gibbs, Gurian, & Barud, 2009; Potgieter, et al., 2009). For instance diarrheal infections are primarily due to consumption of contaminated water (World Health Organizatio United Nation's Children's Fund, 2006). Diarrhea rates are higher in households that consume vegetables washed only with tap water, those that do not have access to a flushing toilet or a reliable water supply (Cifuentes, Suarez, Solano, & Santos, 2002). Furthermore, safe water storage practices (such as covered receptacles) are associated with decreased rates of

infection(Cifuentes, et al., 2002). Households who purchased commercially bottled water had even lower rates of infection than those with various water storage methods (Cifuentes, Suarez, Espinosa, Juarez-Figueroa, & Martinez-Palomo, 2004; Cifuentes, et al., 2002). A significant contributing factor is that waterborne illnesses caused by contaminants such as cholera, giardia, cryptosporidian and other diarrheal causing diseases are undetectable by smell or taste (Cifuentes, et al., 2004; LWW). It follows that knowledge regarding these risk factors can help lower rates of infection, and increase use of water treatment options.

This thesis examines hygiene knowledge and use of treated water. LWW's work focuses on transforming contaminated water into water that is safe enough for human consumption. However, a water source must already be in place (LWW Facts, n.d.) While LWW can provide information about organizations that develop raw water infrastructure or drill wells if needed, it is outside of LWW's scope to do so themselves (LWW Facts, n.d.) Because of this fact LWW's model may not be appropriate in some low resource settings that lack access to an improved water source. Indeed the WHO considers bottled water an improved source of drinking water only when households have access to a consistent improved source of water for cooking and hygiene practices (World Health Organizatio United Nation's Children's Fund, 2006). LWW's model works well in Mexico where 94% of households have access to an improved water source. However, this number is much lower for rural areas (85%) (World Health

Organizatio United Nation's Children's Fund, 2006)The next section looks at LWW's presence Mexico, in particular in the states of Yucatan and Campeche in the Yucatan Peninsula.

2.2. Water and Health in Mexico

Mexico's health system and infrastructure has improved greatly in the past 25 years (Sepulveda, Valdespino, & Garcia-Garcia, 2006). In spite of this, access to water is still an issue in various parts of the country, particularly in rural areas, where 15% of the population still lack access to an improved water source.(Maranon-Pimentel, 2009). An even greater percentage of the population experience irregular service (Ennis-McMillan, 2001; Maranon-Pimentel, 2009). Throughout the Yucatan Peninsula, an estimated 87% of households have access to piped water (INEGI, 2006).

The threat of a cholera outbreak in the early 1990s resulted in radical improvements to Mexico's health system, which included creating epidemiologic surveillance systems, and strengthening water treatment systems by increasing the chlorination of potable water (Sepulveda, et al., 2006). Unfortunately, because chlorination schedules are not reliable in many areas, residual disinfectant is often missing at the point of use, making Mexico's water unpotable (Corella-Barud, et al., 2009).

All these issues are reflected in Mexico's high rates of morbidity and mortality due to diarrhea. Intestinal infections are the seventh cause of death in

children under five, and the second leading cause of morbidity (INEGI & Epidemiologia, 2008; Organization).

Such data illustrate the need for interventions such as those espoused by LWW that increase access to safe water. LWW has been active in the in the Yucatan Peninsula since 2004 when the first system was installed (Lukins, 2010). Since that time a partnership between the Synod of Living Waters Presbyterian Church in the US and Synod of the Yucatan Peninsula, National Presbyterian Church of Mexico to deliver clean water to suitable areas throughout the Yucatan Peninsula has been established.(LWW Our Story, n.d.). There are now over 48 LWW SWEs throughout the Yucatan Peninsula. In many sites, water delivery occurs up to three times a day, especially in urban areas (Lukins, 2010). Some rural areas use large tricycles to deliver water, while others use trucks depending on the size of the town and the market (LWW; LWW Facts, n.d.). Systems are constantly being upgraded with new technologies (Lukins, 2010). Different types of water treatment systems are discussed next with a focus on the sustainability of interventions for each type of treatment.

2.3. Increasing access to purified water

This section looks at different ways water can be purified and discusses different types of water treatment systems including the LWW system. There are many ways to purify water (Peter-Varbanets, et al., 2009). When centralized systems are deficient, decentralized systems emerge. Decentralized water treatment systems range from Small Scale Systems (SSS) that treat water for the

consumption of several families or a small village, to Point of Use (POU) treatment, which happens at the household level (Peter-Varbanets, et al., 2009). This study looks at use and preferences of consumers with regards to purified water quality produced by an LWW site. LWW exponentially builds capacity by training mission teams who in turn train members of local communities throughout the world. LWW's mission is to increase access to safe water throughout the globe. This study focuses on LWW's efforts to increase access to safe water in the Yucatan Peninsula, which may be considered an SSS, and examines other methods used by study participants. It is therefore important to understand the different aspects of these methods. First, the water treatment methods used by LWW sites are discussed. An overview of commonly used water treatment methods follows. All of these methods are potential options for participants of this study.

2.3.1 Water treatment methods

LWW has three types of water treatment systems, the standard system with UV disinfection with chlorine, the standard system with ozone disinfection, and the Reverse Osmosis and Softening System (ROS) (LWW). The SWEs in this study all used the ROS system. According to LWW staff, the reason the ROS system is preferred is due to the high level of water hardness, salinity, and heavy metals present in much of Yucatan source water (Lukins, 2010). Furthermore, ozone disinfection is said to be preferred to UV disinfection both for its residual killing capacity, and the reported superior taste of the water

(Lukins, 2010). LWW staff mentioned that consumers in the Yucatan are more sensitive to the taste of chlorine, and chlorine taste is often cited as a reason for dissatisfaction with tap water (Lukins, 2010; LWW). Indeed, chlorine is the main method of water treatment in the public water system (INEGI, 2010).

Chlorination is a cost-effective way to purify water, and is widely used by public water systems, as chlorine is highly effective against most waterborne pathogens.(Corella-Barud, et al., 2009) Some issues with chlorination at the source are the lack of residual disinfectant that reaches the household, and risks of recontamination that the water is subject to during the water collection and storage cycle (Corella-Barud, et al., 2009). Chlorination can be also used as a POU treatment, however, as previously stated, low socio-cultural acceptance of chlorine taste and odor can inhibit the use of this method to treat drinking water (Peter-Varbanets, et al., 2009).

A widely used POU treatment is simply boiling water to get rid of pathogens, however unless water is consumed immediately it is subject to recontamination risk and improper storage practices (Peter-Varbanets, et al., 2009). An additional concern is the high energy costs required to boil water (Peter-Varbanets, et al., 2009). LWW staff feels very strongly about decreasing the need to water boiling as a means to purify water. When households in the Yucatan Peninsula cannot afford bottled water, their primary water treatment method is water boiling (LWW; LWW Facts, n.d.).

Another water treatment method uses solar power to disinfect water. The Solar Water Disinfection (SODIS) requires that water filled PET bottles be exposed to five hours of midday summer sunshine, which results in results in the inactivation of fecal coliform by 75%, the necessary level needed to destroy giardia, cryptosporidium and other diarrhea causing bacteria (Meierhofer & Landolt, 2009). A barrier to the use of SODIS is the lack of access to PET bottles in certain areas (Meierhofer & Landolt, 2009) . Another issue that can impact the use of this method is the amount of time needed to treat the water, especially during cold overcast days (Meierhofer & Landolt, 2009). This is a problem especially for households that have only one bottle and can be left without purified water for days at a time.

Another solution that can be used at POU or in SSS is the use of filters, and UV lamps or membrane technologies, which, for SSSs provide a cost effective way to remove turbidity and reduce pathogens without the use of chemicals (Peter-Varbanets, et al., 2009). However household filtration devices can be expensive or prone to breaking or malfunctioning (J. Brown, et al., 2009; Peter-Varbanets, et al., 2009). Reverse Osmosis (RO), which is used in the LWW treatment site, is another water treatment method that is cost prohibitive at the POU but can be cost effective for SSSs (Peter-Varbanets, et al., 2009).

The effectiveness of POU interventions depends on knowledge and proper use of the treatment method (Corella-Barud, et al., 2009). Methods that are time consuming and difficult to use for many people are also less effective

(Preston, et al., 2010). Part of the goal of this study is to learn if consumers throughout the Yucatan use any type of water treatment methods.

2.3.2 Safe Water Interventions

Health interventions have different ways to measure success. Manase argues that interventions that target only water and sanitation issues without looking at the underlying causes often fail and that by communicating with the community, projects can be more successful (Manase, Nkuna, & Ngorima, 2009). LWW's success depends on their relationships with the community, and with their partners (Lukins, 2009). LWW focuses on building capacity and leadership by training mission teams, equipping partners with supplies and materials at cost, and sustaining operations. Their training involves partnership development and leadership, health, hygiene and spiritual education, and water treatment system installation, operation and maintenance (LWW; LWW Facts at a Glance, 2009). This thesis takes a look at another aspect of community relationship, namely the relationship of LWW with their consumers. LWW's health education component is meant to be integrated into site operation. The impact of LWW's health education program will be assessed by measuring consumer's knowledge of hygiene practices and health issues as specified by LWW's health education curriculum. This thesis will also measure the number of people that have learned about health and hygiene through the LWW health education program. The next section discuses the faith based aspect of LWW, which influences various parts of

its model from health education to leadership and operation, and has an impact on the success of their intervention.

2.4 . Health and Faith Based Organizations (FBOs)

A FBO is usually made up of members affiliated with a particular religious group that see improving a communities health as a mission congruent with their concerns for human dignity and social justice (Grills, 2009). This is true in part for LWW, which is a mission resource of the Synod of Living Waters of the Presbyterian Church in the US that also partners with members of civic organizations and churches of all denominations around the globe. LWW was created about three decades ago by a Presbyterian minister to help increase access to clean water to communities in need. (Our Story, LWW, n.d.) LWW has since partnered with mission teams to empower local community members in installing over 300 water treatment systems (LWW; LWW Our Story, n.d.).

As evidenced in the LWW model, FBOs tend to have a higher reliance on volunteers than secular organizations (Clerkin & Gronbjerg, 2007). In the US volunteers are more likely to be part of a congregation, have higher incomes and be more educated than non-volunteers (Garland, Myers, & Wolfer, 2008). Other important characteristics of volunteers include the motivation to act on their values, a tendency to reflect on their lives, a high value of their relationship with other volunteers and with program participation (Garland, et al., 2008). Findings suggest that congregation volunteers are more dedicated and committed to the mission of the organization and some argue that this fact makes the service

delivery more efficient than organizations relying on paid volunteers (Clerkin & Gronbjerg, 2007). LWW has a small staff but counts on committed volunteers for the success of its mission. The majority of LWW staff is involved in the training and capacity building of mission teams (LWW; LWW Leadership, n.d.).

The training school of LWW, Clean Water U (CWU) is a five day "simulations experience designed to equip mission teams with the skills necessary to form partnerships with communities in need of clean water, equip local leaders to lead ongoing health, hygiene and spiritual education and install the Living Waters for the World clean water system" (LWW; LWW(CleanWaterU), n.d.). CWU has three components taught in three separate workshops. Every mission team must have at least three members that have attended CWU and at least one member for each workshop (LWW; LWW(CleanWaterU), n.d.). The first component is leadership. The leadership workshop focuses on finding a site, and creating and maintaining a relationship with local partners. The second component is health education, and spiritual training, and the workshop focuses on a health and hygiene practices curriculum that incorporates spiritual parables into various training activities. This curriculum is taught to local community members in the field (LWW Facts, n.d.; LWW Health Education, 2009) The third component is water treatment technology. The workshop teaches members how to install and operate a water treatment system so that the mission team can train local members in the field (LWW; LWW(CleanWaterU), n.d.).

The mission teams or Initiating Partners (IPs) then build a partnership with leaders of local communities or Operating Partners (OPs). Most OPs are pastors of local congregations. Consequently, most LWW sites are set up in Presbyterian churches and are operated by members of the local congregation. Much like the mission teams in the US, the OPs are motivated by a sense of mission and helping the community. The LWW sites are not meant as a for profit businesses, however surplus revenue is used to scale up plant capacity and improve the site. LWW is volunteer led, and the SWE sites they help to set up are primarily mission focused, meaning that they seek to increase access to water to all those that cannot afford it (LWW; LWW Our Mission, n.d.). Participating in these programs is motivated in part by a spiritual calling, and most paid staff members of the FBO have a spiritual connection with the organization's mission (Garland, et al., 2008). Faith is a key component for the success of LWW sites, particularly in the beginning stages.

Evidence suggests that members of a community tend to trust FBOs more than government and secular organizations (Grills, 2009). For LWW, trust can be an important component of sustainability and success. If consumers trust that the water provided by LWW is safe, they are more likely to purchase it, thereby increasing consumption of safe water and improving the likelihood that the LWW SWE will be able to cover its operating costs. However, there is also an issue of acceptance of LWW in the community by members of other faiths. In the Yucatan Peninsula, all treatment plants are set up in Presbyterian churches,

while the majority of the population is Catholic. This thesis will examine if faith is associated with the type of bottled water consumed. The following section discusses SWEs and their role in the community.

2.5. Small Water Enterprises (SWEs)

This section discusses different types of SWEs as well as the advantages and disadvantages of SWEs. Furthermore, this section examines the role of SWEs and other small businesses in the community. The SWEs established with the help of LWW are discussed in detail, as is bottled water consumption in the Mexico.

SWEs are ubiquitous throughout the developing world and respond to local needs for safe and accessible water (Solo, 2003). Opryzco et. al conducted a review of the literature on SWEs(Opryszko, Huang, Soderlund, & Schwab, 2009). Keywords related to SWEs were searched using large search engines such as Google, Google Scholar and PubMed. Reports and studies of multilateral agencies, NGOs, and other organizations working in the field were also researched. Sixty-two relevant documents on various types of SWEs in Africa, Asia, and Latin America were reviewed and SWEs were found to be a common part of both rural and urban areas of Africa, Asia and Latin America(Opryszko, et al., 2009). Advantages of SWEs included their flexibility and ability to respond to local demand. Disadvantages of SWEs included a higher cost for water than infrastructure based utilities and the lack of quality monitoring. Opryszko found no peer reviewed scientific studies that examined the effectiveness of SWEs, and

identified potential research topics that require field based, community-level research (Opryszko, et al., 2009). This thesis examines two of those topics. The first one is the effectiveness of hygiene promotion on household behaviors, and the second is the community perception of the quality of SWE's product. Understanding how consumers value SWEs and the market drivers related to them is necessary to create an optimal model of SWE that is efficient, meets consumer needs, and is profitable (Opryszko, et al., 2009). This illustrates the need for further research on consumers of SWEs. This thesis contributes to the current literature available, and increased understanding of SWE consumers.

There are various types of SWEs: wholesale vendors, distributing vendors and direct vendors, with distributing vendors being the most common. Water kiosks are a type of direct vendors, while raw water trucks and bottled water delivery trucks are considered distributing vendors (Opryszko, et al., 2009). The SWEs set up with the help of LWW fall under the categories of distributing vendors and direct vendors depending on whether water is delivered or if someone goes to the plant to pick it up.

The estimated start up cost of an SWE water treatment site in Mexico is between $13,000 and $30,000 (US). Despite the fact that with a large customer base, and a marketing strategy, return on investment could take as little as two years, liquidity constraints in obtaining start up capital in both formal and informal credit markets, sometimes make it difficult for SWEs to expand and provide a continuous quality product (Bogle & Younos, 2008; Heino, 2006). A

focus on relationship and quality control may help LWW sites avoid drawbacks of other SWEs and micro enterprises in general. The LWW model addresses this issue by making IPs responsible for start-up investment, training and support (LWW Facts at a Glance, 2009).

LWW mission-teams partner with local leaders and assist them in setting up SWEs. LWW provides their partners with training, materials and supplies including a water treatment system and PET bottles. Households typically consume the bottled water and recycle the containers by trading them in for more bottled water (LWW, 2009; LWW Facts, n.d.; LWW Health Education, 2009). LWW stipulates that this partnership must last a minimum of three years, and involve multiple trips to the operating site. LWW estimates a total participation cost of $24,500, which is usually raised by the mission teams' congregation. This estimate takes into account the cost of training the mission team, system and materials, and travel expenses in the first three years of the partnership (LWW; LWW Facts at a Glance, 2009).

By setting up an SWE, LWW allows communities to cover operation costs by selling the water to members of the community that can afford it, but at a much lower price than other brands of bottled water (Lukins, 2009).

Mexico is the second largest consumer of bottled water in the world (Diaz, et al., 2009). Five-gallon water bottles are a staple (He, Jordan, & Paudel, 2008). However, for many households the cost of brand bottled water is prohibitive and they must spend time and energy purifying their water through boiling, chlorine

use or through filters (Opryszko, et al., 2009). SWEs like the ones set up by LWW are able to sell bottled water at a much lower cost. One concern is whether OPs can continue to provide quality bottled water at a lower cost without the help of the IPs. Sustainability is discussed in the next section.

2.6 Sustainability

Breslin suggests that the best measure of sustainability is the number of people that are actually using the improved source, and whether the community has the resources and the capacity to make repairs, and replace parts as they break down (Breslin). System sustainability is a key factor of the LWW mission development approach (LWW; LWW Our Mission, n.d.). The ability of the community to finance the project and make necessary repairs in the long term are key determinants of sustainability (Breslin). The LWW model does not require the community to finance the project. The fact that IPs provide the entire start up cost for LWW sites, and provide financial support for the first three years raises concern over the sustainability of such projects. The LWW definition of sustainability relies on the strength of the partnership. However, an evaluation of the Yucatan Peninsula water treatment sites found that most sites stop receiving financial assistance from the IP after the system is installed. Furthermore, operators are usually members of the church because they are more likely to accept a lower salary when sales are low (Hartman, 2011) . This implies that a plant that barely covers cost is less likely to be able to afford parts replacement and repair when needed, and the quality of the water will likely

decrease. The plants that are more successful are those that sell more, and their water quality is likely to be high assuming they can afford repairs when needed. Understanding consumers is important therefore both for the potential for increased revenue and the quality of the product.

2.7. Consumers

There are not many studies that look at consumers of SWEs, and literature on SWEs is also scarce. Therefore, this section looks at several studies and evaluations that have to do with consumers of treated water and access to water interventions. The first study looks at consumer drinking habits with regards to chlorinated water(Puget, Beno, Chabanet, Guichard, & Thomas-Danguin, 2010). The second study has to do with consumer dissatisfaction with the taste and quality of tap water (Lou, Lee, & Han, 2007). Following that, two willingness-to-pay studies are discussed (Ibarra, Vargas, & Nayga, 2010; Vasquez, Mozumder, Hernandez-Arce, & Berrens, 2009). Finally an evaluation of a POU intervention and two evaluations of community water treatment interventions are presented (J. Brown, et al., 2009; Corella-Barud, et al., 2009; Dewilde, et al., 2008).

The foci of this thesis are consumers of LWW bottled water, and non-consumers in the Yucatan Peninsula. One of the issues this study aims to address is the taste preference of consumers of LWW bottled water. Taste is an important factor in consumer satisfaction (Napier & Kodner, 2008). Many consumers believe that taste is an indicator of water safety. However, most waterborne diseases are transmitted by pathogens that have no impact on the organoleptic

properties of water (Napier & Kodner, 2008). Chlorine is a safe and cost effective way to disinfect water used widely by tap water facilities (Napier & Kodner, 2008). Unfortunately it can negatively impact taste and odor. Consumers prefer the clear appearance and taste of bottled water. Such methods are more costly but avoid the chemical taste often associated with tap water. Water clarity can sometimes be impacted by naturally occurring air bubbles, which can cause a cloudy appearance in water. While this poses no health risk consumers may assume water is contaminated and unfit for drinking (Napier & Kodner, 2008). This study differentiates between consumers attitudes toward bottled water and knowledge on safe water. This thesis seeks to measure the ways in which consumers assess the quality of their drinking water, and whether their method is accurate.

Since most tap water is treated with chlorine, it is important to understand consumer preferences about chlorinated water, since it can also be an effective method of POU treatment. In one study researchers examined drinking water habits by separating participants into tap water consumers and non-consumers (Puget, et al., 2010). The researchers conducted a taste test to determine the differences in chlorine sensitivity and acceptability of the two groups. They found that tap water consumers were not statistically significantly different from non-consumers in sensitivity of chlorine flavor in water (Puget, et al., 2010). The study did find a statistically significant difference between tap water consumers and non-consumers in acceptability of chlorine flavor (Puget, et al., 2010). LWW

staff believe that consumers in the Yucatan are more sensitive to chlorine taste, which is why they do not use it (LWW; LWW Facts, n.d.). However, it appears there is a distinction between sensitivity to chlorine and its acceptability. Lower acceptability of chlorine is the reason some consumers do not drink tap water. This thesis will examine how important taste is in affecting consumer decisions.

Another study done in Taiwan further examined the various reasons consumers choose to consume treated water and found that 60 percent of residents avoided drinking tap water (Lou, et al., 2007). Many times POU treatment is a result of consumer dissatisfaction with the taste of tap water and not a just fear in the safety of their water. Reasons for this included a belief that the water source was not appropriate, and the unpleasant taste and texture of the water. Health concerns accounted for less than twenty percent of the reason consumers do not drink tap water (Lou, et al., 2007). Although the Taiwanese government invested heavily in the water system, a large majority of the population still treated the water before drinking it through various methods such as boiling and reverse osmosis. Consumers still perceived the water to be inadequate, and consumer satisfaction was mainly related to the flavor of the water (Lou, et al., 2007). While consumers in Taiwan may differ significantly from Mexican consumers, the Taiwan study illustrates the ways in which consumers' negative perception of tap water can result in increased willingness to pay for other sources of safe water. The following study examines consumers' willingness to pay for safe drinking water in Mexico.

Vasquez et al studied willingness to pay for safe drinking water in Mexico by using averting behaviors, such as bottled water consumption, home based water treatment, and installation of water storage facilities as an indicator of demand for more reliable water services (Vasquez, et al., 2009). Results showed that households were willing to pay up to 7.5 percent of reported household income more than what they are currently paying(Vasquez, et al., 2009). Bottled water costs up to 100 times the cost of tap water. Yet, less than eighteen percent of households reported consuming untreated tap water (Vasquez, et al., 2009). The study found no statistically significant difference between willingness to pay for safe water in households that consumed bottled water and households that did not (Vasquez, et al., 2009). This did not support Vasquez's hypothesis that improved water system would provide a less expensive substitute for bottled water. This study suggests that bottled water consumption is not solely related to the safety of tap water. Alternately perhaps consumers do not trust that tap water can ever be improved to the level where it is acceptable to drink and they are willing to pay more for more reliable service and less interruptions. Another study looked at willingness to pay for irradiated produce in Mexico, and found that 80 percent of consumers provided with full information on irradiation and water quality info were willing to pay more for the irradiated produce (Ibarra, et al., 2010). Both studies on willingness to pay suggest either mistrust of the safety of public water system or a negative perception of other aspects of public water. This thesis will explore other reasons why consumers choose bottled water over

tap water. The following study by Brown measures success of a water treatment intervention by measuring the number of people using the water treatment method after five years.

Brown looked at the long-term practice of water treatment with ceramic filters in rural Cambodia five years after an initial intervention (J. Brown, et al., 2009). The study measured the success of the intervention by the number of people that were using the filter after five years. Brown found that only 31 percent of households were using the filters after five years. Furthermore, the study found an overall progressive decrease in usage beginning one month after program implementation (J. Brown, et al., 2009). The barriers to continued usage were due to breakages of the filters and, lack of knowledge of where to purchase another filter (J. Brown, et al., 2009). Contrastingly, cash investment in the technology, water source, household water, sanitation, and hygiene practices were all found to be predictors of continued filter use over time (J. Brown, et al., 2009). Brown's findings support the notion that usage is a mediating factor in the success of an intervention (Dewilde, et al., 2008). Brown also identifies a weakness in interventions that do not monitor long-term practice. Brown's findings suggest that a barrier to long-term use was the fact that the filter was given out for free. This supports previous literature that financial investment is necessary to maximize success (Breslin). LWW provides bottled water at lower cost to all consumers, and donates water to those that are unable to pay for it. Therefore by comparing LWW consumers and non-LWW consumers this thesis

can identify differences in consumers that pay more or less for their water. This thesis will also examine the number of LWW consumers that do not pay for their water and compare those to consumers who pay full price. The next study evaluates the success of a water treatment system by measuring water quality and health impact associated with consumption.

An evaluation of a water treatment system in Chihuahua, Mexico set out to identify neighborhood usage of a treated water system, which was set up at a local clinic, and any barriers for using this water source (Corella-Barud, et al., 2009). The researchers also wanted to determine the water quality and any health impact associated with its consumption. The study found participants obtaining water from the treatment source dropped from 63 percent to 40 percent from the first to second visit to the clinic. Participants were switching from the treated water source to other sources such as outdoor faucets and commercially treated water purchased at stores. There were several reasons indentified for not using the clinic water source. The most common among them was related to the distance to the clinic, transportation issues, and the need for a container suitable for transporting the treated water. Furthermore, water testing showed no significant difference between the clinic treated water and tap water. In fact higher coliform levels were found in the treated water because of potential contamination associated with transport and storage of the clinic water (Corella-Barud, et al., 2009). This study supports previous findings that consumers would rather pay for a more convenient product than take advantage of a free water

treatment source. It also supports the notion that usage is a measure of intervention success. In this case the intervention method was not used, and no significant health benefit was observed. This thesis will further study determinants of use by measuring access to transportation, and time spent fetching water. The following study evaluates another safe water intervention in rural Mexico.

Kolb Dewilde evaluated a community based safe water program in rural Mexico implemented by UVWaterworks, a global nonprofit (Dewilde, et al., 2008). The evaluation was conducted five years after the program was implemented. The study found no significant difference in health outcomes of the town where treatment system was implemented when compared to a control (Dewilde, et al., 2008). The author identified user convenience as a key determinant of success of the program. Mediating factors included user convenience, adequate performance of the technology, community capacity and constraints, and options available to users .The evaluation concluded that the water system set up by UVWaterworks had become dysfunctional due to lack of use by the majority of the population. Community members found the use of the treatment plant inconvenient, and even though it was free, they still preferred to pay for commercially bottled water to be delivered or purify tap water at point of use than having to transport the free water themselves. Household preferences are an important determinant of intervention success. If households do not use the water, then merely having access to it is not enough. The ability of a program

to reduce exposure to harmful waterborne pathogens is dependent on the use of the programs by the target demographic, as well as its continued performance (Dewilde, et al., 2008). The findings of this study again link success of intervention with usage and convenience. It also supports the notion that consumers are willing to pay for a product they find superior. Dewilde also stresses the reduced exposure to pathogens that results from a successful intervention. This illustrates that there are other ways to measure the success of an intervention besides health outcome.

2.8. Conclusion

LWW works as an ongoing partnership between volunteers and community members that provides purified water in a venue already accepted by the target population, namely bottled water. The literature review highlights findings related to key components of LWW's model. Diarrhea is a leading cause of morbidity in the Yucatan Peninsula where LWW has a large number of water treatment sites. There are various ways to treat water. The water treatment system used in LWW's Yucatan sites is the most complex system to respond with the areas high salinity and consumers taste preference.

Faith is an important part of LWW's mission, and spirituality is present in the health education component of its curriculum. LWW relies heavily on volunteers who are mission oriented. The LWW model focuses on creating and sustaining partnerships and building capacity. SWEs are ubiquitous in the developing world and respond to local water needs. In Mexico, SWEs that treat

and bottle water compete with the more expensive brand name bottled water. LWW's mission teams help local leaders install and operate water treatment sites and bottling plants that function as SWEs.

Consumer perception of tap water determines water treatment usage and bottled water consumption. Consumers are willing to pay for safe water, and are also willing to pay for convenience. Findings suggest that intervention success can be measured by usage and consumer preference. There is a need to further investigate consumer perception, preferences and needs with regards to purified water in particular bottled water and attitudes and knowledge of hygiene behavior. The following chapter outlines the methods used to complete this thesis.

Chapter 3: Methods

This chapter includes a description of the methods used to complete this thesis, and it is divided into eight sections as follows. The first section explains the research design. Following that are the sections describing the population, project site, and sample. Section five describes the household survey, which is the primary instrument for this study. The next sections are data collection and data analysis. The final section describes the limitations and delimitations of this study.

3.1 Research Design and Procedure:

This is a cross-sectional study comparing consumers and non-consumers of Living Waters for the World (LWW) bottled water. The data used for this thesis were originally collected as part of a comprehensive evaluation for LWW. The LWW staff hired the researchers to evaluate the Small Water Enterprises (SWEs) that were set up by various mission teams throughout the Yucatan Peninsula. The evaluation consisted of looking at the three primary components of the LWW model. The first component has to do with leadership and operations, the second component about health education and consumer use of purified water, and the third component dealing with water treatment technology and water quality. This thesis analyzes the data that is associated with the second component of the LWW model.

3.2 Population

The target population consisted of consumers of purified water in the Yucatan Peninsula with access to LWW bottled water. Both households that consumed LWW bottled water and households that did not consume LWW bottled water were included in the study. The research was conducted in five communities with access to LWW bottled water.

3.3 Project Site

The research was conducted in the Yucatan Peninsula. The Yucatan Peninsula was chosen because of the number of LWW systems throughout the area (45 systems at the time of data collection) and because most of the SWEs had been in operation for at least one year. The large number of LWW sites and the already established relationships of LWW with several communities made it easier for the researchers to communicate with plant operators and to learn about their target market for each site.

The researchers met with LWW staff in the US prior to traveling to the field. The LWW staff provided information on the sites and surrounding areas based on their experiences. They also provided the names and contact information of local LWW staff at various sites. Local staff were contacted by email to gather some information on the LWW plants' presence in each community and broad demographic characteristics of LWW consumers particularly with regards to religion. Both urban and rural sites were selected in

order to ensure a more representative sample of communities throughout the Yucatan.

3.4 Sample:

Three rural sites and two urban sites were selected in which to conduct 300 household surveys. Only households that were located on the delivery route of each LWW plant were included. A target total of 300 surveys was determined by estimating the maximum number of surveys that could be collected given the time and field staff availability. The sample was a convenience sample and sites were selected based on prior communication with site managers. Sites that had been in operation less than one year were excluded. It was assumed that LWW sites that had been in operation for more than a year had a large enough number of consumers for participation. Other factors considered in selecting the sites were ease of transportation, time required to travel to and from the home base and the study sites, size of the towns and whether the site was rural or urban.

Selection criteria of households differed in rural and urban sites. In the three rural sites, households were selected by splitting the town into four quadrants. Field staff then collected a quarter of the surveys in each quadrant. Since rural sites were located in very small towns, it was not feasible to randomize household selection. In urban areas, household selection involved consulting with the LWW staff in charge of delivery to learn about the delivery route. Given time constraints and a larger radius of eligible households in the urban sites, the help of LWW staff was essential to a successful and efficient data

collection strategy. Urban areas were divided into four delivery routes. LWW staff indicated which households consumed LWW water and surveys were collected in those areas.

Household data were collected for both consumers and non-consumers of LWW water. An informal estimation of local population size was provided by members of the LWW site to determine the proportion of surveys conducted in each site. With this information, a decision to collect 75 and 100 surveys, respectively for each urban site, 50 surveys from two of the rural sites, and 25 surveys from the smallest rural site was made. Surveys were conducted with adult males and females over the age of 18 that were members of the household. Adult members of households were selected since it was believed that they would be more likely to know the information required to complete the survey.

3.5 Household Survey:

The instrument used in this study was a household survey. The survey was created in English and then translated into Spanish (see Appendix I for the full survey). The survey had four components, demographic characteristics, wealth and health access, water consumption and health knowledge, and attitudes and beliefs with regards to water. The researchers used the health education curriculum that the LWW mission teams are trained with at Clean Water U (CWU)(LWW; LWW Health Education, 2009), to create the health knowledge and hygiene practices portion of the household survey. The wealth and water consumption portions were adapted a similar study (Ritter, 2008). A

demographic section was also included. The following sections describe the survey instrument in greater detail.

3.5.1. Demographic Information

This section included demographic characteristics such as education, employment, number of household members, as well as, age and sex information for all household members. Given the faith-based nature of LWW and its presence in the Presbyterian Church religious affiliation was also included to determine whether consumer's faith interacted with bottled water consumption.

3.5.2. Wealth, Assets and Access

Section two of the instrument examined access to health services and sanitation facilities. Questions regarding the distance to the nearest clinic, length of time to arrive at a clinic or hospital in case of emergency, and questions regarding access to and type of sanitation facilities were included.

This section also assessed medical, transportation and other household expenses and household assets to determine socioeconomic status. The interviewer was asked to observe and record the type of materials used in the roof, walls, and floor of each house. Furthermore, the interviewer asked the number of beds, hammocks, TVs, phones and vehicles in the household. Crowding was assessed by asking what was the maximum number of people per room as well as the number of rooms used for sleeping in the house.

3.5.3. Water consumption and health knowledge

Section three assessed water use, and consumption, particularly of bottled water. Questions in this section included the type of water primarily consumed in the household, whether bottled water was delivered or fetched, the cost of the water and the number of water bottles consumed per week. Further, this section assessed the reasons a specific brand of water was consumed, whether consumers believed the water to be safe, and how the quality of purified water was assessed. Household members were also asked to specify what type of water was used to perform various activities such as drinking, brushing teeth, cooking, and bathing. Finally, this section examined health knowledge, whether someone in the household had learned about health and hygiene practices, and if so from where.

3.5.4. Attitudes and Beliefs with Regards to Water

Section four included statements that assessed attitudes and beliefs with regards to bottled and tap water. The questionnaire included ten items that used a four point likert scale ranging from strongly disagree to strongly agree. The interviewer explained the likert scale to the participants and then read ten statements such as “There are microbes in tap water that cause illness”, “I believe only children need to drink purified water”, “Drinking tap water from time to time will not affect my health.” Participants were then asked to select a response from the likert scale.

3.6 Data Collection

Field staff were trained during the first week in the field. The field staff consisted of three interviewers, the principal investigator, who constructed the survey, and two researchers who were evaluating the other components of the LWW model. The training involved reading and becoming familiar with all sections of the survey in both English and Spanish, and role-playing as both the interviewer and the participant to determine the interviewer's understanding of the questions and potential answers.

Before conducting each survey, the participant's age was asked to determine eligibility to participate in the study. The interviewer read the consent form (see Appendix I) to each participant who then signed and dated it. The interviewer then gave a copy of the consent form to the participant. All consent forms were then given to LWW staff in the US. This project is not considered "Research" by the Emory Institutional Review Board. Therefore no IRB clearance was required. The data collected belong to LWW. The hard copies of the survey, after being entered into an excel spreadsheet, were also given to LWW US staff. The data set did not contain any identifying information such as name, or town. The area was coded as either rural or urban. Data were then imported into SAS and analyzed.

3.7 Data Analysis

Data analysis was conducted using SAS 9.2 statistical software. The primary outcome variable was whether or not households consumed LWW water. Descriptive statistics for continuous variables were analyzed using the univariate procedure, and frequencies were used for categorical and ordinal variables. Pearson's Chi Square test and T test procedures were used to determine significant differences between LWW consumers and non-consumers. The next section describes the demographic variables analyzed for respondents and households.

3.7.1. Demographics

This analysis looked at descriptive statistics of the overall sample population and then assessed interaction between demographic variables and being a LWW consumer.

3.7.1.1 Respondents

There were a total of six demographic variables used in the analysis including region, gender, marital status, religious affiliation, employment status, and educational level. Two new variables were created for educational level. Educational level was a continuous variable that measured the respondents' total years of elementary and secondary school. Participants that had a higher degree of education specified whether they had finished preparatory school or some had type of higher education. Using this information, a five point ordinal variable was created ranging from no education to higher education. Additionally, a

dichotomous variable was created that divided participants into either "no education" or "some education." Frequencies for each demographic variable were run for all participants. In order to assess significant differences between LWW consumers and non-consumers, Chi Square analysis were run for all demographic variables.

3.7.1.2 Households

There were four continuous demographic household variables: total number of people in the house, total number of women in the house, total number of men in the house, and average household age. Three new variables were created. The variable for total number of women in the house was created by using the sex and age variable for each household members and adding the number of women. The same was done to determine the total number of men in the house. Again using the age and sex variable for each household members, total age was computed and divided by the total number of people in the house. Household demographic variables were analyzed using the univariate procedure to find the mean and standard deviation of each variable. The next section describes the analysis conducted for wealth variables.

3.7.2. Wealth, access, and assets

This section describes the analysis performed to generally assess household wealth.

3.7.2.1 Access

There were two variables that assessed access to health facilities. All towns had access to a local health clinic. One variable measured whether participants attended the local clinic or not. The other variable measured the time it took to access the health facility. This last variable was dichotomized to determine whether participants took less than or longer than 30 minutes to arrive at the health facility. The two variables were analyzed using Chi Square test to determine any significant associations between these variables and being a LWW consumer or non-consumer.

There was one variable that assessed access to a sanitation facility. Participants were asked what type of sanitation facility they had access to. This was a categorical variable and were analyzed using Chi Square test to determine a significant association with being a LWW consumer.

There was one variable that assessed access to transportation. This was originally a six level categorical variable that was recoded into four levels by combining both types of motorized vehicles (motorcycle or car) and both types of public transportation (taxi or public transportation). The other variables were walking and bicycle. All variables were analyzed using Chi Square tests to determine a significant association with being an LWW consumer.

3.7.2.2 Assets

There were four continuous variables that assessed household characteristics: number of bedrooms in the house, number of bathrooms in the house, total number of people in the house, and maximum number of people per room. Continuous variables were analyzed using T test to determine significant differences between LWW consumers and non-consumers. Means and standard deviation were calculated for each variable.

Two dichotomous variables were then created to assess crowding. The first one assessed whether households had only one room in which to sleep in or if they had at least two rooms to sleep in. the second variable created assessed whether more than two people slept in a room or not. Another dichotomous variable was created that assessed whether or not the house had at least one bathroom. Chi Square analysis was performed for all dichotomous variables to determine a significant association with being an LWW consumer.

There were three variables that assessed household construction: material of floors, walls and roofs. These were categorical variables. Frequencies and Chi Square analyses was performed to determine whether or not there was a significant association between these variables and being an LWW consumer.

There were 10 continuous variables that assessed various household assets, such as beds, hammocks, vehicles, TVs, phones, washing machines, etc. All ten variables were recoded as dichotomous variables that determined whether households owned at least one of each asset, or if they owned none. Chi

Square analysis was performed for all these variables to determine whether or not there was a significant association with being an LWW consumer.

3.7.3. Water consumption and use

One variable assessed primary source of drinking water. Other variables included whether households purchased bottled water, the cost of bottled water, bottled water delivery service, and number of bottles consumed per week. A new dichotomous variable was created using cost of bottle water to determine whether bottled water purchased was inexpensive (less than 15 pesos) or expensive (over 15 pesos). Frequencies and Chi Square analysis were performed for all variables to determine whether or not there was a significant association between these variables and being an LWW consumer. Additionally a T test was performed on the cost of bottled water to determine a significant difference in price paid by LWW consumers and non-consumers.

There were five variables that assessed what the main reasons consumers preferred a particular brand of bottled water. New dichotomous variables were created for each reason that consumers preferred a particular brand of bottled water. Frequencies were run for all five variables comparing LWW consumers and non-consumers. Chi Square tests were also performed.

There were six variables that assessed the use of bottled water in various activities such as drinking, brushing teeth, washing dishes, etc. These were dichotomous variables and where analyzed using Chi Square tests to determine whether or not there was a significant association with being an LWW consumer.

3.7.4. Health knowledge and attitudes towards bottled water

There were ten variables that assessed health knowledge and ten variables that assessed attitudes towards bottled water.

A dichotomous variable assessed whether or not households had learned about health and hygiene practices and a categorical variable assessed from where. A new dichotomous variable was created to determine whether households had learned about health and hygiene practices form LWW or from another source. Eight new dichotomous variables were created to using various reasons cited for knowing if water was good enough to drink. Chi square analysis was performed on all variables to determine whether or not they were associated with being an LWW consumer.

To measure attitudes towards bottled water a likert scale was used. All likert scale items were treated as ordinal variables. In order to standardize raw data with respect to each construct, four out of ten likert scale items were reverse coded. All 10 variables were then analyzed using Chi Square analyses.

3.8. Limitations & Delimitations

This study had a number of limitations. Firstly, the study was not randomized, it used a convenience sample based on researchers' time and feasibility of travel to the sites. Furthermore, this study only assessed broad associations between two groups at one point in time and the sample size was not large enough to construct a regression model and find predictors of use and non-use. The sample size was also not large enough to assess further interaction

between variables. Furthermore, the survey instrument measured product use but did not accurately measure satisfaction with the product. Finally, only one member of the field staff was a native speaker of Spanish. The other two had intermediate knowledge of Spanish. This could have affected communication and reduced the accuracy of data collection, especially for open-ended questions. Households located outside the sites delivery radius were excluded from the study. LWW sites that had been in operation for less than a year were also excluded from the study.

Chapter 4: Results

Frequencies and univariate statistics were run for all categorical and continuous variables respectively for the overall survey population. Data were stratified by type of bottled water consumed and whether or not participants were LWW consumers. Additionally interaction was assessed between being a LWW consumer and the demographic, household, water consumption and attitude variables using Chi Square test and Odds Ratios (OR) for dichotomous variables (OR). For continuous variables, T tests were run to assess a significant difference between LWW consumers and non-consumers.

The results chapter is divided into five sections. The first section discusses descriptive demographic statistics for the entire survey population, as well as the results of the Chi Square tests and ORs to assess interaction of demographic variables and being an LWW consumer. The second section describes the findings of the interaction between being an LWW consumer and non-consumer and access to health and sanitation services, and transportation. Following that, the results of the analysis to assess interaction between being an LWW consumer and having certain household assets and household characteristics are assessed. The third describe findings related to the interaction between being an LWW consumer and water usage and consumption. The last section looks at descriptive statistics with of respondents attitudes towards water, and the interaction between being an LWW consumer and having a positive or negative attitude.

4.1 Demographics

This section describes the results of the demographic frequencies and univariate statistics that were first assessed for all respondent and households. This is followed by the description of the interactions and significant differences observed between household variables and being and LWW consumer.

4.1.1 Respondents

The following results are for the overall survey population. All respondents were over the age of 18 since that was the minimum required age to participate in the study. However, respondent age was not included in the analysis except as part of the household information. Respondents were primarily female (78.33%), and married (75.26%). Most respondents had some schooling (90%), while only 13.33% had higher education. Employment status was assessed for all respondents. Being a housewife was the most cited form of employment by respondents (40%), not surprisingly given the fact that respondents were primarily female. Just over twenty-five (25.08%)n percent worked in an informal job market such as crafts or fruit sales, 13.22% who worked for others, either factory workers or civil servants, and 10.85% worked in the agricultural or farm labor market. Less than ten percent (9.49%) held jobs that required higher education.

Religion was assessed because of the faith-based aspect of LWW. The authors were expecting majority of respondents to be Catholic based on national data and found that 46.44% of respondents were Catholic, less than was expected. The percentage of

Presbyterians was in turn higher than expected (24.41%). Other Christians made up 20.37% of respondents (see Table 1 below).

Table 1. Overall demographic characteristics (n=300)

	n	%
Gender		
1. Male	65	21.67
2. Female	235	78.33
Marital Status		
1. Single	48	16.49
2. Married	219	75.26
3. Divorced	4	1.37
4. Widowed	14	4.81
5. Cohabitating	6	2.06
Education level		
0. No education	30	10.00
1.Elementary	131	43.67
2. Secondary	70	23.33
3. Prep school	29	9.67
4. Higher education	40	13.33
Employment		
1. Housewife	120	40.68
2. Agricultural/farm labor	32	10.85
3. Informal business, craft or fruit sales	74	25.08
4. Work for others, factory workers, civil servants	39	13.22
5. Jobs requiring higher education	28	9.49
Religion		
1. Catholic	137	46.44
2. Presbyterian	72	24.41
3. Evangelical	15	5.08
4. Other Christian	60	20.34
5. None	11	3.73

4.1.2. Households

The following results are for the overall survey population. The number of households for each urban and rural location was chosen in advance in order to have a representative sample given the size of the population as advised by the LWW operators. There were 177 (59%) urban households and 123 (41%) rural participants . There were an average of 4 people per household (4.44 SD=1.79) ranging between 1 and 11. On average there were more women per household than men (2.28 SD=1.3 vs. 2.16 SD=1.13). The mean age of household members was 33.7 years (SD=15.49), with a range from 1 to 93 years of age. This average number of household members in this study (4) was congruent with average number of household member estimated by the Mexican Institute of National Statistics Geography and Informatics at 3.9 (INEGI, insert year) .

4.1.3. LWW consumers and non-consumers: Interactions and significant differences

All participants that reported being Presbyterian also reported consuming LWW water. There were no statistically significant differences between respondents who consumed LWW and non-consumers in gender, marital status, educational level, or employment status on the basis of these demographic characteristics. The next section shows findings on wealth variables such as access to various services, and household assets.

4.2 Wealth: Access, and assets

LWW wants to increase access to safe water for those that cannot afford it . We would therefore expect more LWW consumers to be of lower socioeconomic status (SES) than non-LWW consumers. Findings on access to health and sanitation services, and transportation follow.

4.2.1. Access:

Health facilities:

The researchers visited the local health clinic for each site studied, and found that all local health clinics provide free services, and while they attend to everyone, most patients are those that have no insurance or cannot afford to go to private doctors. Since the assumption is that LWW consumers are of lower SES the researches expected to find that more of LWW consumers attend local health clinics compared to non-consumers. Findings show that all households had access to a local health clinic, and that a higher percentage of LWW consumers (84.33%) attended the local health facility compared to non- consumers (79.31%). Furthermore, fewer LWW consumers (29.92%) traveled for more than thirty minutes to get to their regular medical facility, compared to non-consumers (37.7%). This implies that LWW consumers were more likely to attend the local clinic which was located less than thirty minutes away from all households surveyed.

Sanitation services:

Our findings indicate that the majority of LWW consumers had access to a flush toilet (95.81%). There was no statistically significant difference between LWW

consumers and non-consumers who had access to a flush toilet. However, this number was slightly higher than the 94 percent estimated by the Mexican Institute of National Statistics Geography and Informatics (INEGI, insert year) .

Transportation:

Almost twenty-four percent (23.74%) of LWW consumers reported taking public transportation as their primary mode of transportation. Just over twenty percent (20.99%) use a vehicle as primary mode of transportation, 9.94% use either a tricycle or bicycle, and 32.6% do not have access to improved modes of transportation (i.e. walking). There was no statistically significant difference between transportation modes of LWW consumers and non-consumers.

4.2.2. Assets:

Assets were measured as a proxy of wealth. It was expected that LWW consumer would have fewer assets than non-consumers. This section compares the number of rooms in the house and the level of crowding (>2 people per room) of both LWW consumers and non- consumers. It also assesses significant differences. Furthermore, this section looks at the interaction between household materials of floors, walls, and roofs and being an LWW consumer. Lastly, this section looks at various household assets and assesses the interaction between owning at least one asset and being an LWW consumer.

Rooms:

LWW consumers have an average of 2.1 (SD=0.95) bedrooms in the home compared to non-consumers who had an average of 1.9 (SD=0.78). This difference was

not found to be statistically significant. Twenty-five percent (25.41%) of LWW consumers have only one room to sleep in compared to 28.87% of non-consumers.

LWW consumers (2.7 SD=1.2) have a statistically significantly lower level of crowding (people per room) than non-consumers (3.1 SD=1.6) (p=0.026). Taking crowding as proxy for SES where increased crowding equates to lower SES, these finding are not congruent with the expectations that LWW consumers have a lower SES than non-consumers.

Household materials:

This section looks at the interaction between household materials and being an LWW consumer. Overall findings show that the floor material of households to be comparable between LWW consumers and non-consumers.

LWW consumers were slightly more likely to have a tile floor (60.22%) and slightly less likely to have a cement floor (39.25%) compared with non-consumers (tile: 59.57%, cement: 39.36%). There was only 1 LWW consumer household with a dirt floor (0.54%). No households with dirt floors were found for non-consumers. LWW consumers were slightly more likely to live in a household with cement walls (97.30%) compared to non-consumers (96.7%). The remainder had walls made out of straw, mud or tin. Almost seventy-four percent (73.94%) of LWW consumers had a tile or cement roof versus 86.81% of non-consumers. LWW consumers were more likely to have a roof made out of tin (22.87%) and less likely to have cement or tile roof (73.94%) compared to non-consumers (tin: 12.09%, tile or cement: 86.81%).

Overall most households had at least one bathroom. Although LWW consumers were slightly more likely to have at least one bathroom (94.79%) compared to non-consumers (93.88%). The findings on household materials are not all congruent with the assumption that LWW consumers are of a lower SES than non-consumers and would therefore be more likely to have inferior materials. The following section looks at the interaction between owning household assets and being an LWW consumer.

Household Assets:

Beds were not the norm and no household had a bed for each household member, and many households did not own a bed. However, LWW consumers were more likely to have at least one bed (79.27%) compared to non-consumers (61.22%). Hammocks are commonly used for sleeping the Yucatan Peninsula. Findings are congruent with this fact as the majority of households of both LWW consumer and non-consumers had at least one hammock per household member (97.93% vs. 98.98%). Other assets that were measured were bicycles, cars, TVs, phones and refrigerators and washing machines (see Table 2 below). The percentages of LWW consumers and non-consumers that owned these assets were very similar.

Table 2. Household assets (N=291)

	LWW consumer		Non-LWW consumer	
	N	%	N	%
Bed	153	79.27	60	61.22
Hammocks	189	97.93	97	98.98
Bicycles	103	53.37	61	62.89
Motorcycle	54	27.98	25	25.51
Car	64	33.16	25	25.51
Radio	122	63.21	68	69.39
TV	185	95.85	93	94.90
Refrigerator	177	91.71	87	88.78
Telephone	113	58.55	60	61.22
Washing Machine	156	80.83	78	79.59
Missing=9	N=193		N=98	

The following section looks at water consumption and use for LWW consumers and non-LWW consumers and assesses the interaction of these variables with being an LWW consumer.

4.3 Water consumption and use

Overall survey population:

Out of 300 households surveyed, the majority (98%) reported consuming bottled water as their primary source of drinking water. Only five households (1.67%) used tap water as primary source and one household (0.33%) reported well water as its primary source of drinking water. Furthermore, 97.32% of participants reported purchasing bottled water while 2.66% reported bottled water being given out for free. There were 193 (66.32%) households that reported consuming primarily LWW water, 41 (14.09%) reported consuming the more expensive brand name bottled water, and 56 (19.59%)

reported consuming a either a mix of LWW, brand name or other locally produced bottled water. Bottles were delivered in 96 percent of households, while only 3.72 percent reported fetching water.

LWW consumers versus non-consumers:

LWW consumers pay a statistically significantly lower price for bottled water than non-consumers (8.35 SD=1.45 vs. 12.34 SD=4.83) ($p<0.0001$). The maximum reported price paid by non-consumers was 21 Mexican pesos. LWW consumers purchase a significantly higher number of bottled water per week than do non-consumers (5.14 SD=2.83 vs. 4.14 SD=2.46) ($p=0.0037$).

Two percent (2.07%) of LWW consumers receive bottled water for free. Because of small n values, the researchers were unable to assess the interaction between receiving bottled water for free and being an LWW consumer. Additionally, the small n values prevent the researchers from looking at further interactions with other variables such as use of bottled water, and hygiene practices.

Nearly thirty-five percent (34.69%) of non-consumers pay over 15 Mexican pesos for their bottled water while the maximum amount paid by LWW consumers was 12 pesos.

Over ninety-eight percent (98.45%) of LWW consumers had their water delivered versus 91.58% of non-consumers. Additionally non-consumers are over five times more likely to fetch their bottled water compared to LWW consumers (OR=5.82 CI 95% 1.51, 22.48) ($p=0.0043$). However, further analysis to investigate this interaction is not possible due to low n values. This is because stratifying fetching water with other

variables would result cells with zero values. The next section looks at consumer preference with regards to bottle water.

Consumer Preference:

Table 3 shows the reasons cited by consumers when asked why they preferred the brand of bottle water they consumed over others. Consumers cited multiple reasons. Therefore, column percents are not meant to add to one hundred. LWW consumers were more likely to cite price as a reason for preferring a specific type of bottled water (33.51%) than non-consumers (18.47%). Among LWW consumers, price was the most cited reason for preferring LWW bottled water. Convenience and taste were equally cited (26.32% and 26.84%), and the least cited reason was to avoid sickness (18.82%). Among non-consumers, the most cited reason they preferred a specific brand of bottled water was convenience (34.69%), the second highest was wellbeing (30.61%) and the least cited reason for preferring a specific type of bottled water was price (18.37%).

Table 3. What are the main reasons you prefer this brand of bottled water? (n=288)

	LWW consumer		Non-consumer	
	N	%	N	%
Price*	64	33.51	18	18.37
Convenience	50	26.32	34	34.69
Taste	51	26.84	23	23.47
Avoid sickness	35	18.82	20	20.41
Wellbeing	42	22.11	30	30.61
	n=190		n=98	

These results are congruent with the expectation that LWW consumers are less likely to be able to afford the more expensive brands and therefore would consider price an important factor. Convenience was an important factor for determining consumer's preference with a brand of bottled water, although convenience was more likely to be cited by non-consumers (33.69%) than LWW consumers (26.32%). This is congruent with the literature that states that interventions fail if they are not convenient to consumers (Dewilde, et al., 2008). The next section looks at consumer use of bottled water.

Consumer Use of Bottled Water

Table 4 shows the type of water used by LWW consumers and non- consumers to perform various activities, such as drinking, brushing teeth, cooking, and washing dishes. Most of LWW consumer and non-consumers reported using bottled water for drinking, although LWW consumers were more likely to report using bottled water for drinking (99.48%) than non-consumers (96.91%). Additionally LWW consumers were statistically significantly more likely to report using bottled water for brushing their teeth (51.56%) compared to non-consumers (34.02%) ($p=0.0049$). LWW consumers were also statistically significantly more likely to report using bottled water for cooking and preparing food (93.23%) than non- consumers (76.29%) ($p<0.001$). Furthermore a minimal number of LWW consumers reported using bottled water to wash dishes and clothes (1.56% and 1.04%) compared to none of the non-consumers.

Table 4. What type of water do you use for the following activities? (n=289)

	LWW consumer		Non-consumer	
	N	%	N	%
Drinking	191	99.48	94	96.91
Brushing teeth*	99	51.56	33	34.02
Washing dishes	3	1.56	0	0
Washing clothes	2	1.04	0	0
Bathing/showering	1	0.53	2	2.06
Preparing food, cooking*	179	93.23	74	76.29
*significant ($p<0.05$)	N=192		N=97	

The LWW health education curriculum advocates using bottled water for drinking, cooking, and brushing teeth(LWW, 2009). These findings suggest that LWW consumers are also learning about how to use their bottled water from LWW staff. The next section looks at health knowledge and attitudes, and assesses how many households reported learning about health and hygiene form LWW staff.

4.4 Health knowledge and attitudes towards bottled water

The following results are for the overall survey population

Overall, 63% of participants reported having learned of health, and hygiene practices, while 36.48% reported no prior knowledge. Out of participants that reported prior health and hygiene knowledge, only 6.47% learned it through LWW staff, 74.1% through local clinic health education programs and health promoters, and 19.42% reported having learned through either school, work, or family. All participants that

reported having learned about health and hygiene practices from LWW staff also reported being LWW consumers (11.54%). These findings indicate that LWW health education curriculum is not reaching a large percentage of the population. Although the ones that do learn about health and hygiene through LWW also end up consuming LWW water, this suggests that the LWW staff is not including the health education component in their operations. Furthermore, LWW consumers were less likely to report having learned about health education overall (60%) when compared to non-consumers (68%). This finding is congruent with the assumption that LWW consumers are of a lower SES and therefore less likely to have access to health education than non-consumers. The next section assess consumers knowledge of safe water.

Safe Water

To assess knowledge of safe water, consumers were asked how they knew water was safe to drink (see Table 5). Respondents cited multiple reasons, therefore column percentages are not meant to add to 100%.

For LWW consumers the most cited reasons mentioned were "taste" (18.42%), "the way the water looks and feels" (17.37%), and "trust in brand"(17.37%). LWW consumers were more likely than non-consumers to cite "trust in brand" (17.37%) as a way to know water is good too drink compared to non-consumers (13.27%). Conversely, most non-consumers reported "the way the water looks and feels"(26.53%) as a way to know water is safe to drink, followed by "what others say" (18.37%), "water is in a sealed bottle"(16.33%) and "taste" (16.33%). Non-consumers were more likely than LWW consumers to cite the fact that water comes in a sealed bottle (16.33% versus

8.95%) as a way to know water is good enough to drink. However, interactions were not statistically significant.

Table 5. How do you know if water is good enough to drink (n=288)

	LWW consumer		Non-consumer	
	N	%	N	%
Others say	29	15.26	18	18.37
No bugs	8	4.21	1	1.02
Looks clear, feels normal	33	17.37	26	26.53
Has no microbes	18	9.47	4	4.08
Water is in sealed bottle	17	8.95	16	16.33
Taste	35	18.42	16	16.33
Has chlorine	4	2.11	3	3.06
Trust in brands/seller	33	17.37	13	13.27
	N=190		N=98	

The next section looks at health and hygiene attitudes of LWW consumers and non-LWW consumers.

Health and Hygiene Attitudes

Table Six looks at health attitudes and beliefs with regards to bottled water for LWW consumers. Overall LWW consumers and non-consumers did not differ in health attitudes and beliefs. However, LWW consumers were significantly more likely to agree with the statement "the brand of bottle water I drink tastes better than other brands" compared to non-consumers. This indicates more brand loyalty among LWW consumers.

Table 6. Health attitudes and beliefs among LWW consumers (n=262)*

	Agree		Disagree	
	N	%	N	%
It is very important to wash your hands before eating	182	99.45	0	0.0
The brand of bottle water I drink tastes better than other brand*	68	55.28	12	9.76
Everyone needs to drink purified water	113	80.7	15	10.7
I don't get sick as often when I only drink bottled water	123	67.96	12	6.63
There are microbes in tap water that can cause disease	128	71.51	5	2.79
It is never ok to drink tap water	107	64.46	24	14.46
The type of water I consume can impact my overall health				

*Statistically significant difference compared to non-consumers

4.5 Conclusion

Results showed a number of different factors that distinguish LWW consumers from non-consumers. First, LWW consumers pay significantly less for bottled water and purchase more bottled water per week than non-consumers despite have a lower SES. Also, LWW consumers were more likely than non-consumers to cite price as a reason they prefer a specific brand of bottled water. LWW consumers were also more likely to use bottled water for other purposes besides drinking, namely, cooking, preparing food, and brushing their teeth compared to non-consumers. The next chapter will discuss the implications of these findings in detail.

Chapter 5: Discussion

This chapter includes a summary and discussion of findings, as well as the implications of these findings, followed by recommendations for practice and further research.

The goal of this thesis is to explore the differences between consumers of Living Water for the World (LWW) and non-consumers in the Yucatan Peninsula, Mexico. Three hundred household surveys were conducted in two urban and three rural towns throughout the Yucatan Peninsula to assess consumers' health and hygiene knowledge, uses, preferences and attitudes with regards to bottled water. There were some significant differences between LWW consumers and non- consumers with regards to bottled water consumption and use, health knowledge and attitudes towards bottled water, household characteristics and demographics. These findings are discussed below.

5.1. Summary and Discussion of findings

This section discusses the results of the analysis. Bottled water consumption and use is discussed first, followed by health knowledge and attitudes towards water, household characteristics, and demographics.

5.1.1. Bottled water consumption and use:

Bottled water consumption and use measured how consumers used bottled water and why they preferred a specific brand of bottled water. The following findings refer to the overall survey populations.

The vast majority of households surveyed reported using bottled water as their primary source of drinking water. This finding supports the literature that bottled water is a staple in Mexican households and it is widely consumed due to the perception that public water is unsafe (Robles et al., 1999). Bottled water was the only type of safe water consumers mentioned when asked about types of water consumed. Other water treatment methods were not mentioned. Furthermore, bottle delivery is the norm with only a minimal percent of households primarily fetching bottled water. Although fetching water was often less expensive than delivery, the fact that only a few households fetched water supports the literature that convenience is an important factor to consumers (Corella-Barud, et al., 2009; Dewilde, et al., 2008). This finding implies that interventions that don't take into account consumers' preferences may end up providing a service that is inconvenient to the population and therefore not used. Additionally, the fact that bottled water is a familiar product in Mexico implies that Small Water Enterprises (SWEs) that provide affordable bottled water along with delivery service can increase access to safe drinking water throughout the population.

Most of the households surveyed consumed primarily LWW water. The fact that the sample was larger for LWW consumers than for non-consumers may have led to an underrepresentation of non-consumers' views and practices. Because of this and also due to the fact that this was a convenience sample, findings cannot be broadly generalized.

The following findings were statistically significant. Assessing the interaction between bottled water consumption and being an LWW consumer revealed that LWW consumers pays less for bottled water than non- consumers, and are more likely than non-consumers to list price as reason for preferring a specific type of bottled water. LWW wants to increase access to safe water (LWW). These findings are therefore to be expected since LWW water is supposed to be less expensive than other bottled water in order to increase access to safe bottled water to those that would be unable to afford it otherwise. Since one of the main advantages of LWW water is its lower price, it follows that price would be cited as a reason for preferring the LWW brand. Furthermore, since non-consumers are less likely to cite price it also implies that price is less of a concern for non-LWW consumers. This is congruent with the researchers' assumption that non-consumers are of a higher Socioeconomic Status (SES) and would therefore not be as concerned about price as LWW consumers. However, this is only an assumption since income was not assessed in this study and an interaction between income and being an LWW consumer cannot be analyzed.

Furthermore, LWW consumers purchase more bottles per week than non-consumers. LWW consumers are also more likely to use bottled water for other activities besides drinking such as brushing their teeth and cooking or preparing food than non-consumers. Research shows that price can prevent consumers from purchasing enough treated water to use for purposes other than drinking (Ritter, 2008). This would imply that the lower price of LWW water allows

consumers too use bottled water for activities other than drinking. It could also imply that consumers are learning about the need to use bottled water for other purposes besides drinking through the LWW health education program.

LWW consumers are less likely to fetch water than non-consumers. LWW plants have delivery service in all the communities in this study, which is probably why fetching water was uncommon in this population. While they did offer water at a lower price if people would go to the plant and fetch it, few took advantage of this option, preferring instead to pay a higher price for delivery. This again implies that convenience is an important factor in the consumption of safe water and having a delivery service can increase the likelihood consumers will purchase bottled water. Furthermore, the fact that LWW consumers are less likely to fetch water than non-consumers could mean that since water is more affordable consumers are more likely to choose to have their water delivered compared to non-consumers. Furthermore, it could mean that consumers who found delivery service too expensive are now able to afford it through LWW. However, it could also mean that the LWW plant is less convenient for many to fetch water, as opposed to other brands that are sold in local stores. The next section discusses additional interactions that were not statistically significant.

Although the following observations are not statistically significant they are still important to mention because they may n provide insight into areas for further research. However, these findings are limited by the size of the sample, and thus ungeneralizeable .

After price, convenience and taste were the most cited reasons for LWW consumers preferring a specific brand of bottled water. For non-consumers, the most cited reason they preferred a specific brand of bottled water was convenience, second highest was wellbeing and the least cited reason for preferring a specific type of bottled water was price. This is in contrast to LWW consumers who cited price the most. Nevertheless, both LWW consumers and non-consumers cited convenience as one of the top reasons for preferring a specific brand. As previously stated convenience is a determinant of intervention success (Dewilde, et al., 2008). The fact that more non-consumers cited convenience as a reason why they prefer a specific brand of bottled water suggests that they would consume LWW water if it were more convenient for them. Price not being cited as much by non- consumers supports the researchers assumption that non-consumers have a higher SES.

However, selling more bottled water increases the likelihood that LWW plants will be able to cover operating costs, repairs, and staff salary (Hartman, 2011). Therefore, in order to increase access to safe water to those who are not able to afford it, LWW plants should also target other consumers who may have a higher SES.

There were only a few households that reported bottled water being given out for free by LWW. This suggests that most people in the communities studied had the means to pay the price set forth by LWW. Literature on willingness to pay suggests consumers are willing to pay for safe water (He, et al., 2008;

Vasquez, et al., 2009). Therefore, providing a more affordable option for bottled water may be more effective than giving products out for free, and there may be no need for water to be given out for free. Since the sample of LWW consumers that received bottled water was so low, it was not possible to conduct further analysis to see what other factors interacted with consumers receiving free water. The next section discusses findings on health knowledge and attitudes towards bottled water.

5.1.2. Health knowledge and attitudes towards bottled water

The following findings are for the overall survey population. Most participants reported having learned about health and hygiene practices through local clinic health education programs and health promoters. Out of participants who reported having learned about health and hygiene practices only a small portion learned this through LWW health education. This indicates that LWW's health education program is not being taught as prescribed by LWW mission (LWW). LWW's Operating Partners (OPs) may not have time to incorporate the health education curriculum into operations. However, given Mexico's increase in government sponsored health education campaigns, both thru health promoters and media campaigns, it is possible that OPs feel it is not necessary for them to include the health education component (Sepulveda, et al., 2006).

The following findings assess interaction for health knowledge and being an LWW consumer. Although only a few participants reported learning about health education through LWW, findings show that all those who learned about

health education through LWW also reported being consumers of LWW water. It is uncertain whether the health education component would actually increase consumption of LWW bottled water since price seems to be the main factor effecting consumption of LWW bottled water. This could also mean that the health education is additional benefit for LWW consumers and does not impact consumption. Further research is needed perhaps in sites where the health education component is more widely available.

LWW consumers were less likely to report having learned about health and hygiene practices compared to non-consumers. Studies show that knowledge of health and hygiene practices is inversely related to diarrheal disease and infection (Dewilde, et al., 2008; Potgieter, et al., 2009; Quihui, et al., 2006). These findings indicate again that LWW OPs are not including the health education program as intended. Since the health education program does not appear to be used the effectiveness of this program cannot be measured. However, we do recommend that since this thesis' overall findings show that there are more women than men per household, a health education that targets mothers might be effective. Next, findings on more consumer health knowledge variables are discussed.

In order to better assess consumer knowledge with regards to safe water, participants were asked how they knew that water was safe to drink. For LWW consumers the most cited reasons were taste, the way the water looks and feels, and trust in brand of water. LWW consumers were more likely than non-

consumers to cite trust in brand as a way to know water is safe to drink compared to non- consumers. Conversely, most non-consumers reported "the way the water looks and feels" as a way to know water is safe to drink, followed by "what others say", "water is in a sealed bottle" and "taste." Non-consumers were more likely than LWW consumers to cite the fact that water comes in a sealed bottle as a way to know water is safe to drink. Furthermore, LWW consumers were more likely to agree with the statement "the brand of bottle water I drink tastes better than other brands" compared to non-consumers. This suggests a higher level of brand loyalty among LWW consumers. Evidence suggests that members of a community tend to trust Faith Based Organizations (FBO) more than other organizations (Grills, 2009). It follows then that since LWW is an FBO and LWW plants are run by members of the community, LWW consumers are more likely to trust their brand of bottled water than non-consumers. Furthermore, while not all LWW consumers were Presbyterian, all Presbyterian households were LWW consumers. Since there were no non-consumers who were Presbyterian, it was not possible to run further analysis. The next section discusses findings on household characteristics.

5.1.3. Household Characteristics and Socioeconomic Status (SES)

Researchers assumed LWW consumers to have a lower SES than non-consumers. However, wealth indicators used such as household materials, and crowding gave contradicting results. Therefore, we recommend measuring different indicators and correlating that to consumers' income to get a better idea

of the SES of consumers. The next section addresses implications of the current study and recommendations based on our findings.

5.2. Implications and Recommendations

Implications and recommendations for both public health practice and LWW are discussed in this section, along with recommendations for further research.

5.2.1 Public Health Practice

LWW consumers cited trust as a reason for knowing water is safe. This finding suggests that brand loyalty and trust is a way consumers determine water quality. If people don't trust the quality of a product they are less likely to use it. In the case of other health interventions, developing a relationship with community members can increase trust, thereby increasing usage of the intervention (Breslin; R. R. Brown & Farrelly, 2009; Manase, et al., 2009; Yayemain, et al., 2009). Based on the literature and current findings the researchers recommend that health interventions prioritize forming a relationship with the community. Furthermore, insight into the community may increase long term use of an intervention. The literature suggests that providing access to a service like safe water is not enough, and that the convenience of that intervention should be assessed prior to implementation (Corella-Barud, et al., 2009; Dewilde, et al., 2008). Convenience was cited in this study by both consumers and non-consumers of LWW as a reason for preferring a specific type of bottled water. This suggests that convenience is a determinant of use and should be more closely monitored by health interventions.

5.2.2. LWW

Since few consumers reported learning about health and hygiene through LWW health education program, this implies that the health education component is not being incorporated into operations. Additionally the finding that all those who had learned about health and hygiene through LWW were also LWW consumers suggests that providing health education will increase use of LWW bottled water. We recommend that LWW monitor that OPs are incorporating the health education component into their operation. Health knowledge is a mediating factor of intervention use (Dewilde, et al., 2008). Therefore, LWW should scale up the health education component of their program and ensure its implementation.

Consumers are willing to pay for water. In the case of LWW willingness to pay for safe water should be assessed throughout the community(J. Brown, et al., 2009; Ibarra, et al., 2010; Vasquez, et al., 2009). This can provide some guidance into designing a pricing strategy. Increasing sales can improve the likelihood that LWW plants will be able to cover maintenance costs, and have salaried employees.

New LWW sites should conduct baseline research to determine knowledge, attitudes and practices with regards to bottled water in the community, especially in other countries.

5.2.3 Further Study

Limitations of this study are discussed first and then recommendations for further research and for updating the instrument are provided.

In order for the study to have more power, a larger sample is needed, preferably randomized so as to be representative of population. If available, GIS may help map households that are located in the delivery route of SWEs. GIS could also be used to determine which households fall outside the delivery route and would therefore be more likely to fetch water. Furthermore, if time and field staff is limited it is recommended that rural areas be chosen over urban areas. The reason for this being that urban areas are more spread out and it is therefore more difficult to obtain a representative sample. Additionally the faith aspect of LWW should be studied further. All consumers who reported being Presbyterian also reported consuming LWW water. Further study is needed to determine what proportion of the congregation consumes LWW water and how do they compare to congregants that do not consume bottled water. Further study is needed to better understand determinants of using LWW water. Also willingness to pay for treated water should be assessed given that so few households reported water being given for free. The interaction between how much households pay for water was not studied in this thesis due to a small sample size. Qualitative research such as focus groups with participants can provide a better understanding of why participants purchase a type of bottle water and the role of health in making that decision.

The household survey should be updated to better measure consumer satisfaction with the product. Furthermore, variables that measure levels of convenience with bottled water would help to explore the interaction between convenience and use. Also household income should be added to assess interaction with being a consumer. Household income could also be used to determine better predictors for wealth given the contradicting findings of this thesis with regards to wealth indicators. Other possible predictor variables such as willingness to pay, maternal education, knowledge of specific waterborne illnesses, and access to health education campaigns, should be added to increase the likelihood of being able to construct a predictive model and assess for confounding. The next section provides a summary of the discussion points .

5.3. Conclusion

Major findings of this study supported by the literature are that community engagement and trust of an intervention can increase the likelihood that community members will be exposed to that intervention. Furthermore the findings of this study support the notion that convenience is an important factor in use of an intervention, and that consumers are willing to pay for a product they find convenient and a product that they trust. Further research should be done looking specifically at predictors of use such as consumer convenience, trust, and price.

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Appendix 1: Household Survey

Informed Consent

Protocol Title: Understanding Consumer Behavior and Perception in regards to Small Water Enterprises in the Yucatan Peninsula, Mexico. Please read this consent document carefully before you decide to participate in this study.

Purpose of the research study: The small water enterprises that are created with the help of LWW are designed to be sustainable, and to offer clean water to at a low cost. Sustainability is defined primarily by demand generation, cost recovery, and consumer satisfaction. We seek to measure consumer demand of LWW treated water in the Yucatan Peninsula and understand consumer behavior and perception in regards to LWW treated water and local competitors.

What you will be asked to do in the study: You will be required to complete a short survey regarding the uses of treated water in your household, as well as demographic information.

Time required: The survey should take no more than 20 minutes.

Risks and Benefits: There are no known risks or benefits associated with completing this survey. However, participating in this survey will assist us in evaluating the effectiveness of LWW water treatment system.

Compensation: No compensation will be provided.

Confidentiality: Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number, in lieu of any personally identifying information. The list connecting your name to this number will be available only to the principal investigator. When the evaluation is completed and the, the list will be destroyed. Your name will not be used in any report.

Voluntary participation: Your participation in this study is completely voluntary. There is no penalty for not participating. You may also refuse to answer any of the questions we ask you.

Right to withdraw from the study:

You have the right to withdraw from the study at anytime without consequence.

Whom to contact if you have questions about the study:

Principal Investigator: Joanna Galvez

E-mail: jgalvez@emory.edu

Agreement:

I have read the procedure described above. I voluntarily agree to participate in the procedure and **I have received a copy of this description.** [

Participant: _____ Date: _____

Principal Investigator: _____ Date: _____

Survey
Survey Number _____ Name of interviewer _____

Read consent to interviewee.
Was Consent Given? Yes No

Name of town _____

	Section 1.00: Demographics	
1.01	Sex	1. Male 2. Female
1.05	What year were you born?	Year _____
1.10	Marital status	1. Single 2. Married 3. Divorced 4. Widow 5. Cohabitating
1.15	Religion affiliation	1. Catholic 2. Presbyterian 3. Evangelical 4. Other Christian_____
1.20	How long have you practiced (name religion stated above)?	Years_____
1.25	How often do you attend religious services	1. Once a week 2. More than once a week 3. 1-3 times a month 4. Less than once a month 5. Never
1.30	What is the name of your church	
1.35	Education level? How many years of education?	Years /grade_____ Never attended school _____
1.40	What do you do?	
1.45	Specify type of work	1. Housewife 2. Agricultural/farm labor 3. Informal business: craft, fruit sales 4. Works for others (non farm) 5. Jobs requiring higher education
1.50	How many people live in your house?	Total_____

1.55	What is the age and gender of each household member?	1. Sex____ Age____ 2. Sex____ Age____ 3. Sex____ Age____ 4. Sex____ Age____ 5. Sex____ Age____ 6. Sex____ Age____ 7. Sex____ Age____ 8. Sex____ Age____ 9. Sex____ Age____ 10. Sex____Age_____

	Section 2.00: Wealth, access and assets	
2.01	If there are children under five, has the child been sick with diarrhea in the past month?	1. Yes 2. No
2.05	How long has child been sick	Time_____
2.10	Do you use the local clinic	1.Yes 2. No
2.15	How far is the clinic/hospital/doctor	Distance
2. 20	How much does it take to travel to your medical facility?	Time_____
2.25	What mode of transportation do you use when you have to go to the clinic/hospital/doctor?	
2.30	What is your primary mode of transportation? How do you get around	1. Walking 2. Bicycle 3. Motorcycle 4. Car 5. Taxi 6. Public transportation
2.35	Transportation expenses (approximately)	_____(Month) Would rather not answer _____
2.40	Medical expenses (approximately)	_____(Month) Would rather not answer _____
2.45	Bills (electric, water) expenses (approximately)	_____(Month) Would rather not answer _____
2.50	Food expenses (approximately)	_____(Month) Would rather not answer _____
2.55	Other expenses (approximately)	_____(Month) Would rather not answer _____
2.60	Number of bedrooms in house	
2.65	How many people sleep in each room?	
2.70	(Observe: Type of flooring in the house)	1. Dirt 2. Cement 3. Tile 4. Other___
2.75	(Observe: Type of walls in the house)	1. Cement 2. Tin 3. Straw 4. Other
2.80	(Observe: Type of roof in the house)	1. Cement 2. Tin 3. Straw/thatched

2.85	Which ones of the following items do you have in your house, how many?	Beds _____ Hammocks _____ Bicycles_____ Motorcycles_____ Car/truck_____ Radio_____ TV_____ Refrigerator_____ Telephone/cell_____ Washing machine_____ Other _____
2.90	How many bathrooms do you have?	0 _____ (g to q 2.50) 1 o more_____ (write total and skip q 2.50)
2.95	Type of sanitation facility	1. Flush toilette 2. Latrine 3. Other_____

	Section 3.00: Water consumption	
3.01	What is your primary source of bottled water?	1. Bottled 2. Tap 3. Well 4. Lake, river water 5. Rain water 6. Other_____
3.05	Do you purchase bottled water?	1. Yes 2. No 3. Bottled water is free
3.10	How much does a bottle of water cost?	Price_____
3.15	What brand of bottled water do you consume?	Name of brand/location ----------
3.20	Is water delivered or fetched by someone?	1. Delivered 2. Someone fetches water If someone fetches, who? _____
3.25	How often is water delivered?	
3.30	How many bottles of water do you consume a week?	
3.35	How many times a week does someone fetch water?	
3.40	Have you learned about health and hygiene practices? (Hand washing, risk of disease, etc)	1. Si 2. No
3.45	If yes to 3.40, where did you learn?	
3.50	How long ago did you learn?	
3.55	Why do you prefer the brand of water you consume?	1. Price 2. Convenience 3. Taste 4. Avoid getting sick 5. Health and wellbeing 6. Other _____
3.60	Do you believe bottled water you consume is safe tor drink?	1. Si 2. No
3.65	How do you know water is good enough to drink?	1. Others say 2. No bugs 3. The way water looks 4. No microbes in water 5. Water comes in a sealed bottle 6. Taste

		7. Has chlorine 8. Trust in brand/seller
3.70	How do you know if water is not good enough to drink	
3.75	What type of water do you use for the following activities?	1. Drinking _____ 2. Brushing teeth_____ 3. Washing dishes_____ 4. Washing clothes_____ 5. Caring for the baby_____ 6. Bathing/shower_____ 7. Cook/prepare food _____

	Section 4: Attitudes and beliefs about bottled water					
	I am now going to read you some statements related to water consumption. For each statement please tell me whether you agree, somewhat agree, disagree or somewhat disagree. If you do not know please let me know.	Do not know	Disagree	Somewhat disagree	Somewhat agree	Agree
4.01	Washing your hands before eating is very important	9	1	2	3	4
4.05	It is necessary to use bottled water to wash my hands	9	1	2	3	4
4.10	The brand of bottle water I drink tastes better than other brands.	9	1	2	3	4
4.15	The brand of bottle water I drink is the only one I consider to be safe to drink	9	1	2	3	4
4.20	I don't believe drinking bottle water is important	9	1	2	3	4
4.25	Only children and the elderly need to drink bottled water, not everyone needs to drink it	9	1	2	3	4
4.30	I don't get sick as often when I only drink bottled water	9	1	2	3	4
4.35	There are microbes in tap water that can cause disease	9	1	2	3	4
4.40	Drinking tap water	9	1	2	3	4

	every once in a while is ok					
4.45	The type of water I consume has no impact on my overall health	9	1	2	3	4

This is the last question, thank you for participating in this survey.

*LWW health education module, and the center for Global Safe Water Survey and templates were used to create this survey.