Willingness-to-Pay for Water Resource Protection in El Salvador: Price Is Not the Only Factor

Willingness-to-Pay for Water Resource Protection in El Salvador:

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Abstract

Failing infrastructure and environmental degradation threaten access to water resources for millions around the world. Water resource management is particularly complex in developing countries because of limited financial, technical, and administrative capacities to effectively manage source watersheds. Few water users pay tariffs that adequately provide for infrastructure maintenance and source protection, leaving many systems highly subsidized by underfunded municipalities. Evidence indicates that investments in source watershed protection can result in improved quality and quantity for water service providers at a lower cost than traditional gray infrastructure. The purpose of this research is to better understand the value water users place on protecting source watersheds, as well as the major contributing factors influencing this value.

This research seeks to answer two primary questions: 1) Are water users in developing countries willing to contribute financial resources to source watershed conservation efforts? 2) Is the presence of good water governance a factor in the amount of money water users are willing to pay for source watershed protection? To answer these questions two hypotheses were evaluated: 1) Despite living in financially poor areas, individuals will be willing to pay for water resource protection in addition to their current water payments. 2) Communities that lack strong civic engagement and institutional capacities in terms of water resource management will demonstrate lower willingness-to-pay (WTP) for source watershed protection initiatives.

Using the Contingent Valuation (CV) methodology, this research elicited WTP values for protecting source watersheds in two municipalities in El Salvador, Tamanique and Comasagua. The CV survey contained a hypothetical referendum to create a water fund and multi-actor administrative board to carry out appropriate conservation interventions in source watersheds for each community. Logit models were estimated to determine the most relevant variables influencing WTP at the household level. Controlling for distribution frequency and family income, the variables that were statistically significant in predicting WTP were the proposed price increase of the referendum and participant level of education. Findings also indicate there is a significant gap between Tamanique and Comasagua in terms of local willingness to pay for watershed protection. This gap is believed to be influenced by differences in social and political variables contributing to local governances as determined by contextual evidence and third-party research.

Results of the WTP model indicate that the average household was willing to pay $3.03 more on their current water bill. This represents a 50% increase to the average monthly cost of $6 and would represent 5% of average monthly income of $200. These results can be used by policy makers in the study sites to adjust pricing structures, which could provide the needed financial means to ensure sustainable water resources in developing regions.

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I also greatly appreciate Dr. William Vásquez, professor of economics in Fairfield University, for patiently answering all my questions on statistical modeling and econometrics and Paul Hicks, Water Resource Specialist for CRS, for asking tough questions and making me think through all the complex issues that encompass water resource protection.

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Definition of Terms

Catholic Relief Services (CRS): A non-profit aid agency working in developing nations around the world.

Contingent Valuation (CV): a survey based method that determines individual´s values for a proposed change in the environmental quality (Raheem, 2015).

Ecosystem Services: defined as the benefits to human populations derived from a natural resource (MEA, 2003).

Integrated Water Resource Management (IWRM): management approach that seeks to promote the efficient, equitable, and sustainable allocation of valuable water resources (Lenton & Muller, 2009).

Social and Environmental Systems (SES) Framework: an interdisciplinary approach to identifying specific variables that promote self-organization of users to maintain shared resources (Ostrom, 2009).

Water Governance Self-Assessment (WGSA): A participatory methodology for measuring and monitoring water resource governance based on social and environmental systems framework.

Willingness-To-Pay (WTP): The economic value of a good or service as defined by the maximum amount that a potential customer is willing to pay.

Chapter I

Introduction

An estimated 40% of the land area in the world´s source watersheds are degraded by development, poor agricultural practices, and deforestation (Abell, Asquith, Boccaletti, Bremer, & Chapin, 2017). Degraded land in source watersheds has a negative impact on the quantity and quality of water that can be derived from the source for human consumption. As more of the world's population moves to urban and semi-urban areas, it is imperative that land areas around source water for potable water systems are protected (McDonald & Shemie, 2014).

The typical approach to solving water insecurity has been through engineering gray infrastructure for improved extraction, delivery, and treatment processes. Yet, evidence shows that investments in source watershed protection can directly enhance water quality and quantity at a fraction of the cost of traditional gray infrastructure (Abell et al., 2017). Green-infrastructure activities such as reforestation, targeted land protection areas, and implementing agricultural best practices can reduce water security risks while providing a wide range of co-benefits: mitigating climate change, building climate resilience, improving human health and wellbeing, and conserving biodiversity (McDonald & Shemie, 2014).

Research Significance and Goals

Water security is a primary focus for local and international institutions´ development strategies. Goal six of the newly revised United Nations´ Sustainable

Development Goals seeks to ensure the availability and sustainable management of water and sanitation for all (United Nations, 2016). This research focuses on water resource conservation and the role of socio-economic factors on resource valuation that particularly addresses targets 6.6, protecting and restoring water related ecosystems, and 6.B, support and strengthen participation of local communities in water resource management (United Nations, 2016). The objective of this research is to provide a better understanding of the economic value water users place on local water resources and to assess the impact of a variety of variables on this value.

One goal of this research is to validate work performed by local institutions and international non-governmental organizations that support social institutions, awareness building, and political advocacy around water resource protection as a complement to gray infrastructure. The project also intends to contribute to a growing body of knowledge on Integrated Water Resource Management (IWRM) and valuation of ecosystem services, demonstrating that the CV methodology serves as a valuable tool for resource managers when measuring the effectiveness of water resource protection interventions focused on building social and political awareness.

Therefore, a key objective of this research is to assess the monetary value semi-urban water users place on source watershed protection for water resources directly responsible for providing community water systems with a variety of important ecosystem services. This study relies on the Contingent Valuation (CV) survey methodology to elicit the stated value of these ecosystem services. The research also seeks to evaluate a range of social, economic, and political variables involved in valuing water resources as a non-market good.

The study was conducted in two semi-rural communities in El Salvador. The socio-economics, political structures, and water infrastructure are indicative of many towns on El Salvador. Both communities struggle to maintain water infrastructure and water users struggle with poor quantity and quality of services. Understanding water users' willingness to pay for resource protection and the factors that contribute to those values can help local policy makers make informed decisions on how to invest resources to improve water services.

Background

Increased demands from growing populations coupled with rising contamination are endangering many of our world's ecosystem services. This affects humans' ability to access clean drinking water for domestic use, agricultural production, and sanitary conditions. Exacerbating this problem, the natural elements that provide regulating ecosystem services are being degraded at an alarming rate by anthropogenic causes. In developing nations, water scarcity is often intensified by a lack of financial resources, technical training, and political efficacy that prevent millions of citizens from accessing reliable water services (CRS, 2013).

While water scarcity is a growing issue on a global scale, all water problems are local or regional in nature (Fishman, 2011). This in turn means the solutions to water management must be local as well. There is not one global water crisis but thousands of local water crises, each with its own distinct problems, actors, and potential solutions (Fishman, 2011). To solve these local crises, time, energy, and financial resources must be invested by all stakeholders at the watershed and sub-watershed level.

Over the years, policy makers, development professionals, and hydrologists have identified critical components found to promote improved water services for human populations. These components include the identification of specific natural conditions that protect our water resources, the important social components needed to ensure sustainable allocation of water services, and the need for financial contributions from a range of stakeholders to maintain and improve water services. The background section of this report details the most relevant concepts and frameworks currently influencing the field of water resource management.

Protecting Ecosystem Services

Ecosystems services are defined as the benefits to human populations derived from a natural resource (MEA, 2003). Critical ecosystem services that humans depend are divided into 4 categories: provisioning (e.g. food production), regulating (e.g. water filtration), supporting (e.g. carbon sequestration), and cultural (e.g. sacred lands) (Kumar & Wood, 2010). In terms of freshwater, the provisioning service is the source of water we drink and the regulating services are the natural conditions of a watershed that produce and filter water for consumption; both are paramount to human populations around the world.

Protecting water at the source can prove to be cheaper than man-made treatment facilities for improving water quality or the engineering cost for interbasin transfer when more water is needed for a growing population (McDonald & Shemie, 2014). Although built infrastructure is necessary to extract and deliver water to population centers, incorporating natural solutions such as reforestation, agricultural best practices, and targeted land protection should always complement this built infrastructure to ensure sustainable quantity and quality of water resources (McDonald & Shemie, 2014). Aside from improving quality and quantity, improvements to natural resources can have positive impacts on local development, employment, recreation, protecting biodiversity, and improving climate change adaptation (Abell et al., 2017).

Integrating Social Systems into Water Development

Typically, water supply projects funded by international development institutions and national governments focus primarily on technical aspects of water management such as building viable infrastructure. Unfortunately, they fail to sufficiently address the environmental, social, and political complexities involved in managing water resources. As a result, even well-designed projects fail due to social or political conflicts (Hileman, Hicks, & Jones, 2015). This is especially true where water is scarce.

Evolutionary thinking on sustainable water resource management places increased attention on the importance of social factors and the influence they have on the success or failure of community water systems. To effectively account for the varying needs that multiple actors have for water resources, it´s necessary that resource managers and stakeholders come together to collectively manage limited natural resources. When adequate coordination among competing water needs is not addressed, low intensity and even violent conflicts can arise between actors (Hileman et al., 2015). This coordinated effort among stakeholders is the practice of good water governance.

In recent years, two important frameworks have been introduced that explicitly integrate social and political factors into water resources management: Integrated Water Resource Management and Social-Ecological Systems.

Integrated Water Resource Management

Integrated Water Resource Management (IWRM) as a conceptual framework outlines a holistic approach to watershed management that focuses on water resources being shared by users as well as the social, economic, and environmental factors that contribute to the sustainable use of a given water resource (Lenton & Muller, 2009). Successful IWRM is measured by three interrelated outcomes, called the three E´s: economic efficiency in water use, equity in water distribution, and ecological sustainability. Success in achieving progress in the three E's requires political will as well as civic engagement across multiple sectors. The range of political, social, economic and administrative systems that are in place to develop and manage water resources are collectively called "water governance" (Rogers & Hall, 2003).

A foundational element of good governance is social capital, defined as the relationships and interactions that enable people to resolve problems related to public goods (Rogers & Hall, 2003). Social capital resources include trust, norms, and networks of association representing any group that gathers consistently for a common purpose (Ostrom & Ahn, 2003). Social capital is critical for getting diverse stakeholders to come together to plan and implement water development and management, including the ability to prevent and work through potential conflicts. Social capital is especially important for communities in developing countries because social capital at the local level can help overcome deficiencies in the capacity of local or national government agencies (Woolcock & Narayan, 2000).

IWRM has been very successful in shaping water programs and policies in many countries – most modern water laws specifically reference IWRM principles. Nevertheless, IWRM has been criticized for being a predominantly top down and formulaic model that in some cases results in policies and regulations that do not consider local context and norms (Smith, 2013). Including tools that can support an iterative process for reviewing IWRM foundations in a culturally appropriate manner would improve the outcomes of the policies.

Social-Ecological Systems Framework

A significant breakthrough in environmental resource management was the Nobel Prize winning work of Elinor Ostrom on management of common-pool resources (CPR). Ostrom's Social-Ecological Systems (SES) framework provides a multi- and inter-disciplinary approach to identifying specific variables that promote self-organization of users to effectively manage shared resources (Ostrom, 2009). The SES framework recognizes the relationships between four core systems (resource systems, resource units, governance systems, and users) and a series of second-tier variables that influence the four core systems and translate into positive governance (Ostrom, 2009).

The purpose of assessing the multiple levels of interaction is to identify those variables that promote collective resource management as well as those that need improvement (Ostrom, 2009). The SES framework has proven to be a valuable analytical and conceptual framework for researchers; however, the framework has been criticized for failing to provide tools and guidance on how to build capacities for managing common pool resources (Hileman et al., 2015).

Valuation of Ecosystem Services

In both the IWRM and SES frameworks there is an emphasis placed on investments in ecosystems services from all stakeholders. While water resources play such an important role in our everyday lives, most users, whether domestic or industrial, pay very little for their water. Investments into water resources in developing countries are especially underfunded (Figueres, Rockström, & Tortajada, 2012). The lack of investments from all stakeholders (e.g. governments, users, and organizations) is leading to failing infrastructure and degradation of the environmental conditions that produce, protect, and filter water resources. In Central America, it is estimated that 70% of water infrastructure begins to fail within the first five years of construction (CRS, 2013). Investments are not only needed to improve infrastructure but also to restore those ecosystem services that ensure sustainable production of water resources (OECD, 2011).

An important research approach to evaluate investment proposes that the ultimate affirmation of good governance of a defined resource can be measured by individual´s willingness to pay for the sustainable protection of ecosystem services responsible for provisioning and regulating source water for human consumption. Contributing financial resources demonstrates a high level of trust in the institutional capacity in the region as well as the active engagement from stakeholders (Oh & Hong, 2012).

Understanding what individuals are willing to pay for ecosystem services can tell us a lot about the social, cultural, and political norms that are present in a defined geographical area. WTP is a clear indication that a good or service is valued and therefore will be protected and maintained by the beneficiaries (Whittington, Briscoe, Mu, & Barron, 1990). To address this important gap in resource management, a more thorough understanding of the value proposition for water resource protection as well as the factors that contribute to stakeholders´ engagement is necessary.

Willingness-To-Pay

An ecosystem is considered to have monetary value if at least one individual is willing to pay a dollar amount to improve the conditions of the resource or believes they should be compensated for suffering due to that ecosystem´s degradation (Raheem, 2015). Economists often refer to the economic value of a good or a service as the maximum willingness-to-pay (WTP) by a potential beneficiary or consumer. WTP has been used in many traditional markets to define the price of goods and services; in more recent years WTP valuations have been used to assess benefits from ecosystem services as non-market goods.

Environmental economists believe if resource managers and resource users have an understanding of the economic value of the local ecosystem services, improvements could be made in local policies and management decisions (Raheem et al., 2012). One distinct benefit of placing a monetary value on these services is to provide a standard unit of measurement that stakeholders from all sectors are able to understand and assess (Raheem, 2015). Resource users´ WTP can be measured through various methodologies, normally categorized between stated preferences and revealed preferences.

WTP in Developing Countries

For over 20 years, researchers have conducted WTP studies in developing countries to better understand individuals' values for a range of potential policy improvements. A great deal of focus for these studies has been in the water sector. The methodology most often used in the context of the water sector in developing countries is the Contingent Valuation (CV) study. This may be due to the common difficulty of acquiring good data in developing countries, making the revealed preference methods unreliable. Even though these studies are often criticized for their hypothetical nature, improvements in survey design and econometrics modeling make the CV method one of the best tools for determining WTP for a specific environmental policy change (Whittington, 2002).

A number of studies have been carried out in Central America to determine WTP for a variety of water services improvements. Many of these studies focus on improvements to services through new infrastructure construction or administrative changes to current water systems. It is often assumed that local populations in developing regions cannot, or will not, pay more money to improve water services. The assumption that poor water users are not willing to pay for water services is typically based on the dollar amount of those services. Yet, research suggests that many water users are repeatedly willing to pay significantly more for improved services than their current tariffing structure demands (Van Hecken, Bastiaensen, & Vásquez, 2012; Vásquez, Franceschi, & Van Hecken, 2011). The price of water services, although important, may not always be the bottom line when assessing water users´ value for water resource. Studies done with split sample groups have found that there are often differences in responses between different strata and that more research should be done with a focus on the motives behind individuals´ WTP (Spash et al., 2009; Vásquez, 2014).

Research Questions, Hypotheses, and Specific Aims

This research seeks to answer two primary questions: 1) Are water users in developing countries willing to contribute financial resources to source watershed conservation efforts? 2) Is the presence of good water governance a factor in the amount of money that water users are willing to pay for source watershed protection?

To help address these, I evaluated two primary hypotheses: 1) Despite living in financially poor areas, individuals will be willing to pay for water resource protection in addition to their current water payments. 2) Communities that lack strong civic engagement and institutional capacities in terms of water resource management will demonstrate lower WTP for source watershed protection initiatives. Based on observational and third-party evidence of the two community, I believed Tamanique will demonstrate a significantly lower WTP due to the factors presented in the second hypothesis.

Specific Aims

Addressing these questions and hypotheses required completion of the following research aims:

1. Identify two communities to conduct Contingent Valuation (CV) study. The two communities should be similar in geographic location, socio-economic conditions, and potable water services. However, they should be different in terms of social

engagement and political will in regard to water services. The difference in social engagement and political will was determined based on observational and third-party evidence of the two community.

2. Define a sample population from each of the two communities. This sample was stratified proportionally between the two communities based on total populations.
3. Design the CV survey. The survey was comprised of two sections. Section one contained questions perceived to potentially impact willingness-to-pay (WTP). Section two detailed the contingent proposition participants will be asked to hypothetically vote on to register support for water resource protection.
4. Conduct survey. The survey enumerators were certified in Institutional Review Board (IRB) standards and trained on all survey materials before implementing surveys in both communities.
5. Analyze survey data along with proxy socio-political variables collected. Survey data were digitized in Microsoft Excel for easy management. Correlation of the data points were determined using “Stata”. Translating data and survey materials from Spanish to English was also completed.

Chapter II

Methods

The methodology for carrying out field research for this investigation was multifaceted. It required a coordinated effort from the principal investigator, community counterparts, local non-profit organizations, and a team of surveyors. This chapter will describe, in detail, the selection process for choosing the appropriate sites to conduct the research, creating the contingent valuation (CV) survey, implementing the survey in the field, and processing the data in statistical software for analysis.

Site Selection

The goal of this research was to investigate willingness-to-pay (WTP) between two communities. The communities were to be similar in geography, demographics, and cultural norms, but have perceived differences in socio-political factors that contribute to good water governance and social capital. This was a difficult task in El Salvador where little research has been conducted on water resource governance and the important variables that determine its existence. By working with the non-profit organization Catholic Relief Services (CRS), two communities were identified as potential research sites that met these criteria based on qualitative and quantitative data collected in the field--- the municipal town centers for Tamanique and Comasagua in the department of La Libertad, central El Salvador (Figure 1).

The two communities are located within roughly ten miles from one another. Populations of both communities are predominantly low-income families that rely on agriculture as the primary economic means. Each community is serviced by potable water systems derived from nearby river catchments. Water services are administered locally and nearly 100% of residents in the town centers receive water from the tap. In one community pricing is a flat rate set by the municipality and the other uses tariffing blocks to dictate pricing based on water consumption. Currently, no land management laws or ordinances exist in either community to protect the source watersheds that supply the potable water systems. Each source watershed has similar topography, soil characteristics, and land use practices – primarily agricultural (Figure 1).

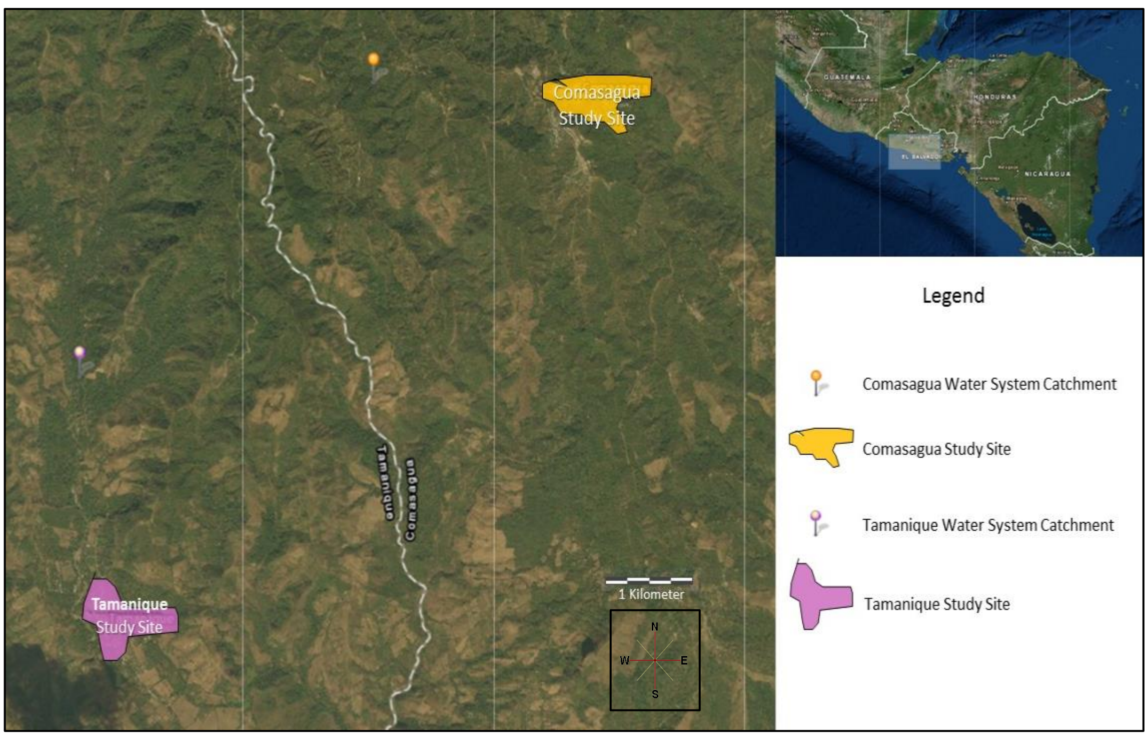


Figure 1. Map of research sites. Pins represent the water catchment locations for water systems.

Comasagua

CRS, together with its local partner organization FUNDESYRAM, has been working with Comasagua´s community members and local officials on water resource management for over three years. The organization´s interventions have been specifically designed to improve water governance in the area. FUNDESYRAM supported this research by providing information about the community, organizing visits with the local water system´s administrative body, requesting permission from the municipal mayor's office to conduct the survey, and coordinating the focus group to review survey materials.

The potable water system for Comasagua´s town center is run by a private-public partnership between the municipality and an independent entity, ADEMAC, created for administering water services. There are 710 households connected to the water system, accounting for close to 100% of the population of Comasagua´s town center. Water users typically receive services seven days a week with limited interruptions. The base cost of service is $2.50 for ten cubic meters monthly. This service is tariffed in incremental blocks in accord with water consumption. Every ten cubic meters above the initial base has a successive charge per meter starting at $0.25, along with an additional $1.15 flat rate. In the weeks prior to implementing the survey, water restrictions cut services for all users to as few as two days a week with frequent interruptions. These restrictions were due to unforeseen circumstances and were not part of the original research plan.

Water resource management and governance has become a major topic of discussion in Comasagua in recent years. In May 2016, with support from FUNDESYRAM, the town held its first annual Water Fair celebrating water resources and informing community members on current conditions and future threats to water resources in the region - a second fair is scheduled for October 2017.

Along with awareness building campaigns, FUNDESYRAM has been tracking progress in water governance over the past three years using the Water Governance Self-Assessment (WGSA) tool created by CRS. The objective of the WGSA tool is to measure the performance of collective and inclusive political, social, economic and administrative systems that regulate the protection, conservation, and management of water resources. As a participatory tool, WGSA is explicitly designed to generate a dialogue between various stakeholders in regard to collective water resources, and facilitate a process whereby they define their own strengths and weakness, and prioritize actions to strengthen water governance. The multi-actor group represented in the WGSA focus group reported high participation by community members and officials in meetings concerning the water system, as well as strong, proactive local leadership in resolving water service issues.

Tamanique

Less than ten miles from Comasagua, along the Balsamo Mountain corridor, is the small town of Tamanique (Figure 1). There are no external institutions currently working in the municipality that focus on water resource management. Over the past several years there have been informal discussions between CRS team members and the municipality´s head of natural resource management about possible support in improving water services throughout the municipality. Preliminary studies were conducted on several municipal water systems, but a lack of support from local officials has prevented any formal interventions on the part of CRS. Lines of communication are being maintained by the municipality's natural resource manager who agreed to support this research.

Potable water systems for all communities, including the town center, in Tamanique are run by the municipality. There are 320 households connected to the town center´s water system accounting for close to 100% of the population for this sector. Water users typically receive services seven days a week with limited interruptions. The cost of water services is a flat rate of $3.00. This cost is part of one municipal services bill charged to all households. Other municipal services costs include trash collection, illumination, and municipal taxes. It is important to note that even though the town center has a reliable water system with frequent distribution, most of the communities outside the town center do not have dependable water service.

No awareness building interventions in water resource management or governance have ever been implemented in Tamanique. As a baseline for future work in the municipality, representatives agreed to work with CRS teams to implement the WGSA in a focus group of multiple actors from the community. After originally agreeing to facilitate this activity, local officials showed reluctance and ultimately refused to conduct the assessment. Community official´s reluctance to speak openly on the inner working of the institution´s administration demonstrates low levels of trust, transparency, accountability, and civic participation.

This is not the first time that Tamanique officials have closed their doors to outside institutions. When Paul Hicks, Senior Technical Water Advisor for CRS, was asked by town officials to review the municipality´s design proposal for a multi-community water system outside the town center in an attempt to solicit funds from the international development organization, he discovered a bloated budget and a poor design. When Mr. Hicks expressed concerns about the proposal, town officials retracted the request for assistance (personal communication, February 5, 2017). This is evidence of a lack of transparency and potential corruption on the part of Tamanique officials.

Around this same time, ACUA, a local non-profit organization whose mission is to improve water resource management through community organization and policy advocacy, was also forced out of the municipality for working with community water committees. According to Lidia Margarita, Social Coordinator for ACUA, municipal leaders saw the organization´s presence as undermining the political party in power (personal communication, February 5, 2017).

Most recently Azure, a social enterprise dedicated to bringing improved water services and administrative assistance to rural and semi-urban areas in El Salvador, began working with one of the local communities in Tamanique on a water and sanitation project. Azure supported the community with preliminary designs and feasibility studies. Working together with the municipality, Azure set out to improve administrative processes to ensure the sustainability of the new project. Oscar Rodriguez, Azure´s founder, accounts that once inquiries into operation costs for current water systems and operational rules were made, communication was cut off and the project has become stagnate (personal communication, February 5, 2017).

This qualitative evidence suggests a high degree of insulation on the part of the local government from other outside institutions in regard to administering water services. Over the years, the topic of water has been contentious in several communities within the municipality. The unwillingness to work alongside these organizations, paired with the unwillingness to participate in the WGSA tool, demonstrate extremely low marks in regard to key variables indicating good governance institutions including trust, transparency, accountability, and civic participation.

Survey Design

I used Contingent Valuation (CV) methodology to measure semi-urban water user´s value of provisioning and regulating ecosystem services in watersheds that directly contribute to their town's drinking water systems. CV is a survey based methodology for measuring resource user´s highest willingness-to-pay (WTP) for non-market ecosystem services. CV surveys rely on the stated preference of participants for a proposed improvement to a defined ecosystem service (Whittington, 1998).

Using best practices set forth by the Asian Development Bank, the following four activities were conducted to ensure the CV survey would be culturally appropriate and contextually relevant in the selected sites (Gunatilake et all., 2007):

1. Review relevant information of the area (i.e. census data, water service conditions, pricing and administration structures).
2. Partner with local institution.
3. Conduct initial field visits.
4. Prepare sampling framework.

The survey was created with two principal components: the CV scenario and the relevant survey questions that were expected to have an influence over the response to the proposed scenario.

The CV Scenario

To effectively elicit the stated preference, a clear and contextually appropriate CV scenario must be developed as the focal point of the survey. Following best practices, the CV scenario was developed in the form of a referendum (Whittington, 2002). The referendum requires a “yes” or “no” vote from participants for a proposed change in administrative practices in the source watershed of a given water system that is responsible for water production and regulation.

The CV scenario included five crucial pieces of information that must be presented to participants: 1) stating the problem, 2) the proposed solution, 3) the benefits derived from the proposal, 4) the cost and payment mechanism for the proposed service, and 5) a reminder of real economic restraints (Whittington, 2002). Due to the complex nature of the complete CV scenario each aspect of the referendum was illustrated and presented in the form of an infographic while being read aloud to respondents. A full version of the illustrated CV scenario is included as Appendix 1.

Stating the problem. In both communities surveyed there are no laws or governing body directly related to the protection and conservation of water resources. In the first section of the survey respondents are asked about their water services and their knowledge of the local source watershed and its administration. To begin the CV scenario, respondents are reminded of the lack of a local administrative body responsible for protecting water resources.

Proposed solution. To counter the lack of any administrative body responsible for protecting source watersheds the proposal presents the case of a hypothetical water roundtable. Using guidelines set forth by The Nature Conservancy in its 2016 report, Beyond the Source, the proposed solution for the two communities is the formation of a multi-actor administrative board that would manage a local fund created through this referendum (Abell et al., 2017). This administrative body would invest in conservation efforts in source watersheds in three specific ways: reforestation, municipal ordinances for targeted protected areas, and implementation of agricultural best practices.

Benefits from proposal. It is important to include a direct or quantifiable benefit that respondents would receive through the CV scenario (Whittington, 2002). Quantifying the benefits derived from water resource management for an individual water system user is difficult. All benefits from source watershed protection are long term and may not be tangible over the course of several years. To account for this, the proposal presents the possible benefits in terms of improved water recharge in the source watershed and potential water catchment in the water systems.

To provide respondents with a reasonable estimated benefit that would result from enacting the proposed referendum, a hydrologic budget was calculated for the source watershed in Comasagua. Using the Subterranean Water Recharge (SWR) methodology which incorporates land area calculated using geographic information software (GIS), local precipitation data, observed land use and agricultural practices, water system user populations, and local norms for water consumption, a monthly hydrologic budget was modeled.

Using SWR methodology, predictions regarding water infiltration in the source watershed were made by changing the parameters for ground cover to account for improvements to land use management that would results from the proposed interventions. The model suggests that these interventions could improve groundwater recharge by as much as 25% of its current state. The benefit to the respondents was presented in terms of the potential increase in recharge that would translate into improved availability of water for the current water system as well as having the potential to ensure more water access for future generations. Given the similarities in topography, soil type, slope, land use, and area, results were extrapolated to represent the potential benefits in Tamanique as well.

Cost and payment mechanism. Once the CV scenario was completed the proposed price increase was defined through an iterative process with local stakeholders and experts in the field of water resource management. First, a comprehensive review of the proposal was conducted with experts in the field of water resource management in El Salvador. These experts focused on three key elements of the CV scenario: feasibility of the overall concept, comprehension of terms, and potential affordability for local water users.

The CV scenario was then presented as an open-ended question to a focus group made up of six potential participants from Comasagua (15 potential participants were invited, however, only six arrived and participated in the focus group). During the focus group participants from the community were asked to state their maximum willingness-to-pay for the proposed referendum by way of anonymous individual note cards. They were also asked to estimate the maximum willingness-to-pay that they believed their neighbors in the community would pay. A focus group was not conducted in Tamanique due to time and financial limitations.

The average price proposed by the focus group was $1.50. A range of prices around this average were included in the final survey to ensure sufficient variation in the WTP econometrics model. Variations in the prices presented to different survey respondents allow researchers to capture the price point where respondents are no longer willing to pay for the proposed project. The range of prices start with a low value that is predicted to be accepted almost universally, and a high end that is predicted to be rejected almost universally (Whittington, 1998). The proposed price increase for the referendum was therefore stratified across six different values: $.50, $1.00, $1.50, $2.00, $2.50 and $3.00. Because the survey would only be conducted with those households already connected to the community water system, the payment vehicle was presented as an increase to the monthly water bill (Vásquez, 2014).

Reminder of real economic restraints. One of the principal critiques of CV methodology is that responses are highly subject to hypothetical bias; if respondents do not consider the economic implications of the proposal to their personal finances they are more likely to vote in favor of the project. To mitigate hypothetical bias, the final part of the CV scenario stressed to respondents that by voting in favor of the proposal they will not be able to use the monetary value of the proposed price increase for other personal or family needs (Gunatilake et al., 2007). Once this reminder is expressed to participants, it is followed up by a "yes" or "no" vote for the hypothetical proposal.

Survey Questions

Based on the research proposal, a clear statement of intent was written before creating the survey to act as a guide when deciding which questions to ask; this helped to minimize asking participants for any unnecessary information. The goal of the research was to understand the relevant variables that influence water user´s WTP for protecting source watersheds contributing to the water services in their community. Given the limited financial resources and overall time constraints it was important that the survey be as concise as possible while providing sufficient information to the participants as to purpose of study.

A conceptual map of relevant factors that may influence user´s WTP was created to define the precise questions to include in the survey. Seven general variables were defined in the conceptual map as being possible influencers of WTP for water resource protection: Current water services administration, understanding of ecosystem services, local governance levels, education levels, income, perceived benefits from the proposal, and the cost increase for the proposal. Using these variables as guides, a series of questions was composed to encapsulate each factor. Figure 2 presents an illustration of the conceptual map used to define survey variables. The final survey questions are included as Appendix 2.

Implementing the Study

To effectively implement the survey in the study sites, an exacting approach was defined to maximize all resources and ensure the research would obtain the most meaningful results possible.

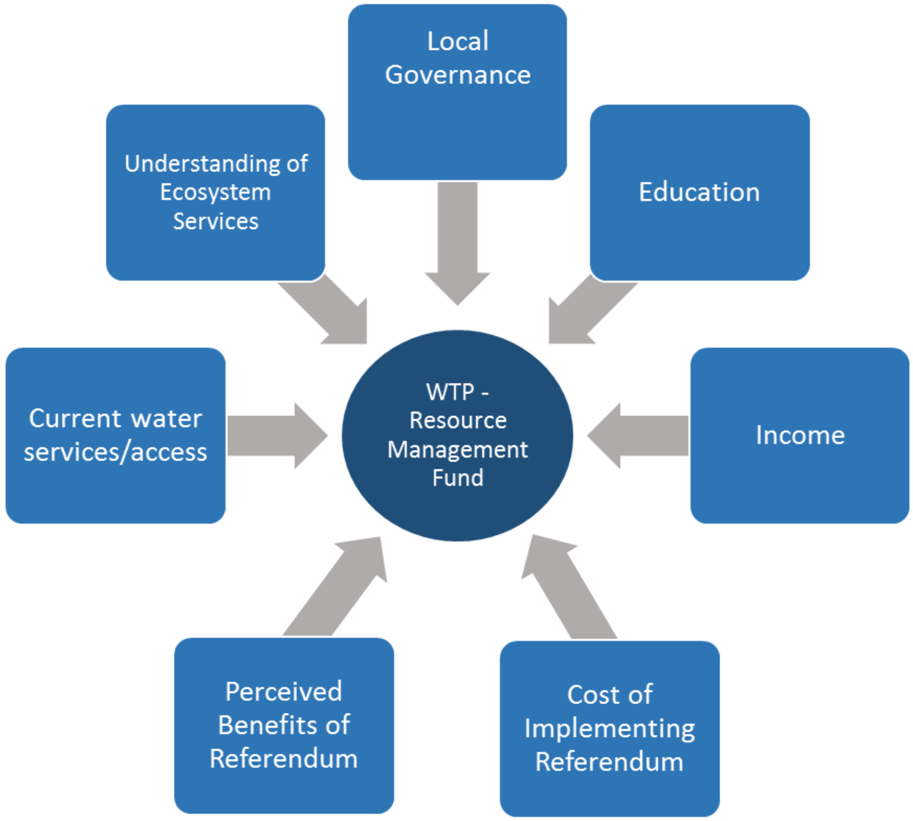


Figure 2. Conceptual map of variables that influence WTP.

Working directly with community counterparts, a sampling framework was developed with the goal of collecting the most representative information from all water users connected directly to water system in the survey sites. Three specific areas of focus translated to the overall implementation of the survey in the two communities; defining the sample population, organizing the survey team, and defining the sampling protocols.

The sample size was estimated using the calculation

$$\frac{\left(N * (Z^2) * p(1-p)\right)}{\left((d^2) * (N-1)\right) + \left((Z^2) * p(1-p)\right)}$$

where 'N' is the total population of the two communities of 1030 households; 710 in Comasagua and 320 in Tamanique. 'Z' is calculated at 1.96 to provide a confidence level of 95%. The percentage picking choice or response is represented as 'p' and was calculated as 0.5. The margin of error expressed as a decimal, 0.05, is 'd'. Under these conditions, a total of 280 surveys needed to be completed. Using stratified proportional sampling, $N1 * Sample\ Size/N$ where 'N' is the total population and 'N_1' is the population of a given strata, the total number of surveys was divided up as 193 in Comasagua and 87 in Tamanique.

To efficiently carry out the survey in both communities in a timely manner, a team of surveyors was organized. The team consisted of eight university students and young professionals: four males and four females, six Salvadorans and two from the United States. As per Institutional Review Board (IRB) requirements, all surveyors underwent a seven-module online ethics certification program on protecting human research participants. All surveyors also participated in a four-hour training on the research materials and survey protocols for this study before collecting data from the field.

Working directly with counterparts in each community, a sampling protocol was developed that would provide a representative sample of all segments of the target population. A census of community members and addresses does not exist in either of the communities sampled. Therefore, each community was divided into sections based on maps provided by the water service providers. Each section was canvased by a team of surveyors. To ensure a random sample of respondents, surveyors were instructed to approach every other household, if no adult representative of the family was available they would move to the next house until receiving consent to conduct the survey. Implementing this protocol allowed for a complete canvas of households connected to the community water system.

Processing Results

After four days of field surveys, three days in Comasagua (including half day of survey team training) and one day in Tamanique, all results were digitized in an Excel workbook. Separate tabs were added where categorical variables were coded as integer values. These coded results were loaded into the statistical software StataMP 14 for detailed analysis. Responses to the referendum CV question were analyzed using logit models and the average WTP was calculated using the Krinsky and Robb´s boot-strapping method (1986).

To measure the probability that different predictor variables included in the survey influenced the response to the vote for the hypothetical referendum question, a series of logistic regressions, or logit models, were calculated using StataMP 14. Logit models were the best analysis method for this study given that the dependent variable, a "yes" or "no" vote for the proposed referendum, was a dichotomous variable with only two outcomes (Penn State, 2017a). Logit models are calculated as the equation

$$P(Y=1) = \frac{1}{1 + exp - (b_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \ \beta_i X_i)}$$

where $P(Y=1)$ represents the probability that 'Y' is the value '1' and 'X_i' represents the proposed fee and other independent variables assumed to be related to the household's willingness to pay. 'b_0' represents the constant model and 'β_1' to 'β_i' are the coefficients of the independent variables (Rupérez-Moreno et. all., 2015).

Krinsky and Robb´s boot-strapping method with 5000 simulations was used to calculate WTP at a 95% confidence interval. This analysis provides the mean WTP amount along with upper bound values, lower bound values, achieved significance level, and confidence intervals. The mean WTP is estimated as

$$WTP = \sum_{i \neq FEE} \bar{X}_i \hat{\beta}_i / \hat{\beta}_{FEE}$$

where $\bar{X}$ is the average of corresponding variables and $\hat{\beta}$ represented the coefficients estimated in the logit models (Jeanty, 2007).

Chapter III

Results

The general results of the survey provide a panoramic view of each community that offer valuable information on the similarities and differences among respondents. All relevant survey responses are reviewed per community to provide a clearer understanding of the local populations involved.

Survey Results Review

Summary statistics on the variables perceived to be relevant predictors of a favorable vote for the proposed referendum, based on the conceptual map presented in Chapter II, include the socio-demographic breakdown of respondents, participant incomes, knowledge on water resources, water distribution frequency at each household per week, the monthly cost of water services, and the overall acceptance of the proposed referendum.

The summary statistics of age, gender, education levels, and incomes were remarkably similar across the two communities, supporting the intention to investigate two analogous communities that varied primarily in water distribution frequency and the cost of water services.

Gender

Close to 75% of respondents from the study sites were women (Table 1). This was most likely due to the timing of the survey, which was conducted between 8am-4pm on weekdays; most males in the communities work outside of the home during these hours. The average age of respondents was 44 years old. It is important to analyze any relationship that gender may have to the probability of a favorable vote given the important role women have in making household decisions, particularly around the issues of water.

Female heads of household spend an inordinate amount of time making sure there is enough water for cooking, cleaning, drinking, and for proper hygiene. Even in homes that have connections to potable water systems, service disruptions and concerns about water quality result in water being one of the most important household issues for women. Access to water has a disproportionate effect on women in developing countries and for this reason it is important that they be included as key stakeholders for decision making on sustainable water resources (Wilbur et al., 2015).

Table 1. Number and percentage of respondents by gender.

		Community		
Gender		Comasagua	Tamanique	Total
Male	Number of respondents	50	21	71
	Percentage of population	25.51%	23.60%	24.91%
Female	Number of respondents	146	68	214
	Percentage of population	74.49%	76.40%	75.09%
Total	Number of respondents	196	89	285
	Percentage of population	100.00%	100.00%	100.00%

Education Levels

Formal education levels vary at a similar distribution throughout the two communities (Figure 3). Over half of respondents have little to no formal education and half completed higher than a sixth-grade level. Only a few respondents stated having a university level education. It is important to note that there is a significant inverse relationship between respondents' age and education levels; younger people in the communities tend to have a higher level of education.

Income

Soliciting income information in El Salvador directly is a delicate issue. El Salvador has some of the highest incidences of violence and extortion throughout Central America resulting in distrust and fear among many citizens. Few people are willing to

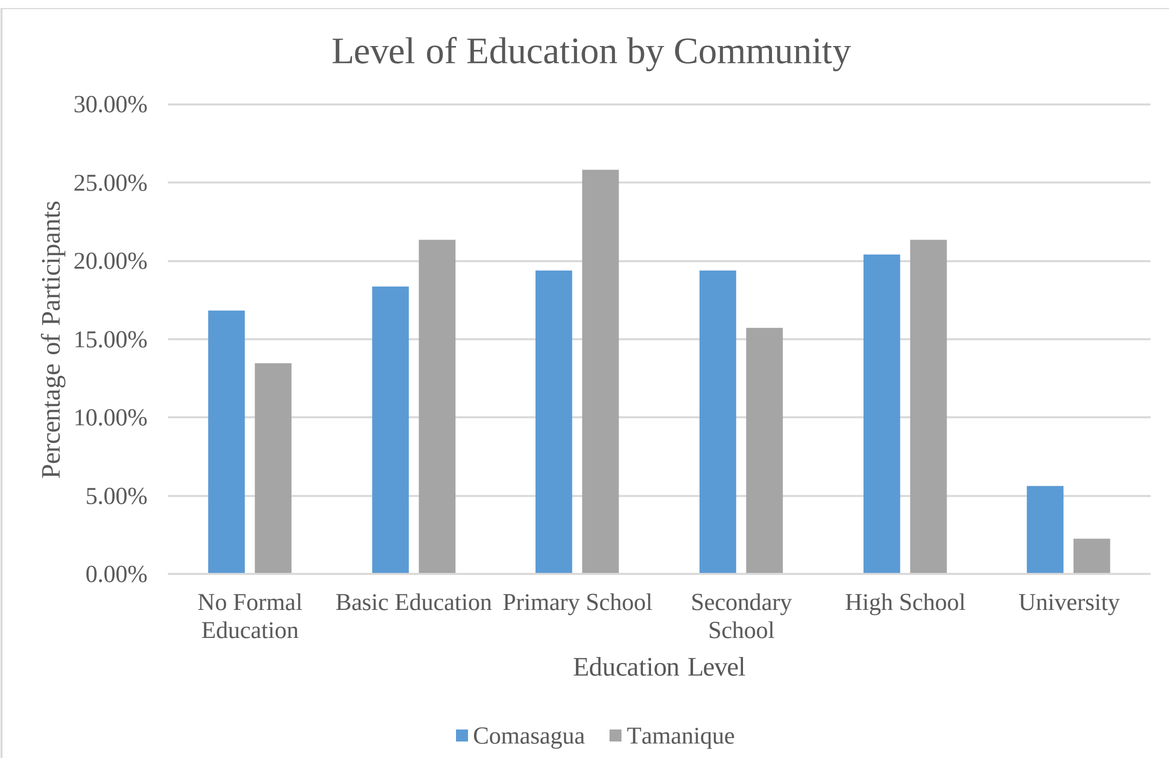


Figure 3. Percentage of respondents by education level in the two communities.

discuss openly the topic of income and remittances. This was taken into consideration when analyzing the stated incomes from participants.

Most participants in the two communities did provide income information and only thirteen respondents refused to answer the questions on income. Most respondents reported receiving little to no remittances and the average household income reported was $200 per month. These responses are consistent with the local minimum wage for the agricultural sector of $200 a month (Laguán, 2017).

Water Supply and Administration

The difference in weekly water distribution for each household in the two communities was much greater than anticipated. In the weeks prior to conducting the survey, the water system's administrator in Comasagua was forced to implement water rationing measures throughout the community due to low flows at the catchment. Even though water services in Comasagua are typically seven day a week, the average frequency users reported receiving water through the system was four days a week during the time of the study (Figure 4). In contrast, Tamanique water users received services an average of six days a week.

Water service fees varied between the two communities. Tamanique charged water users a $3.00 flat rate for water services. In Comasagua water is metered and charged in incremental blocks. The base price is $2.50 per month for ten square meters of water; using local norms, ten square meters should provide a family of four with sufficient water for basic needs. The average stated price paid in Comasagua for water services was $4.97; however, multiple respondents reported water bills exceeding $10.

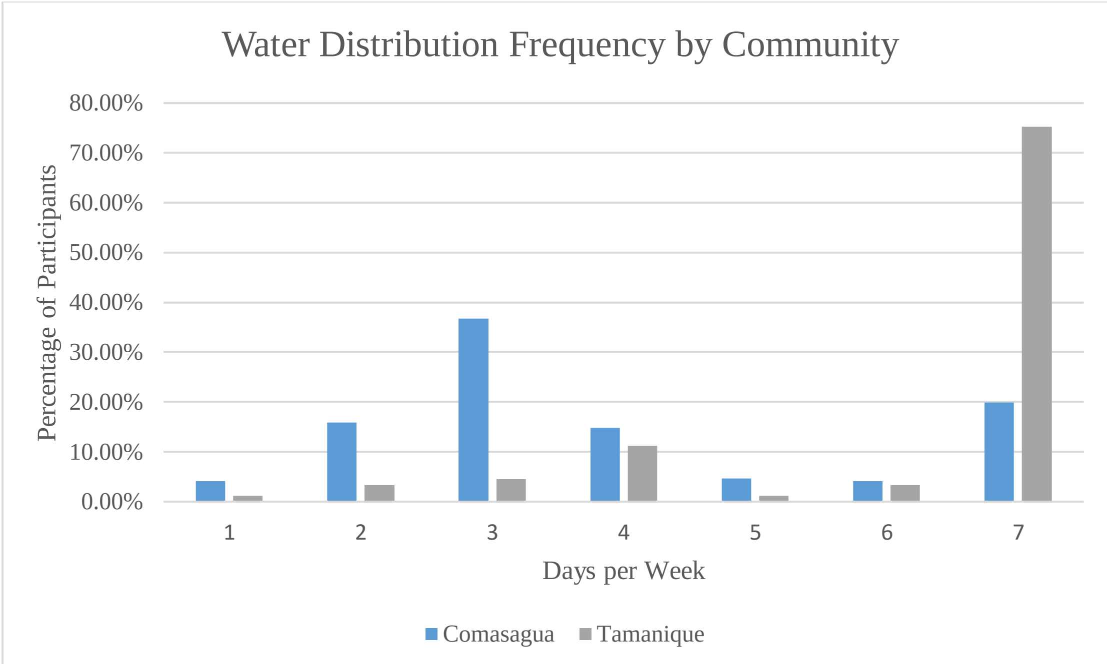


Figure 4. Number of days per week respondents reported receiving water services by community.

The amount of information water users had about the location and administration of the water source and water system was measured in the study. In both communities, most participants were aware of the location of the water system´s catchment source (Table 2). In Comasagua, 82% of respondents knew the name and location of the water system´s source – Rio Refugio. In Tamanique, 77% of respondents knew the name and location of the water system´s source -Santa Lucia.

Even though most water users had general knowledge of the water source location, nearly half were unaware of the name of the institution responsible for administering the water system (Table 3). In Comasagua, 55% of respondents knew the name of the administering body for the water system - ADEMAC.

Table 2. Number and percentage of respondents with knowledge of water source location by community.

Knowledge of Water Source Location		Community: Comasagua	Tamanique	Total
Yes	Number of respondents	161	69	230
	Percentage of population	82.14%	77.53%	80.70%
No	Number of respondents	35	20	55
	Percentage of population	17.86%	22.47%	19.30%
Total	Number of respondents	196	89	285
	Percentage of population	100.00%	100.00%	100.00%

This may be because ADEMAC is a private-public partnership and many Salvadorans typically recognize the municipality as the ultimate authority on all public works. Tamanique had a slightly higher positive response rate, with 62% responding correctly that the municipality was the administering body for water services.

Table 3. Number and percentage of respondents by knowledge of the water system administrator in each community.

Knowledge of Water System Administration		Community: Comasagua	Tamanique	Total
Yes	Number of respondents	108	55	163
	Percentage of population	55.10%	61.80%	57.19%
No	Number of respondents	88	34	122
	Percentage of population	44.90%	38.20%	42.81%
Total	Number of respondents	196	89	285
	Percentage of population	100.00%	100.00%	100.00%

Even though respondents have a general understanding of where the source of their drinking water comes from, there appeared to be less awareness of how and by whom their water is administered. Under 60% of respondents in both communities surveyed were unaware what administrative body was responsible for the potable water system. One key variable in improved water resource governance is that stakeholders engage with administrative bodies on the rules, regulations, and overall statues of water resources (Ostrom, 2009). These results indicate that water system administrators in El Salvador need to improve efforts for stakeholder outreach and processes for inclusion in collective decision making.

Willingness-to-Pay

Before analyzing the response to the proposed referendum, a review of the summary statistics between the two communities helped to get an idea of the general acceptance of the proposal. As an independent variable alone, without considering the price increase, respondents in Comasagua report roughly 15% more support for a source watershed protection program than Tamanique. In Comasagua, 69% of respondents are in favor of the proposal independent of the price increase. In Tamanique, 52% of respondents are in favor of the proposal independent of the price increase.

Analysis of the positive response rate when the independent variable for price increase is taken into consideration shows Tamanique dropping below Comasagua in terms of "yes" votes on all prices over $1.00 per month (Figure 5). Interestingly Tamanique has a higher positive response rate than Comasagua when the proposed price increase is under $1.00. Comasagua shows a low response rate for a $0.50 price increase, but an increase in "yes" votes for $1.00 with a steady decline until reaching the upper end of $3.00. Figure 5 represents the trend in response rates for the referendum by the proposed price increase in each community.

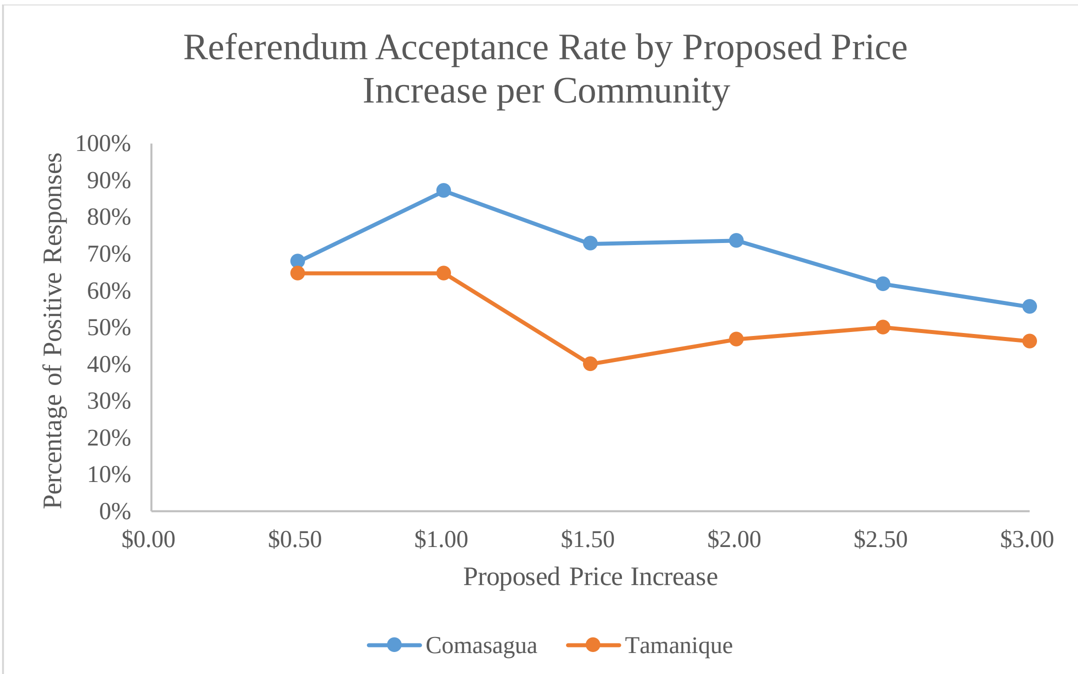


Figure 5. Acceptance rate for referendum by proposed price increase in each community.

Testing Similarities

An important assumption throughout this research was that the two communities selected for the survey shared similar characteristics in terms of socio-demographic structure and access to water services in the home. To examine this assumption each variable was compared across the two communities using statistical test; T-tests were used for all continuous variables and chi-squared (χ^2) statistics were calculated for all categorical variables.

The variables statistically different between the two communities were age, water distribution frequency, and water service costs (Table 4). These results are taken into consideration when calculating the logistic regression models to determine the influence of each variable to probability of a favorable vote for the proposed referendum for source watershed protection.

Table 4. Results from statistical tests of each variable by community.

	Mean		
Variables	**Comasagua**	**Tamanique**	**p-value**
Gender (% Female)	74.49	76.4	0.729
Age *	42	47	0.044
Education **	3.25	3.168539	0.563
Income (USD)	206.01	185.3933	0.471
Water Distribution Frequency (Days per Week) *	3.92	6.19	0.000
Water Service Costs *	5.55	3.78	0.000
Knowledge on Water Source Location (% Yes)	82.14	77.53	0.360
Knowledge on Water Service Administration (% Yes)	55.1	61.8	0.290

* imply statistically significant difference between communities

**Education is the average of the coded response. The mean education level is a sixth-grade education.

(All categorical variables were tested with Chi-squared ($\chi 2$) and all continuous variables were tested with t-values.)

Logistic Regressions

Over ten different models were calculated and a final model was chosen that best estimated the statistical relationship between the most relevant variables to test the research hypotheses. The final model chosen to represent the statistical relationships between independent variables and the response to the proposed referendum as the dependent variable was based on the results of the pseudo R-squared, bayesian information criterion (BIC), and akaike information criterion (AIC).

When calculating the relationships between the various independent variables the pseudo R-squared value was used to determine the total variability of the model, with the more variability explained the better the model (UCLA, 2017). Values for BIC and AIC were used to estimate the probability of the model being true; lower values for these reference values indicate a higher probability (Penn State, 2017b). The chosen model offered the highest pseudo R-squared value and the lowest values for AIC and BIC in comparison to other models calculated.

Predictive Model for WTP

The two hypotheses of this research are that: 1) despite living in financially poor areas, an individual´s WTP for protecting water resources for freshwater production will represent a significant price increase from the current tariffing structures; and 2) the WTP will be highly dependent on the social variables indicating the presence of good local governance in a watershed. The logistic regression that best tests these hypotheses modeled the “yes” or “no” vote for the referendum against the cost of the proposed increase for water resource protection, the community surveyed, current frequency of water distribution, education levels, and household income. The results of the logit model demonstrating the marginal effects and the p-value for each independent variable are provided in Table 5.

In the logit model, the marginal effects for education, the proposed price increase, and the community show the most impact on the probability to vote in favor of the proposed program. Marginal effects measure the expected change in the dependent

Table 5. Marginal effects and p-values for logistic regression model of the probability of a favorable vote for the predictor variables (n=272 respondents).

	Referendum Vote (Marginal Effects)	P-value
Price Increase*	-0.1061893	0.002
Community: Tamanique *	-0.1269435	0.064
Water Distribution Frequency	-0.0236926	0.117
Basic Education	0.1079545	0.264
Primary School	0.164185	0.089
Secondary School *	0.2156536	0.025
High School *	0.3397107	0.000
University	0.2324684	0.147
Income	0.0001521	0.429

* imply statistically significant relationship with probability of favorable vote

variable , the probability of a favorable vote, as a function of a change in the predictor variable while all other variables remain constant (SAS, 2017).These results tell us that, for every $1.00 increase in price, the probability of a favorable vote goes down by 10 percentage points. In Tamanique, the probability of a favorable vote is 12 percentage points less than in Comasagua. Persons with a high school education demonstrate a higher probability for a favorable vote by 33 percentage points. In this model, neither the respondent's water distribution frequency from the water system nor their household income have a significant relationship with the probability of a favorable vote for the proposed referendum.

Removing those respondents that were not willing to pay for reasons other than the cost, such as citing distrust in administration, the project is unnecessary, or the project unfeasible in their community, controlled this model for protest votes. These protest votes accounted for 42 respondents, representing 15% of the total sample population. In this scenario, price increase for the program and education became the only statistically significant predictors of a favorable vote for the proposed referendum (Tables 6).

Table 6. Marginal effects and p-values calculated by logistic regression model controlling for protest vote (n=235 observations).

	Referendum Vote (Marginal Effects)	**P-value**
Price Increase*	-.1206742	0.000
Community: Tamanique	-.0571897	0.396
Water Distribution Frequency	-.0142426	0.340
Basic Education *	.2740024	0.010
Primary School *	.1855923	0.069
Secondary School *	.2461662	0.014
High School *	.3636244	0.000
University *	.3828091	0.004
Income	.000019	0.917

* imply statistically significant relationship with probability of favorable vote

All other variables believed to influence the probability of a favorable vote were also included in various models. Knowledge on water system source and administration had no significant impact on the response to the referendum question, nor did the current cost of water services when included along with water distribution frequency.

Estimates of Willingness-to-Pay

The goal of the contingent valuation methodology was to measure the average value that local water users hold for their water system´s source watershed protection. A calculation for the total populations of the survey sites was conducted as well as separate calculations for each community. The WTP calculation provides evidence that in both communities' water users are willing to pay a significant amount more on their water bills to provide for source watershed protection, however, respondents in Tamanique were willing to pay a difference of 40% less than Comasagua for source watershed protection.

Average WTP of the total sample population is estimated as a $3.03 increase to respondent´s water bills each month to protect source watersheds (Table 7). This model shows an achieved significance level of 0.002 (equivalent to p-value). These values are further increased when controlling for protest votes, showing a WTP of $3.31 in the total population (Table 8).

Table 7. Mean WTP for the full sample population and both communities.

Model	**WTP**	**LB**	**UB**	**ASL***	**CI/Mean**
Full Model	$3.03	$ 2.40	$ 5.26	0.002	0.94
Comasagua Model	$3.39	$ 2.58	$ 6.34	0.002	1.11
Tamanique Model	$2.27	$ 1.28	$ 3.98	0.002	1.19

* = Achieved Significance Level for testing H0: WTP<= vs. H1: WTP>0
LB = Lower Bound; UB = Upper Bound

Krinsky and Robb (95%) Confidence Interval for WTP measures (Nb of Reps: 5000).

Table 8. WTP for sample population and each community with protest votes removed.

Model	**WTP**	**LB**	**UB**	**ASL***	**CI/Mean**
Protest Full Model	$3.31	$ 2.73	$ 5.01	0.0002	0.69
Protest Comasagua	$3.46	$ 2.76	$ 5.44	0.0002	0.77
Protest Tamanique	$3.00	$ 2.20	$ 4.64	0.0004	0.82

* = Achieved Significance Level for testing H0: WTP<= vs. H1: WTP>0
LB = Lower Bound; UB = Upper Bound

Krinsky and Robb (95%) Confidence Interval for WTP measures (Nb of Reps: 5000).

WTP by Community

An analysis of WTP was conducted for each community separately, revealing a significant difference in WTP between the two communities by 40% in the mean WTP Tables 7 & 8). The WTP calculation for Comasagua alone ($3.39) is slightly higher than the total population. This is to be expected considering the rate of positive responses in Comasagua was higher than Tamanique. The lower and upper bound values are both slightly higher in this model.

The mean WTP calculation for Tamanique is 40% lower than that of Comasagua at $2.27 (Table 7). The upper and lower bound values are also much lower than those of Comasagua. There is also a higher increase in WTP when controlling for the protest vote compared to the increase observed in Comasagua (Table 8).

Chapter IV

Discussion

This research set out to investigate two principal hypotheses. 1) Despite living in financially poor areas, individuals will be willing to pay for water resource protection in addition to their current water payments. 2) Communities that lack strong civic engagement and institutional capacities in terms of water resource management will demonstrate lower WTP for source water protection initiatives.

The results of the contingent valuation (CV) survey substantiate the first hypothesis. The WTP for the sampled population was $3.03. This cost for source water protection represents at least a 60% increase from the average price of water services. Qualitative data analyzed in this research also support the second hypothesis. However, given the difficulty collecting quantitative data from both communities, these results are less clear and require further study. This chapter will discuss the research results in terms of the two hypotheses, expound on important findings, and discuss how these data relate to policy implication both at the local level in El Salvador and throughout the developing world.

Willingness to Pay in Low Income Communities

Both communities surveyed in this study have high poverty rates. The average household income stated was in line with the national minimum wage for the agricultural sector of $200 per month. Over 40% of the six million residents in El Salvador live in rural and semi-urban communities and 20% of the labor force work in the agriculture sector (CIA, 2017). Tamanique and Comasagua are representative of many semi-urban towns throughout El Salvador in terms of financial resources.

When local citizens contribute financial resources to their collectively perceived problems, they themselves are taking actions to provide for sustainable community development. Financial contributions are where the rubber meets the road for local development and a well-designed WTP study can be a valuable tool for ensuring the cost of any project captures the value of local beneficiaries. The responses to the CV survey by the sampled population demonstrate that, even in finically poor areas, local water users are willing to contribute considerable financial means to ensure sustainable water production. Furthermore, findings from the CV study provide valuable insight into key demographics that must be included in stakeholder engagement efforts for source water protection planning.

At the local level, this research demonstrates there is a significant willingness to pay for protecting ecosystem services for producing and regulating water. In poor communities, such as Comasagua and Tamanique, a $3.03 increase in water services is a significant amount of money. Water resource protection would amount to 2% of resident´s monthly income and the new water bill could represent 3% or more of monthly incomes (Table 9). Water service bills in Tamanique would increase by over 100%. Nevertheless, such an increase to water services in Tamanique would not put the community over the international affordability threshold of 3% set forth by the Organization of Economic Co-operation and Development (OECD, 2003).

However, if Tamanique moved to block tariffing for water services many households would no longer be below this threshold, such is the case for Comasagua. Even though a $3.03 increase in water bills would pass the affordability threshold in many households surveyed, we can confidently state that this research provides proof that the hypothesis that water users are willing to contribute more financial resources to source watershed protection than current tariffing is correct.

Table 9. WTP as it relates to median household income and current water services in the two communities.

Community	**Mean WTP in Relation to Current Mean Water Service Costs**	**Mean WTP in Relation to Mean Reported Household Income**	**Mean WTP + Current Mean Water Service Costs in Relation to Average Reported Household Income**
Comasagua	61%	2%	4%
Tamanique	101%	2%	3%

If each household were to pay $3.03 more each month for source water protection, Comasagua and Tamanique would receive an annual revenue increase of $26,179 and $11,635, respectively. Further research in each site is needed on the costs of setting up water funds and implementing green-infrastructure projects in the area to determine whether this project would be feasible using this new revenue stream alone or if outside subsidies are needed.

Governance, Social Capital and WTP

The second hypothesis of this research was to determine if socio-political variables indicative of good water governance would influence responses to WTP across the two communities. These data are difficult to quantify and, unfortunately, the original tool proposed to measure these variables could not be implemented in both communities. Nevertheless, even when controlling for other differences in water systems administration across the two communities, such as cost of service and distribution frequency, the community variable remains a significant predictor of WTP.

Qualitative evidence seems to support the assumption that the institutional capacities and levels of social capital in Tamanique are much lower than those witnessed in Comasagua. Two specific indicators witnessed during the time of the research along with past evidence support the inference that the significant negative probability of responses to the referendum CV question in Tamanique is due a lack of socio-political factors contributing to good water governance: 1) Local government institution's unwillingness to work with outside organizations on improvements to water services and water resource management, and 2) Unwillingness to participate in self-assessment workshop on water governance. Other findings from this research help to support this hypothesis indirectly as well: the importance of education and the effect of the protest vote.

Education

Those respondents with a high school education or higher demonstrated the strongest statistical significance of any other variable tested according to the logistical regression models (marginal effects = 0.340; p-value < 0.001). The statistical significance of education was found in every model tested. Education in rural and semi-urban El Salvador has proliferated since the 1990´s. After a devastating civil war, reconstruction efforts have focused on improving education infrastructure throughout the country (Miranda, 2015).

Prior research suggests that education levels have a strong impact on social capital and promote civic engagement (Campbell, 2006). Using education as a proxy variable for probability of civic engagement, it could be said that a well-educated populous is more likely to contribute financial resources to ecosystem protection. If these trends are representative of the country, the future of water resource management could witness a more engaged citizenry with a common knowledge of the importance of source water protection for the sustainable production of quality water for human consumption.

Protest Vote

In each site, 21 respondents would not vote for the proposed referendum, stating distrust, unfeasibility, or that the project is unnecessary. Because the population surveyed in each community was conducted as a proportional sample this means that 24% of respondents in Tamanique rejected the project for reasons other than cost, compared to 10% in Comasagua. If these protest votes are eliminated, the WTP increases for each scenario.

These results support the conclusion that when people trust their administration and collectively perceive a problem, they are more likely to come together and contribute financial resources to solving issues. This does not provide a strong test of the original hypothesis, but does lead the researcher to believe that further investigation on this issue is needed.

Policy Implications

The goal of this research was to better understand semi-urban water users´ WTP for protecting important ecosystem services vital to regulating and producing water for human consumption in their communities as well as the motivating factors that influence this value. The information gathered in this study, along with the tools used in the investigation, is relevant to policy makers and practitioners. At both the local and international level, valuations of ecosystem services can improve water system tariffing in efforts to create sustainable water services by protecting source watersheds. Furthermore, understanding the importance of social and political variables in influencing these values validates important work conducted throughout the developing world to increase stakeholder engagement around water resource management.

In 2016, El Salvador´s Ministry of Environment (MARN) published the national plan for integrated water resource management. Nationally, income from water users only covers roughly 70% of the cost of water service operations (MARN, 2016). Most water systems in the country are underfunded and depend on subsidies from the national government and international donors. Between 2004 and 2012, an average of $66 million of operating cost were subsidized and over 90% of water users are subsidized each year (MARN, 2016). As argued here, current water bills propagate incorrect values of water to consumers and current tariffs do not cover the costs of operation and limit the sustainability of the systems and the ability to invest in the sector (MARN, 2016).

Research Limitations

Many difficulties can arise when collecting data from human subjects. This is especially true when collecting data in a foreign country while coordinating with multiple actors. Several limitations and unforeseen difficulties arose during the implementation of this research. These limitations included the unexpected water rationing implemented in Comasagua in the weeks prior to conducting the survey, and officials in Tamanique refusal to participate in the Water Governance Self-Assessment (WGSA) tool.

Research plans called for two similar communities in regard to demographic factors as well as access to potable water systems. During the preliminary research the two sites that were selected were both known to receive water from locally administered water systems at a similar distribution frequency. However, in the weeks leading up to the survey implementation one community, Comasagua, entered severe water shortage and household water distribution was rationed drastically. This fact was considered during the survey results analysis by controlling for water distribution frequency.

In addition, research plans required that CRS field teams work with municipal actors in both communities to collect quantitative data on socio-political variables related to good water governance. These data were collected in Comasagua before beginning the study and plans were made between the principal investigator, CRS, and the Tamanique mayor’s office to collect the same data through a participatory multi-actor workshop in Tamanique. Due to municipal authorities´ uncertainty on organizing this type of event, officials pulled their support before conducting the water governance self-assessment tool activity. The lack of participation along with other qualitative data is used in this study to assess these variables.

Conclusion

This research studied two communities in El Salvador. The results add to a growing body of knowledge on water resource management, water governance, and valuation of ecosystem services. To expand on this research more work can be done regarding WTP for source water protection and the relevant factors that motivate water users´ engagement in source watershed protection through WTP. El Salvador, like most tropical countries, is characterized by two principal seasons, the wet season and dry season. This research was conducted towards the end of the dry season. It would be interesting to replicate this research during the wet season to see if seasonality and the short-term abundance of water impacts respondents' positive acceptance rate.

At the national and international level, more research on the factors influencing WTP could be conducted, particularly on how improving water resource governance and social capital can result in more stakeholder engagement and local financing for water resource protection. A larger sample of sites with data on water resource governance data is needed to further validate inferences drawn from this research on the importance of water resource governance as it pertains to WTP among water users.

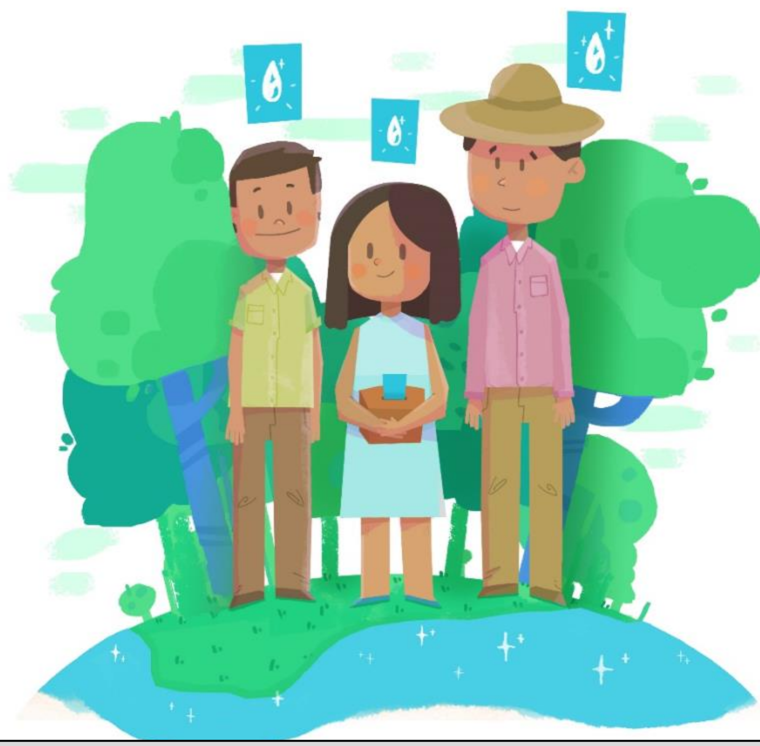
Of the $66 million annual subsidy for water services, only 22% go to poor households; the majority of households receiving subsidies can afford to pay more for water services (MARN, 2016). Based on this research and other studies in the field, it could be concluded that many of these households would be willing to pay more for their water services and water resource protection to ensure sustainable services in the future. Improving tariffing schemas based on WTP models could help these national systems recover more cost to improve system sustainability through investments in green-infrastructure

Appendix 1

Illustrated Contingent Valuation Question

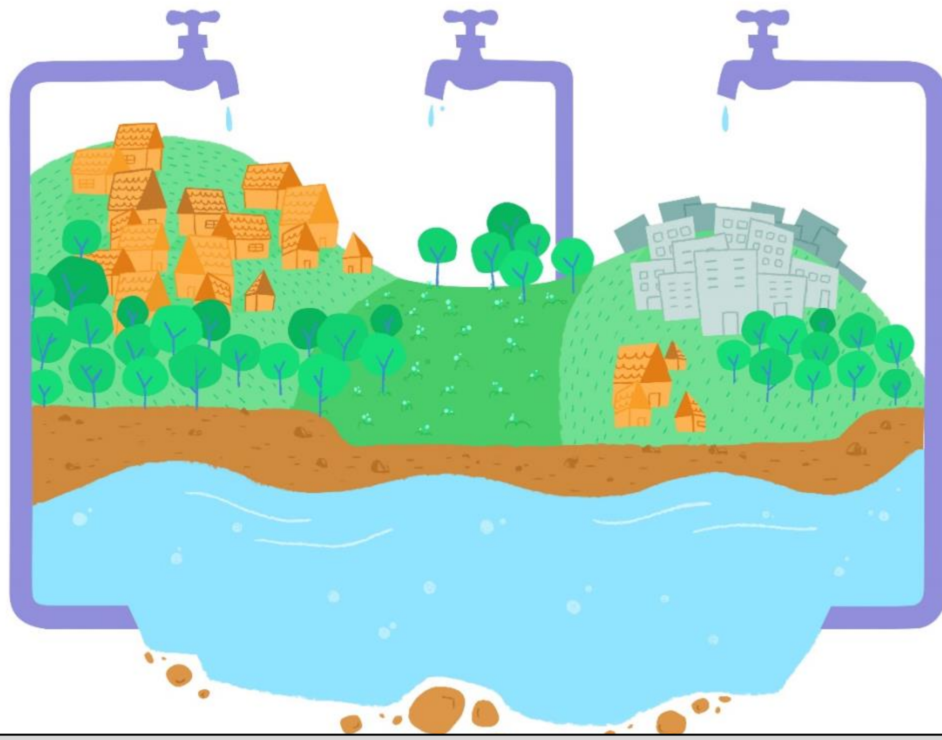
The illustrated contingent valuation question with the corresponding text read to respondent when presented each image:

1. Please consider you have the opportunity to vote in favor or against a program to improve local water sources that supply potable water for your community.



Por favor considere que usted tiene la oportunidad de votar a favor o en contra de un programa que mejorará las fuentes de agua locales que abastecen el sistema de agua potable para su comunidad.

2. Keep in mind that currently there is no management plan for water sources in the municipality and the land use around the potable water system is not regulated.

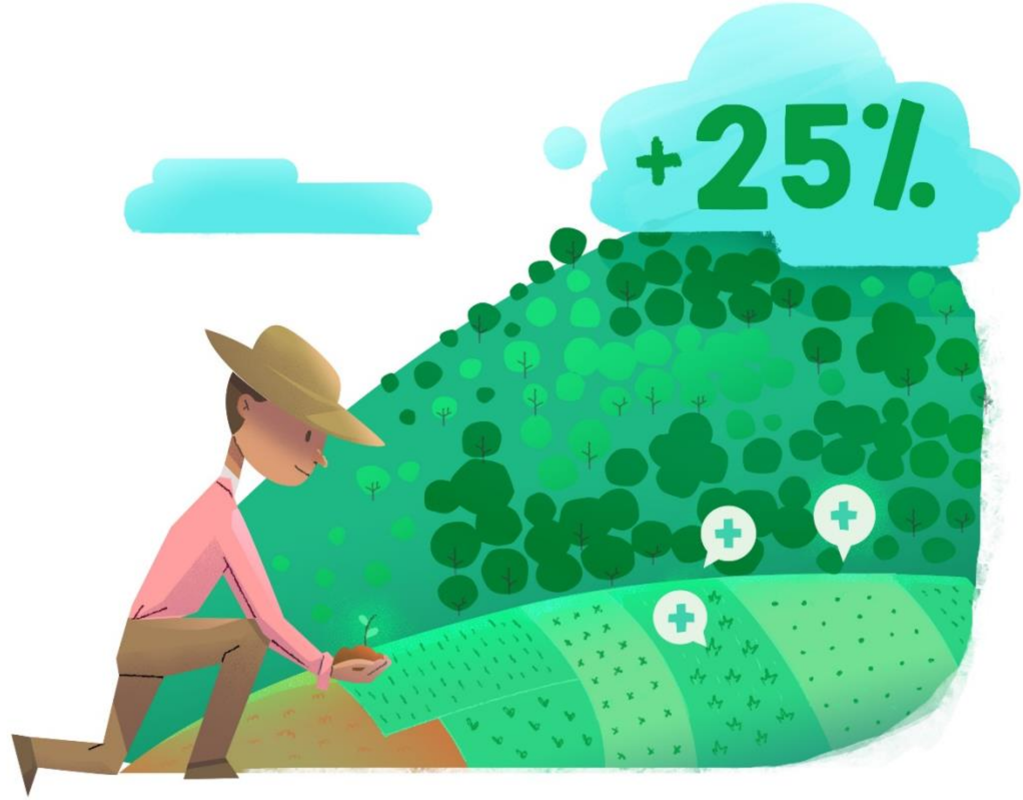


Recuerda que actualmente no hay un plan de manejo de las fuentes de agua en el municipio y que las tierras alrededor del sistema de agua no tienen ordenamiento de sus diferentes usos.

3. The new program will form a committee of stakeholders from multiple organizations that will be in charge of administering a community fund to implement projects that will improve the infiltration and rainwater recharge in the lands around the potable water system. The committee will be made of representatives of the water system users, the local mayor's office, non-governmental organizations, and representatives of the private sector.

El nuevo programa formará un comité con personas de múltiples organizaciones para que se encarguen de administrar un fondo comunitario con el fin de ejecutar proyectos que mejorarán la infiltración y captación de agua de lluvia en los terrenos alrededor del sistema de agua potable. El comité se formará por representantes de los usuarios del sistema de agua, la alcaldía municipal, organizaciones no gubernamentales, productores, cooperativas y representantes del sector privado.

4. According to our estimates, the implementation of reforestation projects, protected land ordinances, and the application of improved agricultural practices in the lands around the local water sources can result in an increase in rainwater recharge up to 25% from the current recharge.



Según nuestras proyecciones, la ejecución de proyectos de reforestación, ordenanzas de la protección de zonas verdes, y la implementación de mejoras prácticas agrícolas en los terrenos alrededor de las fuentes pueden resultar en un incremento de la capacidad de captar agua de hasta un 25% de lo que se capta actualmente.

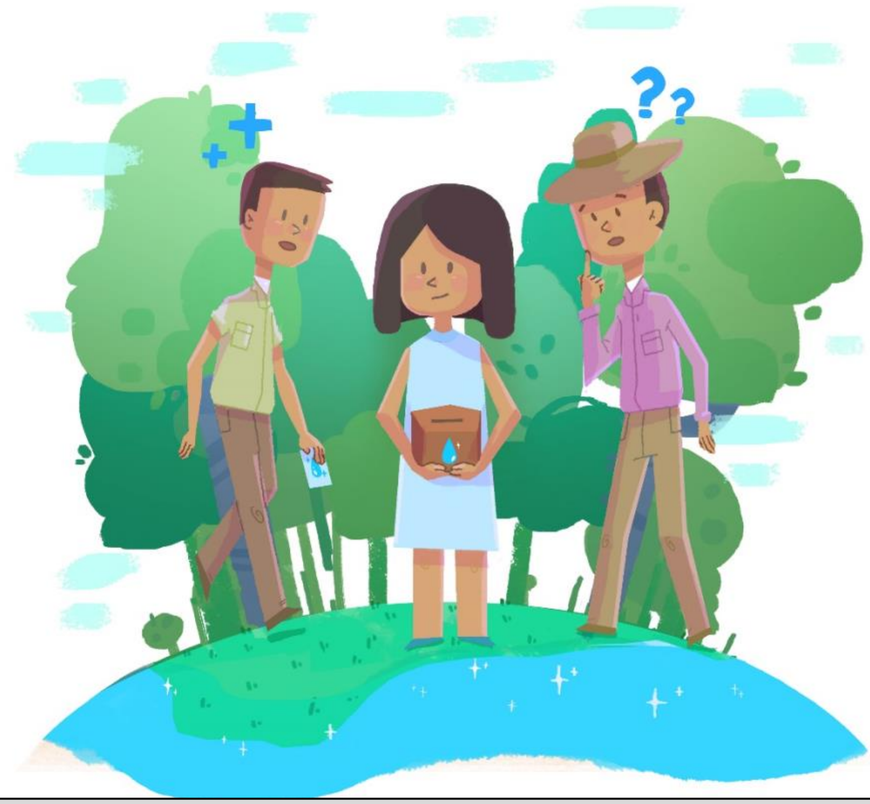
5. The increase in rainwater recharge can result in improved access to potable water in the water system and will help to secure water resources for future generations.

Este incremento en la captación de agua puede resultar en mejor acceso a agua potable en el sistema de agua y ayudará a potenciar las fuentes para el uso de consumo humano para futuras generaciones.

6. This program would be financed through an increase in the monthly water bill for all homes connected to the potable water system.

El financiamiento del programa seria a través de una contribución adicional en la cuota de agua para todos los hogares conectados al sistema de agua potable.

7. Please take into account that any money that is spent in the increase of your water bill is money that you will not be able to use for other personal or family necessities.



Por favor tome en cuenta que cualquier dinero pagado a este proyecto es dinero que usted ya no podría usar para otras necesidades personales o familiares.

Appendix 2

Full CV Survey

Encuesta del **Valor contingente**

Comunidad: ____________(Comasagua o Tamanique)

Servicios de Agua Potable y Sus Recursos Hídricos

1- ¿Cuántos días cayó agua del chorro en su casa durante la semana pasada?

_______ días por semana

2- En el día que hubo más agua en la semana pasada ¿Cuántas horas cayó agua?

______ horas

3- En el día que hubo menos agua en la semana pasada ¿Cuántas horas cayó agua?

______ horas

4- ¿Cuánto pagó el mes anterior por el agua del chorro?

__________ US $

5- ¿Usted sabe de dónde viene el agua que abastece al sistema de agua de su comunidad?
(Si responden "No" pasa a la pregunta 7)

Sí ☐ No ☐

6- ¿Cómo se llama la fuente principal de agua que abastece el sistema de agua potable?

____

7- Para usted ¿Qué tan importante son las ordenanzas, leyes, y/o normas para la protección de la fuente de agua que abastece el sistema de agua potable?

☐ Poco Importante ☐ Importante ☐ Muy Importante

8- Para usted ¿Qué tan importante son las ordenanzas, leyes, y/o normas para el manejo de los terrenos alrededor de la fuente de agua que abastece el sistema de agua potable?

☐ Poco Importante ☐ Importante ☐ Muy Importante

Las siguientes preguntas tienen como objetivo conocer su opinión sobre el efecto de diferentes usos de terreno y su impacto sobre la fuente de agua que abastece el sistema de agua potable en su comunidad.

Por favor escoja entre **Impacto Positivo, No Tiene Impacto, o Impacto Negativo** para decirnos su opinión sobre el efecto de cada uso de terreno alrededor de la fuente de agua.

Uso del terreno alrededor de la fuente...	Impacto positivo	No tiene impacto	Impacto negativo
9- Para la construcción de viviendas			
10- Para comercio o industria			
11- Para la siembra de milpas o granos básicos			
12- Para la siembra de café o cacao			
13- Para el pastoreo de ganado			
14- Para una zona de bosque natural			

15- ¿En algún momento usted ha recibido información o capacitación acerca de temas del buen manejo de agua o cuencas? (Si responden "No" pasa a la pregunta 17)

Sí ☐ No ☐

16- ¿De parte de quien recibió información o capacitación acerca de temas del buen manejo de agua o cuencas? (Seleccione todos los que aplican)

☐ La Alcaldía Municipal

☐ El Administrador del Sistema de Agua

☐ Instituciones de Gobierno (CENTA, MAG, MARN, etc.)

☐ Una ONG (CRS, FUNDESYRAM, CLUSA, etc.)

☐ Anuncios de radio o televisión

Otro: ______________

Gobernanza Local de Agua

Las siguientes preguntas tienen como objetivo conocer su participación en grupos u organizaciones que administran los recursos de agua potable en su comunidad. **Por favor responda con un Sí o No a las siguientes preguntas.**

17- ¿Usted sabe quién es el responsable de la administración del sistema de agua potable?

Sí ☐ No ☐

18- ¿Que usted sepa, existe algún grupo u organización encargado de la gestión de recursos de agua o cuencas? (Si responden "No" pasa a la pregunta 23)

Sí ☐ No ☐

33- ¿Cuál es su estado civil?

☐ Soltero(a) ☐ Divorciado(a)

☐ Separado(a) ☐ Casado(a)

☐ Unido(a) ☐ Viudo(a)

34- ¿Hace cuantos años viven en esta casa?

________años

35- ¿Son ustedes los dueños de la casa, la alquilan, o son cuidanderos?

☐ Dueños de la casa ☐ Alquila la casa

☐ Cuidandero

36- ¿Cuál es su oficio?

☐ Ama de casa ☐ Agricultor

☐ Albañil/Carpintero ☐ Empresario

☐ Trabajo Gubernamental

☐ Otro: ____________

37- ¿En cuál de los siguientes rangos se encuentran las remesas mensuales que su hogar recibe como promedio de familiares que vivan en otra ciudad o en el extranjero?

☐ No recibo remesas ☐ Menos de $100

☐ $100 a $300 ☐ $300 a $500

☐ $500 a $1000 ☐ $1000 a $2000

☐ Más de $2000

38- ¿En cuál de los siguientes rangos se encuentra el ingreso promedio mensual de su hogar? Por favor, no incluya remesas que familiares que vivan en otra ciudad o en el extranjero le hayan enviado.

☐ No hay ingreso ☐ Menos de $100

☐ $100 a $300 ☐ $300 a $500

☐ $500 a $1000 ☐ $1000 a $2000

☐ Más de $2000

Sección a ser completada por el entrevistador

39- ¿Cuáles son los materiales predominantes de la casa de entrevistado?

39- Piso		40- Techo		41- Paredes Exteriores	
Tierra		Lámina metálica		Bloque	
Cemento		Teja		Madera	
Piso cerámico		Paja		Adobe	
Otro: ________		Duralita		Bajareque	
		Otro: ________		Lámina metálica	
				Ladrillo	
				Otro: ________	

40- ¿Estaba alguien más con el entrevistado al momento de la entrevista?

Si ☐ No ☐

41- ¿Parecía el entrevistado estar interesado en la encuesta?

Si ☐ No ☐

42- ¿Parecía el entrevistado honesto en sus respuestas a la encuesta?

Si ☐ No ☐

43- ¿Se distrajo el entrevistado durante la entrevista?

Si ☐ No ☐

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