Water Source, Use and Cost in a Context of Poverty:

A case study of Tlamacazapa, Guerrero, Mexico

by

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Abstract

A grounded case study in Tlamacazapa, Guerrero, Mexico is analyzed to document residents' experiences of obtaining water. Twenty households participated in a detailed journaling exercise over two years to document water access, quantity, sources, uses and costs. The work revealed that the majority of Tlamacazapa residents access insufficient water to meet consumption, sanitation and hygiene needs, let alone productive purposes. Water from most sources is impure, falling short of national standards. Inconsistency in piped water network supply increases vulnerability and reduces health benefits that might otherwise be achieved through infrastructure improvements. Economic and opportunity costs are high both as a ratio to income and in absolute terms illustrating that the poor pay more for water. The resulting situation presents grave health risks for the community. In spite of water contamination and documented low levels of access, Tlamacazapa is considered to have an 'improved' water supply according to proxy indicators used both in national and international statistics. These indicators both reflect and perpetuate a focus on physical infrastructure at the expense of the people and processes that that they are intended to serve. The retrenchment of the state in water governance, encouraged through global policy and mirrored in Mexican legislation, has resulted in insufficient support for institutions and capacity building. The case study of Tlamacazapa suggests that the cost of such misguided policy, both in Mexico and globally, will be great both in terms of wasted infrastructure investments and human lives.

Preface

Approval for this research was granted through the UBC Behavioral Research Ethics Board. An ethics review submission was submitted in July 2008 (with appendices in August, 2008) and was granted with certificate number H-08-0512.

A substantial amount of the work for this thesis, in particular data collection, was completed by the author prior to enrollment in the School of Community and Regional Planning at the University of British Columbia. The data collection began in January 2007 when the researcher was a volunteer working on the water and sanitation program with the organization *Atzin* in Tlamacazapa, Mexico.

A number of *Atzin* volunteers contributed substantially to the data collection effort, including: Susan Smith, Xochitl Ramirez Velasco, Paul Klassen and Robin Lynch. A number of Tlamacazapa residents also contributed, but their names are not mentioned so as to protect their anonymity.

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Others also spent countless hours tracking down calendars across Tlama's steep hills: Xochitl Ramirez Velasco, Paul Klassen and Robin Lynch - thank you for your help, patience and friendship.

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1 Introduction

This thesis presents a descriptive case study in a context of water scarcity in Tlamacazapa, an Indigenous community in the arid mountains of Guerrero, Mexico, exploring the questions,

> *In Tlamacazapa, which factors influence a family's access to water and what implications do water access, quantity and cost entail in terms of a family's security?*
>
> *How can an understanding of these factors inform decision-making locally, nationally and globally?*

The study utilizes multiple methods to document twenty Tlamacazapa households' experiences of obtaining and using water. A two-year survey structured as a monthly calendar was completed by households and close-ended interviews clarified and enhanced the calendar data. Comparison of household baseline data with community census data demonstrates the extent to which the participating households are representative of the broader community. Through a review and discussion of pertinent literature, I explore the global policy debate surrounding water pricing and governance to infer how this policy framework may be influencing Tlamacazapa and to draw out context specific lessons about how these policies are experienced on the ground.

The resulting knowledge is useful for strategic planning locally in collaboration with a non-governmental organization called *Atzin Desarrollo Communitario* [1] and informs the water policy debate more broadly.

This research examines in detail how residents of a Nahua town in Mexico access, store and use water. The intent is to both explore and better understand challenges to water access and to then extrapolate knowledge of this experience to inform both local and broader (federal and global) policies on water governance.

1.1 Background

In order to establish the background for this research it is important to understand in some detail the local, regional, federal and global context in which the case study is

[1] Previously, Caminamos Juntos para Salud y Desarrollo, Associacion Civil, referred to from here forward as *Atzin*, for short.

situated. I therefore briefly present some of the global policy trends that influence how water is governed within Mexico, specific institutions at the federal and state levels in Mexico that are responsible for governance of water, and then establish the context of the town of Tlamacazapa itself, where this case study is situated (see Figure 1.1).

FIGURE 1.1 MAP SHOWING LOCATION OF THE CASE STUDY: TLAMACAZAPA, GUERRERO, MEXICO

1.1.1 Access to water and implications for health and well-being

One billion people lack access to safe drinking water and 2.4 billion to adequate sanitation (United Nations 2000a). Globally, an estimated 1.87 million children die each year from diarrhea, which accounts for 19% of total child deaths (Boschi-Pinto et al. 2008). Risk factors associated with this alarming rate of child mortality include unhygienic and unsafe environments, ingestion of unsafe water, insufficient water available for adequate hygiene and a lack of access to sanitation (Black et al. 2003).

Access to water and sanitation was among the eight goals set by the United Nations in 2000 as part of an ambitious agenda to reduce world-wide poverty by 2015 – an agenda

that has become widely known as the Millennium Development Goals. Millennium Development Goal #7 *Ensure environmental sustainability* includes the target of reducing by half the proportion of people without sustainable access to safe drinking water, by 2015 (United Nations, 2000a and b). The primary indicator for this target is defined as being the ratio of people with access to an improved water source (United Nations, 2003). *Improved* is further defined as being water originating from a household connection, public standpipe, borehole, protected dug well, protected spring or rainwater collection. Sources not included as improved are: unprotected wells, unprotected springs, vendor-provided water, bottled water and tanker truck-provided water.

The United Nations Development Group explicitly recognizes that these sources are proxy indicators of water access and quality because specific data about quality, cost, distance and consistency of availability are difficult and expensive to access and monitor (UN, 2003, p65). Indeed, a substantial body of work has shown improved health outcomes correlated with water supply interventions (Fink et al, 2011, Fewtrell et al., 2007); however, these improved outcomes are often minimal or not statistically significant when improvements in water quality and water supply are isolated from corresponding improvements in sanitation (Esrey 1986, 1991 and 1996).

Differences in interpreting vague concepts of “safe” and “improved” have important implications. Cost estimates from eleven reports written by international organizations, including, among others, the World Bank and the World Health Organization, for implementing Millennium Development Goal number 7 ranged from nine billion to thirty billion USD per year (Toubkiss, 2006). The vast differences in ranges appear to be due largely to differing interpretations of the term “safe,” which is not well defined by the proxy indicator suggested by the United Nations. Oversimplification of the concept of access without appropriate attention to cost, consistency of access, governance and management, water quality and infrastructure maintenance are likely to underestimate true costs of attaining clean water and paint an overly optimistic picture of the degree to which water access has improved (OECD, 2006; Toubkiss, 2006; Satterthwaite, 2003; Sullivan et al., 2003). The spatial scope of monitoring is also important because water access can only be experienced on a local scale and on-the ground realities can differ vastly between two communities only a number of kilometres apart (Sullivan et al., 2003). The hardships and risks borne by individual communities can therefore be lost in the averaging process.

The 2011 Millennium Development Goals Report emphasizes that the world is on track to “surpass the drinking water target,” (United Nations, 2011) though it does offer the sobering reminder that one in ten people could still be without access in 2015 even if the goal is achieved. Critics of the methodology of monitoring the goal point out that the ratio of people without access to safe water is much higher. Painting an inaccurate and overly optimistic picture, they argue, entails consequence because many countries and development organizations have publicly committed to reaching the targets and have even modified their internal operating systems and targets in order to do so (Satterthwaite, 2003, OECD, 2006). By focusing on inaccurate proxies and creating an emphasis that is based entirely on infrastructure at the expense of people and systems

at a local scale (Smith and Martin, 2005), the Millennium Development Goals could, in fact, be leading governments and non-governmental organizations astray.

The inaccuracies that may be hidden within these proxies have been shown to be grossly misleading. One study that created epidemiological models using data from the literature on three common water-borne pathogens in Africa found that a single day of interruption after six months of fully functional treated water delivery would increase risk of illness from enterotoxigenic *E.coli* in children under three years of age by 12.75% (Hunter et al. 2009). The authors emphasized that correlations between health indicators and improvements in water provision documented in the literature (for instance, Fink et al. 2011, Fewtrell et al. 2005) may not be as strong as anticipated because inconsistent delivery of clean water would confound the results.

Some limited work has examined additional ways of monitoring and quantifying water access, though these pieces have not been incorporated into formal indicators and monitoring initiatives of the Millennium Development Goals. Various academics, practitioners and institutions have proposed thresholds of acceptable access based on water quantity, cost, distance to source and water quality as well as indices amalgamating these components. Each component is explored here in more detail.

Water quantity

Using documented evidence about how water quantity can impact health, Peter Gleick (1998) proposed a threshold of 50 litres per person per day, which is generous for a minimum requirement when compared to other thresholds proposed in the literature. This amount, he purported, would provide 20 litres for basic sanitation and hygiene, 5 litres for drinking water, 15 litres for bathing and 10 litres for cooking. The World Health Organization published a range of levels of service equating these to access measures, the degree to which basic needs are met and the resulting health concern (Howard and Bertram, 2003). The authors defined a service level of *no access* as sources providing an amount less than five litres per person per day, located a distance greater than one kilometre from the household and / or requiring more than thirty minutes total collection time. With this level of service, they presumed that consumption needs could not be met and that adequate hygiene would not be possible unless bathing and laundry were practiced at source. They rated this level of service as constituting a *very high* health concern. *Basic access* was presumed to provide quantities in excess of 20 litres per person per day, be between 100 and 1000 metres in distance from the household and / or require between five and thirty minutes total collection time. Howard and Bartram assessed that this level of service would likely assure consumption and basic hand-washing and food hygiene but that there would likely be insufficient water for laundry and bathing unless these activities were carried out at the water source. They considered a basic access level of service to constitute a *high* level of health concern. *Intermediate access* the authors defined as providing an average quantity of about 50 litres per person per day, within 100 metres or five minutes of the household. With this level, they

presumed that consumption, personal hygiene, food hygiene and laundry and bathing at the household could all be assured with a *low* health risk. *Optimal access* however, would require water supplied through multiple taps continuously with all consumption and hygiene needs met and a *very low* health concern level.

Important work in documenting water access and impacts on daily lives of residents has occurred in South Africa. The South Africa National Water Act (NWA) includes within it a basic human needs reserve defined as providing for "the essential needs of individuals served by the water resource in question and includes water for drinking, for food preparation and for personal hygiene." This reserve was further defined as 25 litres of water per person per day within 200m of the home at a 98% assurance of supply at a flow rate of 10 litres per second of potable quality. In 2000, the Free Basic Water Provision policy was introduced that made the first 6,000 litres per month free to all households in the Republic of South Africa estimated from a household size of eight people consuming twenty-five litres per person per day (Hope, 2006).

South Africa based this amount on minimum volumes suggested by several international development organizations, which appear to have been poorly substantiated (Smith, 2010). In a careful analysis of access, use and payment in one South African community, Smith (2010) found that the 25 litres per person per day threshold appeared to be woefully inadequate for households to cover their basic needs, that is, consumption and basic hygiene and sanitation. She described the general state of households restricted from exceeding the 6,000 litre per month threshold:

> *Water was recycled until the smell could no longer be tolerated. Homes smelt – the smell of urine waiting for the cistern to fill seeped through the home. Water could not be used freely. That is, at the time it was needed, in sufficient volumes required and in the mode preferred. Every water activity had to be consciously thought about, calculated, planned and timed*
>
> p 601.

Whether the 25 litres per person per day benchmark is actually an adequate amount for positive public health outcomes has been questioned by several authors who have tested it empirically on the ground and, indeed, little documentation is available in the peer-reviewed literature to support that this volume is sufficient to meet basic needs.

Water Cost

Various income thresholds have also been proposed in the literature as a maximum acceptable percentage of household income expended on water. Water and wastewater expenditures not to exceed 2% (Asian Development Bank, 2003) or 3-5% (WHO, 2004; OECD, 2003; Whittington et al. 1990) of gross household income are commonly

proposed as monetary thresholds. Discussions about appropriate income thresholds vary widely depending on the objective of the question being asked. For instance, a rich collection of literature examines willingness to pay for water in developing countries as a planning tool to determine financial capacity for infrastructure construction and maintenance. These papers show a wide range of willingness to pay ranging from below 2% to as high as 10% of household income. For example, a willingness to pay study conducted in a Southern Haitian village found a mean threshold of 1.7% of household income for public posts and 2.1% for private connections (Whittington et al. 1990). A study in Brazil suggested a mean willingness to pay of 2.3% of reported family income (Briscoe et al 1990). In five small Moroccan cities, a similar study reported willingness to pay ranging from 7% to 10% of household income (McPhail, 1993).

Another body of work addresses an entirely different question – what can poor households safely pay without increasing their vulnerability or decreasing positive health outcomes? Most of these discussions have been qualitative in nature and do not provide specific thresholds of comparison. Rather, several authors argue that willingness to pay for a resource that is essential to life and that is often provided within natural monopolies is not a useful indicator of a poor household's ability to make that payment. For instance, in her study examining connections of poor households in Jakarta, Indonesia, Bakker (2007b) emphasizes that the poor are price takers rather than price setters with private vendors operating within a spatial monopoly. A number of researchers have addressed this anomaly by differentiating between households' willingness to pay and their ability to pay (Smith, 2010; OECD, 2003), although again this tends to be a theoretical dichotomy rather than a quantitatively defined one.

It is evident that household payments for water vary greatly both between countries and within countries. Data from England, Wales and Scotland dating from 2002 to 2003 documents that households pay an average of 1.3% of household income on water and wastewater services in Scotland and 1.1% in England and Wales. The range of payments is hidden in the averaging process, however; the lowest income decile pays 3.1% in Scotland and 3.0% in England and Wales (Sawkins and Dickie, 2005).

In a study examining water affordability in a number of transition countries in South Eastern Europe, Central Eastern Europe and the Baltic States, and the Commonwealth of Independent States, the authors suggest that five percent of net household income is a roughly appropriate threshold based on the information in the literature, although they also critique the paucity of information available to consider what is affordable for a household (Frankhauser and Tepic, 2007). In the three regions that they examined, they found that households in all countries spend less than 5% on water and waste services, on average. Average proportions of net household incomes in countries in Central Eastern Europe and the Baltic States range between 0.8% and 4.1% with an average of 1.6%. Average proportions of net household incomes in countries in South Eastern Europe range from 0.7% to 3.1% with an average of 1.5%. In countries in the Commonwealth of Independent States, average household expenditures for water average 1.0% and range between 0.0% and 3.5%. The proportion of household income expended for water and wastewater services increases when only the lowest income

decile is examined; averages increase to 2.3% in Central Eastern Europe and the Baltic States, to 1.9% in South Eastern Europe and to 1.2% in the Commonwealth of Independent States.

A review of pricing policies in member countries of the Organization for Economic Cooperation and Development (OECD) presented estimates of average household net income ratio spent on water and wastewater services from all OECD countries for one year between 1997 and 2000. The figures range from 0.5% (in the US) to 2.4% (in Poland). Vast ranges and inequities, they point out, can be hidden in country-wide averages. Even when ratios by categories of income deciles are provided, the cases for the most poor are still often not explicit. When breaking up the lowest income decile in England and Wales, for example, it is seen that the lowest 10% of income earners spend 4.1% of their income on water and waste services, the lowest 5% of earners spend 5.6, the lowest 2% spend 8% of income and the lowest 1% spends 10.5% of income on water and waste services (OECD, 2003).

Another evident trend is that poor households not only pay for more water in a *relative* sense (as a proportion of their household income) but also in an *absolute* sense in a price per unit (Gulyani et al, 2005; Bakker, 2007b).

The clear challenge is that the amount of money needed to provide adequate water services in poor areas often outstrips both ability and willingness to pay. Elucidating appropriate tariffs and subsidies to simultaneously meet objectives of financial sustainability, equity, health and environmental conservation remains a challenge and has been identified as a sector-wide research priority (Tortajada 2010).

Distance to Water

It is also recognized that distance to the water source is an important indicator of water access as decreased disease burden and other improved health outcomes have been documented when water sources are more proximate to households or located on household properties (Esrey et al. 1991). In their simplified grid assessing water source improvements, Howard and Bartram (2003) suggest that the lowest grouping of water sources, which they define as essentially being *no access*, are often at distances greater than 1,000 metres from dwelling place or take longer than thirty minutes to retrieve. *Basic access,* they suggest, constitutes sources located between 100 and 1000m, from which water can be retrieved in fewer than 30 minutes. *Intermediate access* includes sources located within 100 metres or 5 minutes of the dwelling place. *Optimal access* would be multiple taps located on site with continuous supply. The emphasis on distance *or* time is important as it is often the case that the trip to the water source is not nearly as time consuming as the wait at the source because of line-ups and low water pressure resulting in slow flow rates (Satterthwaite, 2003; Sullivan et al. 2003).

Water quality

Thresholds are, of course, widely available for water quality: the World Health Organization provides recommended limits (WHO, 2011) and countries, including Mexico (Secretaría de Salud, 2000), typically legislate drinking water quality guidelines, though adequate monitoring is costly and hence implementation practices vary enormously. Importantly for the purposes of this case study, the *Mexican Law for Environmental health: Water for Human Consumption*, specifies that municipal operators are responsible for ensuring consistent absence of fecal coliforms and *E.coli* as well as arsenic concentrations less than 25μg per litre of water and lead concentrations less than 10μg per litre of water. These concentrations are less conservative than WHO guidelines, which specify maximum acceptable concentrations of 10 μg per litre water for both lead and arsenic.

Integrated water access indices

More complex indices incorporating multiple indicators have also been proposed. The water poverty index (Sullivan et al., 2003) is one such example, using five broad indicators: resources, access, capacity, use and environment. Resources include a technical hydrological and / or hydrogeological assessment of available resources, the consistency of its availability and the quality of the water available. Access includes consideration of the type of supply, conflicts over use, access to sanitation, gender issues, time spent in collecting water and access to irrigation. Capacity recognizes that other poverty indicators will influence the ability of a community to maintain a water system including wealth, income, infant mortality, education, existence of water user associations and morbidity rates. Use as an indicator includes more detailed investigations into water availability for various purposes and includes domestic water consumption rate, water used for agricultural, livestock and industrial purposes. Finally, environment as an indicator recognizes that water access can only be sustainable if it does not adversely impact the environment and so recommends proxies such as people's use of natural resources, crop losses and land erosion.

Several authors working from grounded case studies have concluded that if public health benefits are to be realized with regards to improvements in water and sanitation, improvements must not only consider infrastructure but must also implement and monitor improvements in consistency of delivery, quality, management, monitoring and institutional capacity (see, for example, Massoud et al, 2010; Budds and McGranahan, 2003; Budds, 2004; Bakker, 2007b; Wilder and Romero Lankao, 2006). Infrastructure without the people and capacity to effectively administer the service, they argue, will certainly not achieve its intended goals.

1.1.2 Global water governance policies

Current literature about water governance issues in developing countries focuses on decentralized authorities and market mechanisms to increase efficiencies and to protect the environment. Increasingly, however, researchers are critical of the dominant paradigm, suggesting that much of the literature has been ideologically driven and is not supported by empirical evidence. The broader policy context in which this Mexican case study is situated is considered.

Global policy trends

Water provision was once discussed in terms of engineering approaches and assumed a degree of internal cross-sector subsidies as well as international aid in the case of the world's poorest countries. The dominant rhetoric has shifted to emphasizing that in fact, there is a demonstrated willingness and ability to pay among the world's poorest and that this source of financing can improve water access for the poor. Although policy shifts in this direction are difficult to pinpoint, an important benchmark was the Dublin Principles that emerged from the 1992 International Conference on Water and the Environment; in particular, the fourth principle:

> *Water has an economic value in all its competing uses and should be recognized as an economic good. Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources*[2]*.*

A second significant policy agreement marking this policy trajectory was the General Agreement on Trade in Services (GATS) established in 1995 during the Uruguay Round of the World Trade Organization, when member countries negotiated liberalization of a number of service sectors that had previously fallen within the jurisdiction of the State (Mehta and la Cour Madsen, 2005).

These global policy trends are well documented. In a World Bank policy paper analyzing cross-country developments in policy and institutional governance, the authors identified four dominant commonalities, including (1) a shift from "development to allocation", (2)

[2] The Dublin Statement on Water and Sustainable Development is available on-line through the World Meteorological Organization website: http://www/wmo.int/pages/prog/hwp/documents/english/icwedece.html

an emphasis on decentralization and privatization, (3) an approach that integrates water management across sectors and (4) “an increased focus on economic viability and physical sustainability" (Dinar and Saleth, 1999, p35). While there is general consensus about the direction of institutional and legal change, there is much less clarity and agreement about the causes for these changes and their definitions, desirability and implications.

Market Mechanisms and Water Scarcity

Explicit in the global policy trend is an emphasis on full-cost accounting, the principle that water should be paid for at its full value by those who use it. Proponents of such market mechanisms point out that to date the poor have been largely excluded from improvements in water supply and that, in fact, historic tendencies for large-scale subsidization of the sector have tended to benefit the rich, at the expense of the poor, rather than actually increasing access to marginalized populations. Cost recovery is thus needed to expand and maintain the infrastructure (De Azevedo and Baltar, 2005).

Such water policy also has underpinnings in environmental sustainability. It is argued that as water is a finite resource that is spatially limited and vulnerable to environmental degradation, economic pricing is the most efficient means by which water can be preserved and conserved. In the face of scarcity, the only way to allocate consumptive rights to their most efficient use is by pricing water accordingly so that buyers can be responsive to price signals (De Azevedo and Baltar, 2005).

Decentralization

Full-cost accounting is not the only principle underpinning the modern dominant water policies. Global policy trends are also moving towards widespread decentralization of water resource management (Dinar and Saleth, 1999; Salazar, 1997a). Again, a number of principles underlie this policy shift, most notably, that participation is key to good governance and adequate provision, and that the only way to govern water allocations according to its finite characteristics is to do so at the spatial unit at which it is available – the water basin unit. By decentralizing powers, proponents argue, those most impacted by water use within a region can negotiate such that finite water is allocated efficiently to the most important uses.

Decentralization is best understood as three distinct though sometimes overlapping types: (1) administrative, in which functions of delivering certain services once delivered by a central state are deconcentrated to lower levels of government; (2) fiscal, in which lower levels of government are given the authority to allocate financial resources and in some cases to collect resources through taxation or fees; and (3) political decentralization in which actual powers and authorities are transferred to lower levels of government (Robinson, 2007a).

A number of assumptions underlie the push for decentralization. First, that the level of government attaining the new responsibilities or powers has sufficient administrative capacity to deliver the decentralized service (Robinson, 2007b). Secondly, that local governments are more responsive to and therefore more accountable to citizens than higher levels of government. Thirdly, local governments, by being more proximate to the citizens being served, will be able to make more appropriate and therefore more efficient decisions in allocating resources to local preferences and needs (Robinson, 2007a). Fourthly, that sufficient financial resources are available at the local level to support the provision of decentralized service (Robinson, 2007a) and finally, that decentralization will result in increased user participation thus resulting in strengthening local capacity and agency (ibid).

Critiques

Some authors have harshly criticized these policy directions, labeling them as neoliberal (Bond, 2006; Goldman, 2007) and arguing that treating water as a commodity will inevitably put it in the control of the richest with the poor being further excluded. Priorities, some argue, will be focused on efficiency and profit maximization with the exclusion of universal access (Mehta, 2000). The use of market mechanisms in particular is often dichotomized as being irreconcilable with the designation of water as a human right. Other critics go so far as to say that the hegemonic policy direction may use environmental conservation and pro-poor policy underpinnings as a guise, but in fact, decentralization in tandem with the introduction of market mechanisms is explicitly intended to open the door to privatization of water delivery for the benefit of multi-national corporations rather than any other segment of the population (Goldman, 2007). These critics suggest that a powerful group of international donor elites driven largely by World Bank policy has created a self-referential impression of consensus (Goldman, 2007; Mehta and Mirosal Canal, 2004). Indeed, trends towards increased privatization in the water sector have been evident with 93 countries having partially privatized water or waste water services worldwide, more than 65% of which were developing countries (Brubaker, 2001). Loans issued by the International Monetary Fund have also carried explicit conditions requiring the creation of legislative and institutional frameworks that prioritize privatization or full cost recovery (Mehta, 2005; Goldman, 2007; Wilder and Romero Lankao, 2006).

The argument that market mechanisms are necessary to incent conservation is made through a strong rhetoric that presents water scarcity as being universal and inescapable, whereas many point out that water distribution needs to be considered with more accurate nuance. Water is spatially and temporally variable, culturally contextual and its distribution and accessibility is influenced by socio-political factors as much as by natural phenomena (Bakker, 2003a; Goldman, 2007; Mehta, 2003; Mehta and Mirosa Canal, 2004).

Several researchers also question the assumptions that underlie policy trends towards decentralization. A number of risks are commonly played out at local levels with fiscal, administrative and political decentralization. Firstly, regional disparities can often be accentuated and perpetuated as the role of upper governments in spreading institutional capacity broadly and implementing regional or national cross-subsidies decreases (Robinson, 2007a). Secondly, proponents of decentralization who claim that local level of governments will often be more responsive and accountable to their citizens often romanticize the community unit and neglect to pay attention to power imbalances, wealth gaps, gender inequalities and other conflict that can at times play out more dramatically at the local level (Mehta and Mirosa Canal, 2004; Mehta, 2000; Robinson, 2007a). The result can often be what is called, elite capture, wherein a small but powerful group of citizens gain control of a public service at the exclusion of the broader community. Thirdly, efforts to decentralize are often stymied by insufficient technical capacity (Conyers, 2007; Robinson 2007a) so that the service cannot be appropriately delivered in spite of good intentions. Gaps in capacity can at times be exacerbated by frequent cultures of senior political appointments in positions that should be technically staffed; the resulting quick turnover leaves a dearth of technical expertise and leadership. Finally, economic efficiencies are not certain; duplication of roles among smaller levels of government can at times have the unintended effect of increasing the size of the public sector with consequent increases in financial risks (Robinson, 2007a). Fourthly, administrative and even political decentralization can, and often does occur, without corresponding financial decentralization, leaving local levels of government ill equipped to resource their new responsibility. In a similar vein, where financial devolution does occur, it is often directed solely at infrastructure without corresponding resources for service delivery, administration and training (Conyers, 2007) and can be allocated in one-off grants that leave little local control nor opportunity for long-term planning (Salazar, 2007). Sharing lessons from Uganda, Conyers writes,

> *the decentralization of funds for the construction of infrastructure without comparable measures to improve operation and maintenance can create as many problems as it solves*
>
> *(2007, p22).*

Given all of the pitfalls associated with decentralization, authors call for, at a minimum, corresponding efforts to strengthen institutional capacity and governance at the local level and corresponding adequate financial resources that realistically take into account the task of capacity-building (Robinson, 2007a and b; Mehta and Mirosa Canol, 2004; Mehta, 2000). They further warn that decentralization should be incremental as capacity and financial resources grow (Robinson, 2007a and b; Conyers, 2007). This facilitation, Conyers opines, is most effective “if provided in a ‘facilitator’ rather than didactic manner” (2007, p27). These slow, arduous approaches have been documented elsewhere by those with experience working on the ground who describe them as being challenging but vital to success (Smith and Marin, 2005).

South Africa provides an interesting example in which the evident need for training and capacity building was recognized but outsourced to private companies with the underlying assumption that the private sector would house more expertise and would be able to pass on the knowledge and training to public administration. A Build, Operate, Train and Transfer (BoTT) scheme was devised for a number of water supply and delivery projects. Bakker and Hemson (2002) present the case study as a compelling example not to privatize, explaining that institutional capacity is needed as much to manage private contracts as it is to publicly deliver the service. She further critiques the private-sector involvement for having undermined local capacity rather than strengthening it: the more likely outcome being that the private sector entrenches itself as a permanent provider rather than a transitional solution.

Water as a human right

A related body of literature has argued for the explicit declaration of water as a human right. Whereas, many have argued that water is implicitly included as a human right (see, for instance, Gleick, 1996, 1998 and 2007) international acceptance of this declaration has come slowly and only in tandem with caveats that emphasize that this right comes with an associated cost. For instance, the fourth Dublin Principle cited previously recognizes water as right while simultaneously declaring that this right exists as access "at an affordable price." Those who would like to see water explicitly and unequivocally declared a human right, allege that defining water as a human right will set a strong foundation for subsequent advocacy work including catalyzing discussions to raise public awareness, identifying appropriate benchmarks and thresholds of access, setting priorities for governments and holding governments accountable (Al Jayyousi, 2007; Mehta, 2005).

Setting *water as a right* and *water as a commodity* in opposition to each other is neither accurate nor constructive (Bakker, 2007a). Efforts have been made to tease apart this false dichotomy and to create a more nuanced discussion about possible forms of water governance and their associated strengths and weaknesses.

Towards a more nuanced discussion

Bakker (2001, 2003a 2005, 2007a) has challenged these ideological simplifications and has proposed more detailed and constructive differentiations of governance options, more accurately describing a range of delivery options in which various components of the infrastructure itself or the delivery of water is either priced, outsourced or out-right sold to a private entity. She further emphasizes that nothing in the rationale for privatization explicitly precludes human rights and, in fact, privatization can be proposed as a method to ensure that the human right to water is achieved (Bakker 2007a). Those in opposition to the concepts of treating water as a commodity or to loosening state control over its delivery would do better to use the language of the commons, Bakker

argues, which is a more accurate antonym to the word *commodity.* Furthermore, many changes in governance that might be supported by those preferring to see water treated as a commons, could also be supported by those favouring privatized resource management. Decentralization, for instance, can be favoured for its possibilities in increasing local participation but it can also be an opportunity for loosened state control, which would increase possibilities for privatization within the sector (Bakker, 2007a).

Increased nuances are needed throughout the debate to facilitate a clear discussion of what objectives are being sought and to evaluate to what extent these are being achieved. Those arguing for treatment of water as a commons can often oversimplify the role of participation, romanticizing the local context and seeing a local community as a homogenous, unified unit (Mehta, 2011; Bakker, 2007a) when in fact this assumption could easily obscure conflict, inequities and power struggles that are experienced on the ground.

A constructive and accurate discussion of privatization requires careful definitions of associated words and distinctions between the different types of policies and economic models that can be used to govern water: privatization, commercialization; marketization and commodification all have different meanings and encounter unique challenges when put into practice (Bakker, 2001, 2003b, 2005, 2007a). Privatization refers to a distribution system in which actual ownership and /or management of a water system has been turned over to private business. In contrast, commercialization refers to economic regulation in which market-based instruments are used to attain efficiency and sustainability goals. Simply put, privatization could be defined as organizational change and commercialization could be defined as institutional change (Bakker, 2003b). Bakker (2005) emphasizes that in cases where commercialization of water utilities has occurred, the public become *customers* rather than *citizens* and the provision of water is demand-led rather than supply-led. Commercialization thus refers to an ethos and a particular mode of governance, rather than a particular ownership model. Depending on the model chosen, commercialization can occur without privatization. Similarly, commodification refers simply to the act of pricing water, which can still be done within a state-run utility. Privatization and commercialization can also occur without commodification as Bakker (2001, 2003b, 2005) illustrated was the case in England and Wales, where ownership was privatized and market-based instruments were used to create proxy competition between service providers but full-cost accounting was never successfully introduced. Citizen resistance to the notion of commodification was too great and the price increases that would have been necessitated for full cost accounting would have created social inequities that were politically unpalatable.

Recognition of these distinctions is important. Although the water as a human right rhetoric has often been set in opposition to policies that could commercialize, commodify or privatize water, most authors recognize that the two objectives are not inherently incompatible. The question is one of governance and not of ownership as, as Al Jayyousi (2007) notes, “governance models and business models are closely interrelated” (p. 335). Firstly, authors have advocated a focus on attributes of good governance as benchmarks for water distribution services and regulation, regardless of

public or private water utility ownership (Bakker et al., 2008; Budds and McGranahan, 2003). There is little empirical evidence, they argue, that either public or private utilities have had more success in connecting the poor to water services but that some common obstacles are shared by both sectors. Among these governance failures are first, those attributable to problems within decision-making mechanisms including: absence of a mechanism by which basic access is guaranteed; lack of a mechanism by which marginalized voices can be included in the decision-making process; an elite dominated culture of governance; and economic disincentives for poor households to connect. Secondly, households themselves may have characteristics that act as obstacles to connecting to a networked supply: lack of property title, insufficient literacy and other skills to access the service; cultural beliefs or perceptions; and inability to pay high up-front connection fees or other challenges associated with the tariff structure (Bakker et al., 2008). These failures, the authors reason, are not necessarily specific to state-run or privately-run utilities but are challenges that any utility will need to address.

Water, an uncooperative commodity?

In spite of the overwhelming speed with which the water sector globally, especially in the European Union and the Global South, has embraced private sector investment, water has a number of characteristics that make it a particularly "uncooperative" commodity (Bakker, 2005) It often functions as a natural monopoly, with a single network of piped systems serving a single public; although, it is important to recognize that in many developing contexts, a number of formal and informal water sources do serve to create a degree of market competition (Bakker, 2007b; Bakker et al., 2008). Water distribution infrastructure is characterized by high fixed or sunken costs which result in non-linear marginal price increases making it difficult to price (Bakker, 2005). Water acts as a public good with a number of externalities that are difficult to include in its full value, just as it is difficult to price environmental externalities into its price (Ibid). Given these characteristics, any privatization of water resources would have to take place within a framework of complex regulation created within strong state-run institutions.

In her detailed case studies of the privatization of water service delivery in England and Wales, Bakker uncovers a number of contradictions inherent in the nature of water being treated as a commodity (2003b). For instance, governments and the private sector seem unable to reconcile the divide between equity and efficiency. While regulators established profit caps on private sector earnings in order to ensure political acceptability and citizen equity, they concurrently reduced efficiency incentives to business. Similarly, water is a remarkably inelastic commodity. Little growth potential exists in a mature market, leaving investors to seek growth elsewhere. With non-linear marginal costs characterized by periodic significant sunken costs into infrastructure, the private sector may have little incentive for continued investment in the long-term. Indeed, Bakker (2003b) has documented speculation that private sector retraction from the market could be because of the financial risk associated with aging infrastructure.

These challenges are evident in cases in OECD countries, where the network had fully penetrated the market thanks to significant state subsidies prior to service delivery being privatized. If these challenges have not been resolved in cases with much stronger financial and institutional capacity, how well could privatization fare in the face of acute poverty? In an analysis of examples from Ghana, South Africa, India, Niger, and Brazil, the authors conclude that the poor do not constitute a profitable market. “This is both because the poor cannot afford to cover the real costs entailed in water provision and because they don’t consume enough either to cover costs or make a profit” they explain (Mehta with Mirosa Canal, 2004:28). Indeed, even private companies have begun to remark on the limitations of private sector delivery to poor areas (Bakker, 2007b) with some corporations going so far as to suggest that expansion into poorer neighbourhoods will inevitably require government subsidies distributed to the private sector interests (Goldman, 2007). Certainly, little documentation has suggested that the private sector has demonstrated much success in expanding networks to rural or poor urban areas, where network connection often exists in “archipelagos” excluding the seas of poor citizens between islands of connected wealth (Bakker, 2003a). Many researchers have concluded that it is simply not profitable for private interests to connect the poor (Conyers, 2007; Bakker, 2003a and b).

While the nuanced discussions of governance models do not provide quick answers to what constitutes the most effective models, it does warn against broad paintbrushing and leaping to conclusions of causality that cannot be substantiated (Bakker et al. 2008; Bakker, 2005). Instead, authors call for more detailed case studies that examine how water access is experienced on the ground, including the specifics of the governance models being used and how the individual user experiences water. The more nuanced discussions will be increasingly needed to bridge what appears to be a monumental gap between the policy dialogue and the way that water access is in fact experienced by the poor on the ground.

1.1.3 Mexican water governance

Reported water coverage throughout Mexico has increased dramatically during the past thirty years. Whereas in 1980, only 50% of Mexico's population was considered to have water infrastructure coverage this increased to 78.2% by the end of the decade and was as high as 85% by 1994 (Ozuna and Gomez, 1998). Reported coverage continues to increase with 2005 coverage estimated at 89.2% (CONAGUA, 2011b).

It is widely recognized that Mexican water policy has been following a trajectory towards decentralization for many decades, particularly following its economic crisis in the 1980s, which resulted in the government accepting significant restructuring loans from the International Monetary Fund (IMF). It is worth noting, however, that initiatives attempting to decentralize authority over water were introduced as early as the 1940s with the creation of Mexico's River Basin Commissions from 1946 to 1986. These Commissions were established to leverage water to encourage integrated development including diverse sectors, but with particular attention to agriculture. These commissions had relatively short (six year) planning horizons, corresponding to presidential terms and resulting changes to federal policies. They were always tightly linked to agriculture production and largely concerned with the development of large infrastructure projects such as irrigation projects and dams, including consequent resettlement projects; however, their influence also extended to the local level with provision of municipal infrastructure (Tortejada and Contreras-Moreno, 2006).

In 1983, constitutional changes in article 115 devolved responsibility to municipalities for a number of public services, which included water and sewage provision (Rowland 1998); however, states largely ignored this decentralized authority and instead created autonomous state utilities (Ozuna and Gomez, 1998; Guerrero Reynoso, 2000; Andwater and Ozuna, 2002).

Following the 1983 constitutional amendment, policies favouring decentralization of water governance have been sequential and consistent in direction, owing their success (to the degree that they have been successful) probably to increased political pluralism and international policy pressures, including directions introduced with IMF loans. World Bank financing in the late 1980s was contingent largely on development of legislation and policy that would allow decentralized authority of Mexico's National Water Resources, as well as water pricing policies developed according to full-cost accounting principles (Wilder and Romero Lankao, 2006).

While external influence appears to have been significant in directing the development of water governance legislation and resulting policy, internal pressures also contributed to decisions at this time. Prior to the 1980s, Mexico was ruled under a single-party system dominated by the PRI[3]. In 1987, a faction of the ruling party broke off to form a coalition called the *Frente Democrático Nacional*, which would form the basis for later left-wing

[3] Political party called 'Institutional Revolutionary Party' or PRI for short for its acronym in Spanish: 'Partido Revolucionario Institucional.'

political parties. In 1995, when Zedillo was elected, the opposition party won the majority of seats such that the unilateral decision-making powers of PRI presidents were sharply curtailed (Salazar, 2007). With growing political pluralism, policy trends continued to support decentralized powers.

Faced with unrest and growing opposition, President Salinas declared an end to the single-party system when he took office in 1998 and he widely communicated that decentralization would be one of the central facets of the new government's approach. The trend would continue with subsequent governments.

Nonetheless, some critics have interpreted these policies more as thinly veiled political gestures than as genuine intentions to increase authorities and capacities at subnational levels of government. The Salinas government developed a social welfare program called *Solidarity* that was purportedly intended to lessen the blow of some of the impacts of new fiscal austerity and that provided for the deconcentration of some federal departments through regional offices. Those skeptical of the program noted that the program altogether bypassed state and municipal governments, so that rather than contributing to a truly decentralized governance system, *Solidarity* actually created federal bodies at local levels (Salazar, 2007). Even stronger critiques have gone as far as to suggest that the true motivation for *Solidarity* was to displace blame for the impacts of spending cuts to subnational governments (Rowland, 1998).

Through both internal and external pressures, Mexico's development of decentralized water legislation and pursuant policy began. In 1989 the National Water Committee (CONAGUA for its acronym in Spanish – *Comite Nacional del Agua)* was established within the branch of the federal government responsible for Agriculture and Natural Resources. CONAGUA's authority and responsibility was laid out in the 1992 National Water Law (*Ley de Agua Nacional – LAN)*. The LAN included three principle factors, which would allow for the development of decentralized water management and full–cost accounting of service provision. Firstly, responsibility for municipal water and sanitation service was devolved to municipalities in spite of state resistance to the 1989 constitutional provision that first laid out this responsibility. Secondly, the LAN established an autonomous regulator and thirdly, the LAN provided utilities with the ability to cut service of water supply in cases of non-payment (Andwater and Ozuna, 2001). The law also included provisions for public participation by creating the authority and structure of River Basin Councils (Scott and Banister, 2008; Ley de Aguas Nacionales, 1992).

A further development that represented an abrupt change to previous water sector policy was the relocation during the 1990s of CONAGUA from the Ministry of Agriculture and Environment to a newly established Ministry of Environmental and Natural Resources (SEMARNAT for its acronym in Spanish – Secretaría del Medio Ambiente et de los Rescursos Naturales). This reorganization was explicitly intended to revise previous policy trajectories that favoured one commercial sector (agriculture) over others and to continue to shift attitudes, as Dinar and Saleth (1999) describe, to seeing water as a "*resource"* rather than a "*usufruct".*

The LAN was modified in1994 to foster participation and increased decentralization through the creation of River Basin Organizations, which were expected to be "autonomous units for technical, administrative and legal purposes" (Tortajada and Contereras-Moreno, 2005:123).

In 2004, further amendments to the National Water law were made with the explicit intention of increasing user participation and promoting decentralization. The amendments created the possibility for watershed level governance structures, which would integrate representation from municipal, regional and federal jurisdictions (Ley de Aguas Nacionales, 2004, Article 5.1). The changes would "foster water users and individual participation in developing and administrating hydrological works and services," (Ley de Aguas Nacionales, 2004, Article 5.2, author's translation) and would "favour the decentralization of water resource management in accordance with the existing legal framework" (Ley de Aguas Nacionales, 2004, Article 5.3, author's translation). This represented a significant convergence from previous centralized policy (Wilder and Romero Lankao, 2006).

The 2004 amendment to the LAN also decentralized CONAGUA into thirteen regional headquarters; however, the federal government later decided to maintain jurisdiction of CONAGUA within the federal ministry (SEMARNAT) with the regional headquarters acting as decentralized branches (Wilder, 2006). Further, neither the regional branches nor the river basin Councils have been granted fiscal autonomy as they are required to pay water user fees to the federal government (Scott and Banister, 2008). A resounding sentiment among authors familiar with Mexico's decentralized bodies of water governance is that they lack the resources and autonomy to function effectively. As Scott and Banister (2008, p68) note,

> *Water user fees that fell short of formal water rights were to be paid by municipalities to the federal government, but local water boards have such small budgets that paying direct costs for staff salaries, equipment etc. proved difficult, a situation that continues to plague municipal water management in Mexico.*

Regional authorities have thus fallen short of their intended role in most documented cases, being unable to fully enact their authorities. In others, they have all together failed to materialize. In fact, by 2006 only one of twenty-five councils were operational and others lacked even basic structure such as staff, offices, implementable plans, financial support and administrative capacity (Tortajada and Contereras-Moreno, 2005).

If fiscal decentralization is not evident in the case of the River Basin Councils, it nonetheless has occurred generally in terms of federal transfers to subnational levels of government. Prior to 1980, 85% of all public revenue was controlled by the federal government (Salazar, 2007). By 2007, greater than fifty percent of government expenditure was spent at the subnational level (ibid). However, it is important to note that this shift in expenditures was primarily the result of federal transfers; approximately 90% of revenue was still controlled by the federal government (ibid).

Policies and legislation favouring decentralization and market mechanisms are thus widespread throughout Mexico; however, it is evident that there is a great divide between what exists on paper and what exists in practice.

1.1.4 Tlamacazapa, Mexico

Tlamacazapa is an Indigenous community in the arid mountains of central Mexico. The majority of the 6,100 Nahua residents make their living from weaving palm that grows in the surrounding countryside. Socially and economically, the community struggles with severe challenges. Alcoholism among men and resulting domestic violence are prevalent. Tlamacazapa's schools: two kindergartens, two primary schools and one telesecondary[4] school (there is no preparatory or high school equivalent in the community) serve 60% of the community's school-aged children, while 40% are unable to attend because of poverty, school costs and lack of space (Atzin, 2006). Weaving the palm that grows locally into baskets constitutes the community's principle economy. Weaving and selling baskets within the community, weavers will earn less than 10 pesos (1USD) per day, though men frequently leave Tlamacazapa for weeks or months at a time to make better profits in Mexico's beaches and tourist plazas. In 2005, 85% of residents used open-air defecation (Atzin, 2006).

My involvement with the Tlamacazapa community began in September, 2005, through a volunteer placement with the non-profit, non-governmental organization *Atzin*, with intern funding from the Canadian International Development Agency. I worked with *Atzin* from September 2005 until August 2007 based in the organization's office in Cuernavaca, Morelos, but spending approximately half of my time in Tlamacazapa. My role was to coordinate the organization's environment, water and sanitation program that consisted of two primary components. The first was a training construction program involving four to seven male youth and adults in the construction of ecological dry toilets and rainwater catchment tanks. The second component was an on-going in-house research program through which grab samples of the community's water supply – the principle wells and the groundwater from which the tap water is pumped – were taken and sent for analysis once each month. Samples were analyzed for trace metals and nutrients.

Atzin's water and sanitation program in Tlamacazapa was motivated by multiple factors: poor sanitation, inadequate drinking water treatment, limited and costly water access and apparent naturally-occurring contamination of the community's water supplies with elevated levels of bacteria, lead and arsenic. Other trace metal sources were also identified in the community including the dyes that many residents use to colour the palm that is used for weaving baskets, and traditional clay pots when used for cooking. Many

[4] Telesecondary schools are secondary schools in which classes are watched by students on television, broadcast by satellite.

cases of health impacts indicative of metal toxicity have been described and recorded by the organization (*Atzin, in progress)*.

Although the organization had gathered, analyzed and disseminated much information about water *quality* in the community, it was also clear that insufficient water *quantity* and access were issues causing hardship for community members. This had not been empirically recorded and reported and thus became the goal of this project.

Local governance in Tlamacazapa is weak and undemocratic. A community member, to date all male, is elected *Comisario* (Comissioner) to be a representative of Tlamacazapa in the larger neighbouring City of Taxco de Alarcón, which has governing authority over Tlamacazapa. The democratic process is notably weak. Yearly elections of this representative figure occur in a churchyard, with residents standing in a particular corner to indicate the person for whom they would like to vote. Reports of intimidation are commonplace.

In terms of the Water User Associations, Tlamacazapa would fall within the IVth Administrative Region of the River Basin Councils – the Balsas River Basin, which was established in 1999 (Tortajada and Contreras Moreno, 2005) and is depicted in Figure 1.2. At the time of writing, however, no evidence could be found to suggest that the Balsas River Basin Water User Association is active and certainly it had no active role in water governance in Tlamacazapa.

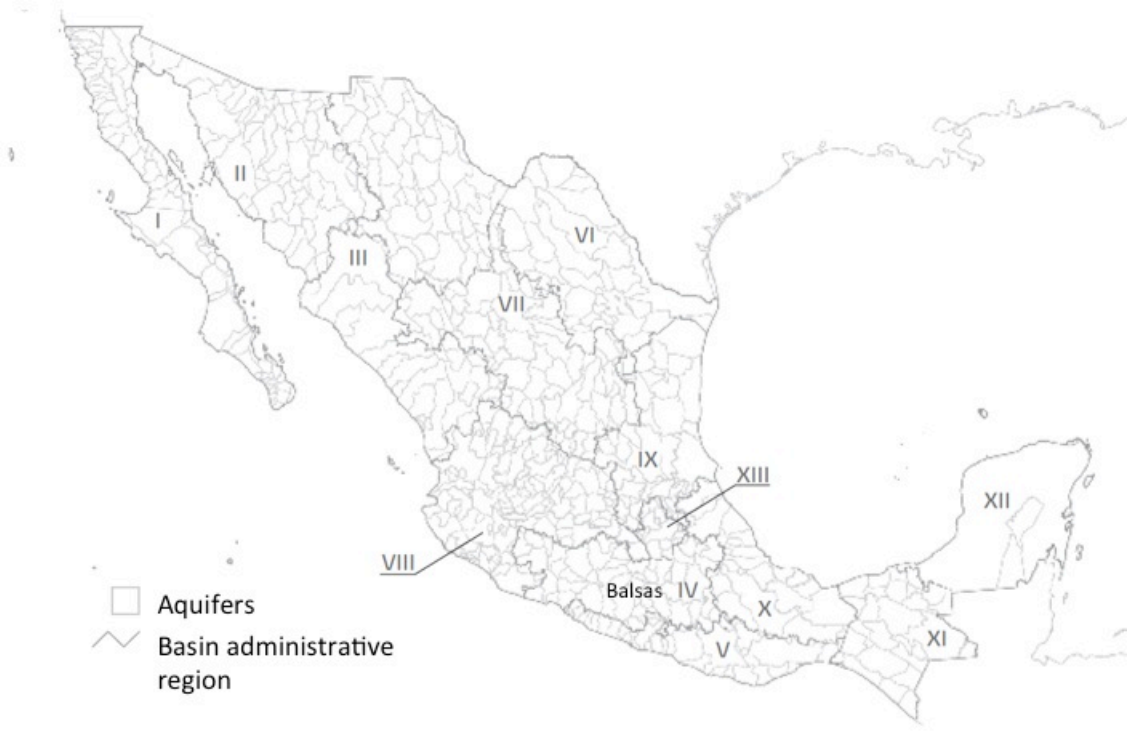

FIGURE 1.2 ADMINISTRATIVE REGIONS OF WATERSHEDS IN MEXICO.

Tlamacazapa is located in Administrative Region IV *Las Balsas*
Source: Modified from CONAGUA, 2011

Water quality in Tlamacazapa, Guerrero Mexico

Water from Tlamacazapa's primary drinking sources – groundwater that can be accessed from the wells or from the pumped tap water – is not potable.

Since 2001, Atzin has been monitoring water quality in five principle groundwater wells as well as the community's tap water source – groundwater pumped from a valley called *Los Sabinos* located 5km from the community (see Figure 1.3). Since 2003, these samples have been taken monthly. There are two sampling sites at *Los Sabinos*, one at the protected well that diverts groundwater toward the intake pipe (referred to as 'capture') and the second at the deposit tank from which groundwater is pumped to distribution tanks in the community (referred to as 'deposit'). Samples are taken according to EPA protocols, preserved with nitric acid to a pH below 2, and sent to an

EPA certified laboratory in the United Sates for analysis[5]. The results have shown intermittent concentrations of lead and arsenic in the groundwater, both from the wells and from the valley where the tap water originates, in excess of drinking water guidelines established by the Mexican government, the World Health Organization and the American Environmental Protection Agency.

Arsenic concentrations were above the WHO guideline of 0.01 mg/l in well #2 for 52% of the measured months (21 months[6]), in well #3 for 86% of the measured months and in well #4 for 81% of the measured months. Arsenic levels were below the WHO guideline for every month sampled in well #1 and well #5 and in both the capture well and deposit tank at *Los Sabinos*. Figure 1.4 illustrates the arsenic concentrations at all sampling sites throughout 2007 and 2008. Arsenic concentrations above WHO guidelines have been measured from all of the wells in previous years. From January 2003 to December 2006, arsenic concentrations exceeded WHO drinking water guidelines in 13% of the samples from Well#1, 62% of the samples from well #2, 87% of the samples from well #3, 69% of the samples from well #4, 11% of the samples from well #5, 18% of the samples from the capture well at *Los Sabinos*, and 10% of the deposit tank at *Los Sabinos*[7].

Lead concentrations exceeded the WHO guideline of 0.01 mg/l guideline in 29% of the 21 samples taken from well #1 and well #2, 5% from well #4, 10% from well #5, and 5% from the deposit tank at *Los Sabinos*. Drinking water guidelines for lead concentrations were not exceeded in any of the samples from well #3 nor from the capture well at *Los Sabinos*. Figure 1.5 illustrates the lead concentrations at all five wells and the two *Los Sabinos* sites in 2007 and 2008. As for the situation with arsenic, lead concentrations exceeding WHO guidelines have also been measured on multiple occasions in water at all sites, including those that did not show levels in excess of guidelines during 2007 and 2008. From 2003 to 2006, lead concentrations exceeded the WHO drinking water guidelines in 11% of samples from well #1, 20% of samples from well #2, 20% of samples from well #3, 16% of samples from well #4, 7% of samples from well #5, 16% of samples from the *Los Sabinos* capture well and 10% of samples from *Los Sabinos* deposit tank.

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[5] All samples were generously analyzed by Groundwater Analytical in Buzzards Bay, Massachusetts.

[6] Results are missing for all sampling locations for the months of June, October and November, 2008. Twenty-one sampling dates are therefore available for 2007 and 2008 for all 5 wells and the two sampling sites at *Los Sabinos.*

[7] In 2003, samples from all sites taken in October, November and December were lost in shipping and duplicates were not available for analysis. Forty-five measurements were available for each of the well sites and for the capture well at *Los Sabinos*. Three additional sample results are missing for the deposit site at *Los Sabinos* because there was no overflow out of the tank during those months and the samplers chose not to hop the fence to take a sample from the tank itself.

Although previous research conducted in collaboration with *Atzin* (Cole, 2004 and Cole et al., 2005) has shown a correlation between high arsenic concentrations and high organic content, the concentration of trace metal contamination cannot be predicted and is not accounted for in Tlamacazapa's current water distribution system. From 2005 to 2010, chlorine was occasionally added to the wells in inconsistent, ad-hoc measurements by the community's state-run health centre. In all, given high risk of fecal contamination with associated pathogen transmission and intermittent concentrations of lead and arsenic in excess of drinking water guidelines, Tlamacazapa's tap water and well water cannot be considered potable. Health impacts indicative of metal toxicity have been documented by Atzin (Atzin, 2012) including hyperpigmentation, nerve damage and sudden flaccid paralysis, among others.

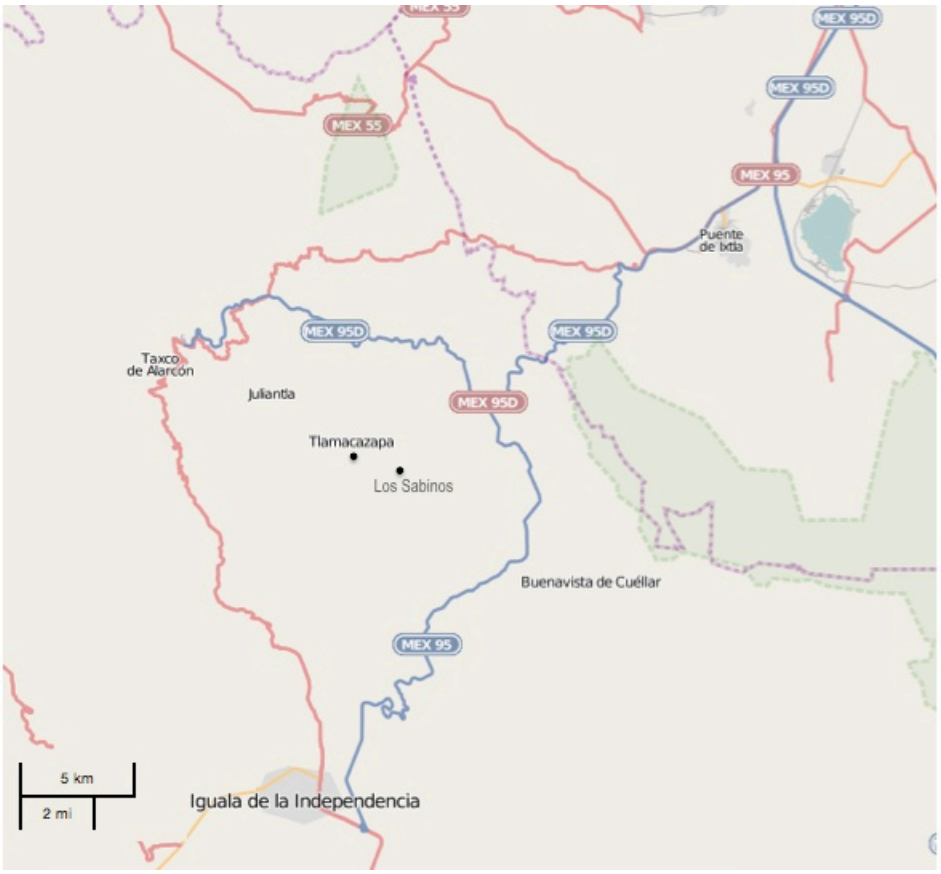

FIGURE 1.3 TLAMACAZAPA IN RELATION TO THE MUNICIPALITY OF TAXCO DE ALARCON AND *LOS SABINOS* VALLEY

Source: Modified from openstreetmap.org

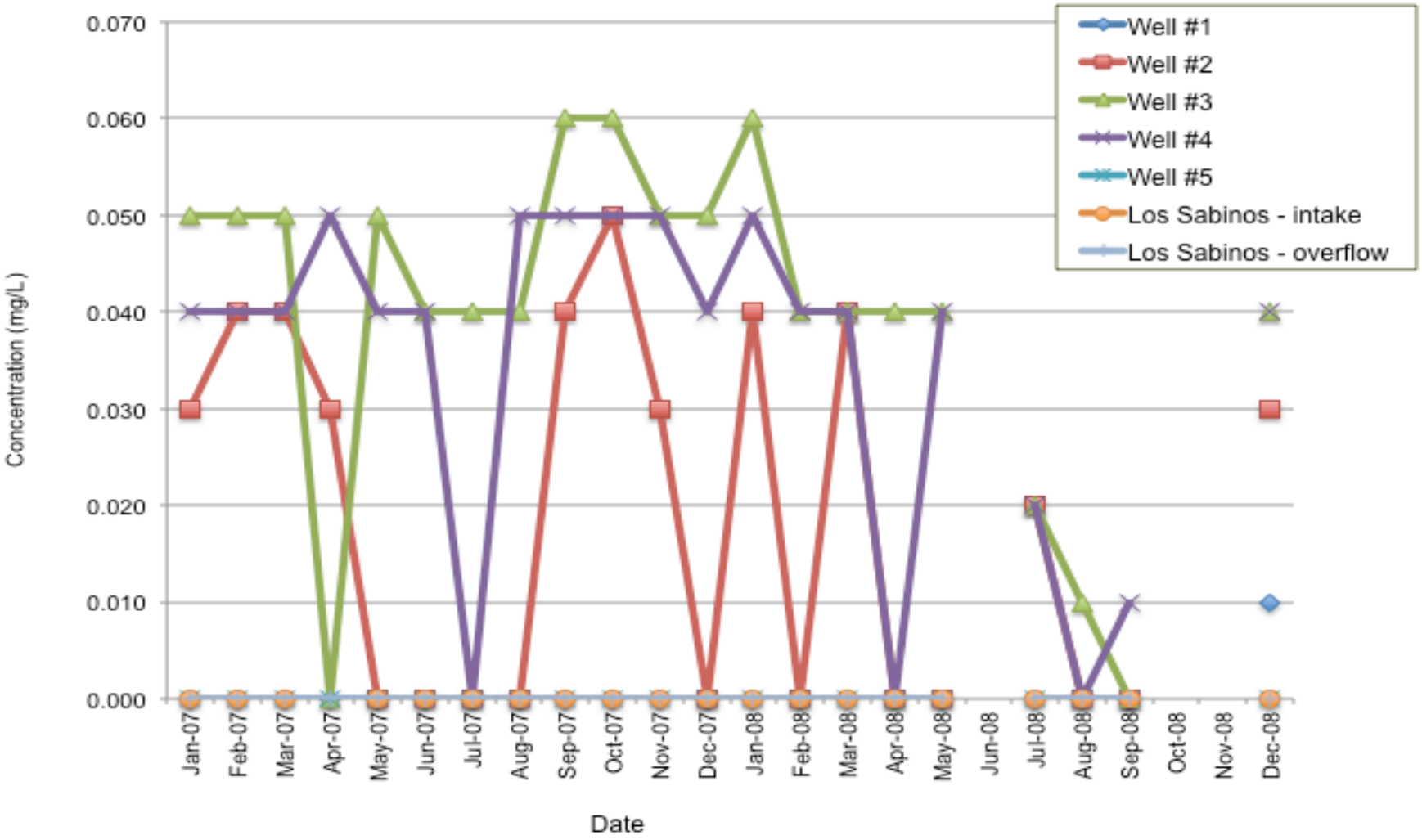

FIGURE 1.4 ARSENIC CONCETRATIONS IN WATER FROM THE WELLS AND TAP SOURCE WATER JANUARY 2007 TO DECEMBER 2008

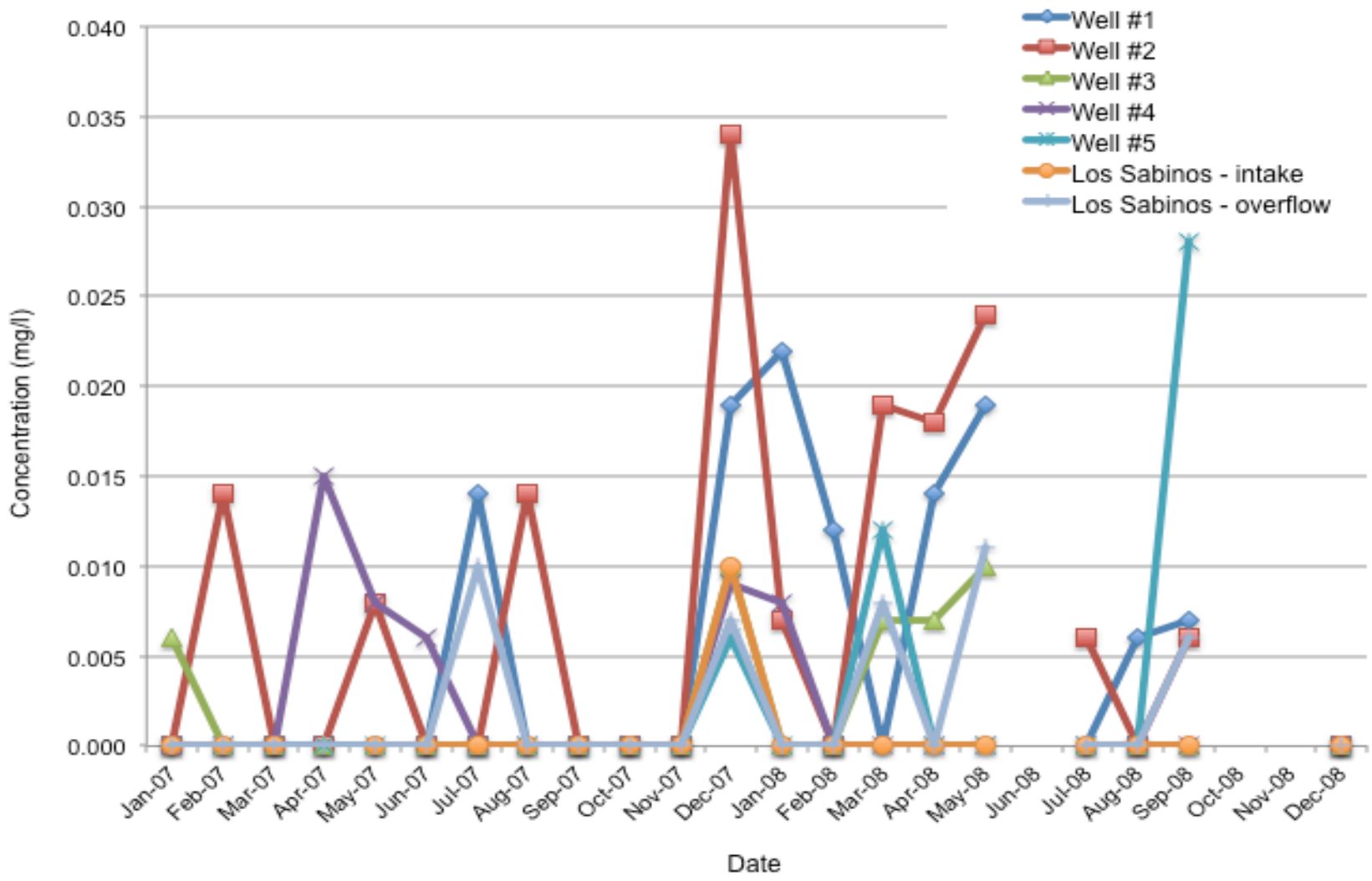

FIGURE 1.5 LEAD CONCENTRATIONS IN WATER FROM THE WELLS AND TAP SOURCE WATER JANUARY 2007 TO DECEMBER 2008

1.2 The need for this research

Tlamacazapa is a community of extreme poverty in Mexico. Most community members live on a meager earnings from weaving palm, with which they are able to afford to eat twice per day often depending on basic tortillas as a staple of their diet, occasionally supplemented with a thin soup stock. For many, protein from eggs or meat or nutrients found in vegetables and fruit are rare supplements; the signs of constant undernourishment are ubiquitous (Smith and Marin, 2005; Atzin, in progress).

Monumental gaps are evident between the policy discussions taking place at national and transnational levels and how these policies play out on the ground in a context of poverty. It is therefore crucial to document water how poor residents access, use and pay for water in order to then consider how the objective of clean, plentiful water for all can be attained.

Increasingly, those examining global policy trends in the water sector are emphasizing the need for more nuanced discussions of water governance that illustrate specific local contexts to understand what challenges are encountered both by sellers and buyers in service delivery. Their writings suggest that broad ideological debates that inaccurately dichotomize privatization and public ownership or privatization and right to access water obscure the more important governance questions that should be addressed when establishing a system of water infrastructure management (Bakker et al., 2008; Bakker 2003; Mehta 2000; Mehta and Mirosa Canal, 2004). The call for grounded case studies is clear, citing the need for:

> *a greater pluralism in the debates and for more attention to the multifaceted dimensions of water and its various expressions in the everyday contexts within which people live their lives. Thus, there is the need for critical research to map out the mismatch between rhetoric and reality across macro, meso and micro realms, calling for explicit links to be made between water and power and politics*
>
> Mehta, 2000.

Tlamacazapa presents a unique opportunity because of the close working relationship that the Atzin team has had with community members over fifteen years. Researchers working in the water sector have acknowledged the difficulty in representative participation in municipal level case studies with the inevitable result that research is skewed towards cases with high levels of transparency and likely, therefore, also high levels of public capacity (Rowland, 1998). This paper depicts a case study from the perspective of end users of local water infrastructure. The insights are therefore unusual in their depth and accuracy. It is probable that the context is representative of similar contexts in Mexico and elsewhere that are likely not rare but are rarely reflected in the literature.

2 Methodology

2.1 Case study

The following is a detailed single-case study at the community level documenting water quantity, access and use in the community of Tlamacazapa, Guerrero, Mexico. Nested cases of twenty representative households are examined in detail as exemplars of how water is experienced by the community as a whole.

As a student with a background in the natural sciences, the case study method proved to be challenging territory for me. Without an anchor of a control group and a firm ballast of statistical analysis in which to embed my research, I frequently felt adrift. I yearned for the structured parameters of a controlled experiment and a narrowly defined research question that could be answered, at least as a start, with a yes or no response. And yet, a voice within me insisted that, in spite of my discomfort, there was value to examining this case in detail. I turned to the literature for some guidance.

In fact, the case study approach provides a constructive method to examining local contexts, testing and potentially disproving broad theoretical suppositions and documenting clear, grounded knowledge from which theories and policies can be derived. Although the case study as a research methodology has been criticized because of this lack of structure with which I was grappling (Yin, 2003), Flyvbjerg insightfully identifies five misunderstandings that have plagued the case study methodology and caused its ill-repute. These misunderstandings are so relevant to the causes of my own discomfort with the approach that they are worth repeating here:

> *Misunderstanding 1. General, theoretical (context-independent) knowledge is more valuable than concrete, practical (context-dependent) knowledge.*
>
> *Misunderstanding 2. One cannot generalize on the basis of an individual case; therefore the case study cannot contribute to scientific development.*
>
> *Misunderstanding 3. The case study is most useful for generating hypotheses; that is, in the first stage of a total research process, while other methods are more suitable for hypotheses testing and theory building.*
>
> *Misunderstanding 4. The case study contains a bias toward verification, that is, a tendency to confirm the researcher's preconceived notions.*
>
> *Misunderstanding 5. It is often difficult to develop general propositions and theories on the basis of specific case studies*
>
> *(Flyvbjerg, 2001:66-67).*

The literature offers substantial support to rectify these misunderstandings and to defend the relevance and strength of the case study as a research methodology. Before exploring these ideas, however, I would first like to share some of my own experiences – those that were nudging me towards a case study in spite of my discomfort.

The first is a personal experience that revealed the power of forced and practiced observation. While working in Tlamacazapa, I was sent on an errand that was not at all within my realm of work but was the sort of situation in which I frequently found myself as a result of working for a small non-profit organization with a number of diverse programming objectives. I was to visit a family to find out if the father, who was very ill, was taking his antibiotics as directed and if he had been able to keep any of them down in spite of severe nausea. The details surrounding this task are not particularly pertinent; what is, is that when I returned to our organization's office, the organization's Director asked me a number of questions about the family's living circumstances. Among the questions, she asked, "where does he sleep?" I responded that he was sleeping on a bed. "What kind of bed?" she asked. I was stumped – a bed, he slept on a bed! She tried to extricate additional details, and I could see why. Was it a mattress or a layer of sticks that simply lifted him off the floor? The difference may have seemed trivial but it was not insignificant in terms of the warmth that the bed could offer. Moreover, in a community in which many struggled to provide for the most basic of needs, the type of bed could be a useful indicator of the degree of poverty in which the family lived as many would choose to purchase a comfortable mattress if they had any opportunity to do so. I would later return to the household and look more closely to discover that the man did indeed sleep on a bed of loosely dispersed sticks, vaguely disguised by a thin blanket. There is nothing surprising about this story. Faced with infinite pieces of information at any given time, our brains are prone to finding simplified codings — shortcuts to analyze and store information.

The result, however, is that the assumptions that we create by means of these simplified pathways often go unquestioned and therefore can perpetuate false understandings. This is the case not only, as it was for me, in research on the ground, but also in broad theories and understandings that can be self-perpetuated in the literature in spite of some inaccuracies. Flyvbjerg describes the phenomenon as blind alleys:

> *Great distance from the object of study and lack of feedback easily lead to a stultified learning process, which in research can lead to ritual academic blind alleys, where form becomes more important than content*
>
> (2001, p72).

It became clear to me that structured, purposeful observation is a useful approach to counter these assumptions and create opportunities for new and more accurate understandings. Based on this experience, I have no difficulty countering the fourth misunderstanding of case studies that Flyvbjerg identifies (i.e. they contain a bias towards verification). I would argue that they do precisely the opposite, in that by

focusing on the minutiae, they require the researcher to carefully question all assumptions. As I had already been working in Tlamacazapa for over a year when I began this study, such questioning and careful, intentional documentation was imperative. It forced me to question all that I thought I knew and allowed me to understand more objectively and in more detail how water in the community was accessed and used.

My second story is about a visitor who came on one occasion to Tlamacazapa. He was a government employee from the state capital – Chilpancingo who came to Tlamacazapa purportedly to learn about the programs that *Atzin* was operating. We had not expected his arrival; rather he was invited by some other guests whom we *were* anticipating. Unlike his fellow travelers, however, his time was limited so he would not be spending the night. He had only a few short hours before he needed to depart again to leave time for the four-hour return trip to Chilpancingo. We therefore could not venture far from the community's centre. As background, it is important to understand that the centre consists of two or three parallel streets with some crisscrossing sections that are decently paved on which large trucks can drive. The centre is also disproportionately filled with concrete, multi-level houses in contrast to single-story homes constructed of various assortments of sticks, corn stalks, and mud, usually roofed with tar paper or thin aluminum sheeting that characterizes fifty-eight percent of Tlamacazapa homes. This is also not to say that poverty is not prevalent in the centre. For example, one such two-story concrete house is home to a household that participated in this study. Twenty-two people live inside those walls. Few houses, even in the centre, have water storage and most households rely on open-air excretion. Of course, no evidence of crowding, poor sanitation, malnourishment or economic poverty is evident from outside the concrete walls. Further, it was not our intent in speaking with the government worker, to enter into homes or to display examples of poverty. We took the problem statement as a given and were trying to explain some of the approaches to address the challenges – the midwifery program, the women's cooperatives, the construction of dry toilets and rainwater catchment tanks, among others. When the brief visit had finished, I was therefore quite taken aback when, upon leaving, he definitively stated that residents of Tlamacazapa were comparatively not poor and that few challenges existed there that deserved any particular attention.

This memory illustrates that there is value in meticulously documenting the role that water plays in the life of Tlamacazapa residents. Not necessarily so that it can serve as an exemplar to inform broader global policy and be of relevance through extrapolation to broader questions but simply because of the importance that an objective accounting of information has *within* the context itself and for the improved understanding of those who work in this particular location. Certainly, this example calls into question the first misunderstanding of case studies that Flyvbjerg identifies, (i.e. "[g]eneral, theoretical (context-independent knowledge is more valuable than concrete, practical (context-dependent) knowledge" (2001, p66)). I cannot be sure from our brief encounter the motivations nor the misconceptions that prevented the visitor from looking more closely and more truthfully at what was right in front of his nose. Was it the enormity of the

challenge that contributed to his apathy because, as he identified, there are many communities in Mexico that are faced with similar challenges? Indeed, I had not focused on the more macabre details that could be found in Tlamacazapa. I had skipped the *why* and jumped directly to the *what* and *how*. I could have told stories about infants dying of dysentery, youth succumbing to tuberculosis. I could have shown him the pictures of deep dark swaths of black covering the abdomens of some residents – indications of metal toxicity. I could have recounted tales of domestic violence and the resulting fear or the stories of wives killed or left paralyzed or of startling rates of homicide among men in a town of only six thousand. But I didn't. Then again, nor did he ask. Rather, he unapologetically reached his conclusion with no line of inquiry and no attempt to observe his surroundings in any kind of detail whatsoever.

This case study's primary objective therefore is to follow a structured method to record evidence of how water is accessed and used in Tlamacazapa. With a detailed and accurate understanding of context, better decisions can be made about what to do in terms of water governance, and how to do it. This case study is, first and foremost of *intrinsic* interest:

> *I call a study an intrinsic case study if the study is undertaken because, first and last, one wants better understanding of this particular case. It is not undertaken primarily because the case represents other cases or because it illustrates a particular trait or problem, but instead because, in all its particularity and ordinariness, this case itself is of interest*
>
> Stake, 2005:445.

Case studies can also be used, however, to question the assumptions made in broader theories and policies. If a particular case does not follow the suppositions implicit in applicable theories, then it can act as a "black swan" — an example where only one case is needed to disprove the rule (Flyvbjerg, 2001). This case is therefore contextualized within broader national and international policy debates not only to explore how those policies have impacted the local context, but also in order to ground-truth widely held assumptions and to provide direction for more informative and constructive policy directions. This case is therefore also a *critical* case (Stake, 2005). By using grounded examples to test theories, critical cases reject the remaining case study misunderstandings. Indeed, one *can* generalize on the basis of an individual case, a case study *is* suitable for hypothesis testing and case studies *do* contribute to the development of theories (Flyvbjerg, 2001, pp66-67).

2.2 Participant selection

Twenty representative households were surveyed and interviewed. Random probability sampling could not be used because of the complex and political nature of water in

Tlamacazapa. More accurate and in-depth information could be collected by targeting families with which Atzin had a strong relationship. The participant households thus serve as qualitative exemplars.

Participant households were chosen through a strategy of maximum variation sampling (Patton, 2001, p 243; Flyvbjerg, 2001, p 79). In collaboration with the *Atzin* Director, I intentionally tried to identify household diversity in choosing participants so that the participating households would reflect the breadth of socio-economic realities of the community. We identified households that varied from one another by the following parameters:

- Spatial distribution in the community;
- Families with and without their own water taps;
- Families with and without their own water storage tanks;
- Income spread: relatively affluent and relatively poor families based on what was known about general income and as reflected in the type of housing.

2.3 Data collection

Several methods were used to collect information about how each of the twenty households collect, store and use water:

- a monthly household calendar served as a longitudinal survey instrument;
- a focused close-ended survey was completed by each household in August of 2008;
- Existing water quality data collected by Atzin was included to document water quality;
- Data from the 2005 census was used to compare participating households to the broader community;
- A literature review was conducted to contextualize the case.

2.3.1 Water calendars

A monthly household calendar was drafted and then piloted for three months in ten households in the community of Tlamacazapa. Through the pilot phase, I was able to

identify how clear the calendar was for use, develop more consistent questions and coding for recording water access information on the calendar and identify gaps in the information that was being collected. A revised version was finalized in December 2006 and a final version of the calendar was distributed in January 2007 to be completed by the household. From January 2007 until December 2008, a fresh monthly calendar was delivered to the household and the previous month's calendar collected.

At the beginning of the two-year survey period, I recorded the number of water storage containers and their respective volumes at each household so that there was a clear understanding of what containers were available to the household for water storage.

An example of a monthly calendar is included in Appendix 1 in English and in Appendix 2 in Spanish.

The intent of the calendar was for households to have a simple method by which to record every discrete event in which:

- water was collected from a well, pond or lake including the number of people-trips made to the water source and the volume of water collected,
- someone was paid to collect water from a well pond or lake,
- tap water was pumped to a tap on the household's property
- the household paid for tap water that was pumped onto their property, a neighbour's tap or a public tap,
- bottled water was delivered to the house
- bottled water was purchased from a store
- truck water was delivered to the house
- truck water was purchased and carried to the house.

Number of occurrences, volume of water collected and pesos paid were all recorded in the day that the event occurred on the monthly calendar.

Generally, one member of the household agreed to be responsible for the completion of the calendar. In some cases, the task was shared among two or three members but in all cases the most literate member(s) of the household who were not prone to frequent travel recorded events onto the calendar. In some cases, this person still had low literacy, in which case, I or other designated *Atzin* team members would visit the household to help record the information. The frequency of these visits varied from household to household. In cases where more help was needed, visits would be as frequent as weekly. In other cases in which consistent and apparently accurate data was being recorded, and especially as the two-year period of calendar use progressed, households were only visited monthly for exchange of the previous month's calendar with a fresh one.

In all cases, participants were trained in consistent and simplified coding to mark water-related events. Each time a bottle of water was purchased, participants would record a 'G' for *garrafon,* which refers to the 20 litre plastic container in which bottled water is sold. When tap water arrived at the house, an 'X' was marked on the calendar. Each day

in which a trip to the well occurred, the participant would mark a “P” for *pozo*, meaning well.

When the Atzin team member came to collect the calendar at the end of the month or to check on progress during the month, additional questions would be to fill in missing information. For instance, I would ask, “how many trips were made to the well this day?” “Who went to the well?” “Which containers were used?” In this way, number of trips and overall volumes were also recorded. In many cases where literacy was high, the participant marked this information independently.

On the reverse of the calendar tool, there was space where any new water containers could be recorded as this would change the total amount of water that the household could store at any one time. There was a further section for notes. Often, members of the household would share observations or experiences about water that they had encountered during the month. This could include waiting times at the well, or details about how tap water was delivered: that it was delivered but only for a short time and they didn’t have time to take any; that it was delivered but they weren’t home to retrieve any, that the pressure wasn’t sufficient to collect any significant volume of water from the tap and other pertinent details. The reverse side of the calendar also asked questions pertaining to tap water payment: how much was paid, when and to whom as well as whether or not a receipt was issued.

2.3.2 Survey

In August, 2008, I prepared a close-ended survey that would be used to verify and to expand on the data collected. The questions were close-ended, intending to solicit further concrete descriptions about water cost and access. The survey was delivered in an interview style because low literacy would have prevented the majority of households from completing the survey independently.

An earlier draft of the survey was piloted with five non-participant households. The pilot phase helped to identify wording that was misleading or that confused the interviewee. In many cases more colloquial and appropriate wording was substituted. The pilot phase also narrowed in on all possible answers. Being a close-ended survey, in almost all cases questions were answerable by a discrete and finite number of responses that were included in the survey so that the researcher could quickly and accurately record the interviewees’ response. This approach was taken in order to ensure consistency among the surveys and also for further replication should the research project be repeated or expanded at a later date.

Some questions served to verify information that had been collected through the water calendars and therefore served as a means of triangulation contributing to the internal validity of the information collected (Stake, 2005 pp453-454; Patton, 2002 pp247-248).

For instance, several questions clarified the ways in which water was shared among nuclear families living within the household or neighbouring households. In some cases, this had not been clear through the calendars and contributed to how the calendar information was later interpreted. The survey again enumerated and measured each container available for water volume to be compared to the data that had been contributed in early 2007 so as to ensure accuracy in the volumes of water that were being recorded on the calendars.

The surveys also expanded on the calendar data with sections pertaining to water meters, water use and choices of water sources. These issues contributed additional information about how the household collected, used and stored water.

The survey tool is included in English in Appendix 3 and in Spanish in Appendix 4.

2.3.3 Literature and document review

Finally, additional documents and background data that had previously been collected by *Atzin* were also used to elucidate context where applicable. These documents include:

- a community-wide census conducted by *Atzin* in 2005;
- water samples collected by *Atzin* from 2001 to 2008;
- rainwater recordings in Tlamacazapa collected by a literate resident.

Internet documents and reviews published in refereed journals were used to gather information about the history and context of Mexican water governance. Refereed publications and academic working documents were also reviewed in order to consider the Tlamacazapa case study in a broader, global context and reflect on what lessons could be extracted to inform policy.

3 Findings

3.1 Data handling

3.1.1 Comparison of households sampled to 2005 census data

In 2005, *Atzin* conducted a community census and surveyed every household in Tlamacazapa. In order to have a better understanding of the degree to which the households used in this sample are representative of the broader community, several indicators are compared to data that was collected in the 2005 census[8].

The following definitions are used to describe each unit of analysis:

A household for the purpose of this study is defined to be a family or group of families (usually extended relatives) who share aspects of water collection and / or water use. Often families within a household will maintain relatively independent routines but will occupy the same lot or adjacent lots and may share a tap, store water in shared containers, or share purchased bottled water.

A family or nuclear family for the purpose of this study is defined to be a mother and father and their single children of any age. If a child lives in the same household but is married or lives with a partner and / or has children of their own, they are then considered to be a separate nuclear family. This definition is in line with that used in the 2005 community census and is repeated here for ease of comparison.

A house for the purpose of this study is a building or a room with stick walls in which individuals sleep. In the case where the house is a concrete structure, each level is considered to be one house. If the structure includes a second story, then the structure is counted as two houses. This definition is in line with that used in the 2005 community census and is repeated here for ease of comparison.

The twenty participating households included 3.13% of Tlamacazapa's overall population, 2.03% of the houses in the community and 2.80% of the community's families, as shown in
Table 3.1.

Demographic information of the sample population closely mirrors the 2005 census data of the broader population in terms of age and sex distribution, spatial distribution and literacy levels. Fifty-two percent of the household members represented in the calendar survey are female compared with 48% male, which is the same female to male ratio for the whole of Tlamacazapa. Thirty-nine percent of residents of participating households are children fifteen years or younger, which is very similar to the proportion of the whole

[8] The census was researched in 2005 and data is reflective of that year although information was compiled and released by *Atzin* in 2006.

community in 2005 (36% fifteen years and under). Spatially, Tlamacazapa is split into three neighbourhoods. Roughly the same proportion of residents in the study sample live in Santiago as in the community as a whole (55% compared with 56%). The sample subset has slightly more residents living in San Lucas (26% compared with 19% of residents overall) and slightly fewer residents living in San Juan (19% compared with 25% overall).

Literacy rates are also comparable. Thirty-five percent of the sample population is literate compared with 36% of the population overall. Sixty-eight percent of the houses represented in the calendar survey are constructed with cornstalk, stick or adobe walls (as opposed to concrete or brick), which is 10% more than the overall population. The pattern of housing types in the participant group is similar, however, to the population overall with fewer residents living in concrete and brick houses. One indicator that stands out as being very different for the participant group compared to the overall population is the type of sanitation used. Only 15% of the residents represented in the calendar data use open-air excretion compared with 80% of residents in the 2005 census. Many of the participating households had developed their relationship with *Atzin* through participation in the water and sanitation program and construction of a dry toilet. Therefore, a disproportionate portion of participating households had dry toilets[9].

Comparisons of demographic descriptions of residents in the study sample compared with results of the 2005 census are detailed in Table 3.2.

3.1.2 Considerations of data analysis

The twenty participating households exemplify how water is experienced in Tlamacazapa. Households are diverse in terms of how they access, purchase, store and use water. All data descriptions are therefore variant and not normally distributed. The data is therefore descriptive and not statistical. Cumulative distribution figures are used throughout the analysis in order to present the range of household scenarios.

TABLE 3.1 PERCENTAGE OF INDIVIDUALS, HOUSES AND FAMILIES SURVEYED

[9] The 2005 sanitation data was, in any case, out of date because a state government initiative in 2006 to 2008 had resulted in the construction of roughly four hundred dry toilets. No data was available at the time of writing about how many of these dry toilets were operational but many residents had critiqued both the construction and distribution process, suggesting that uptake by households was low.

	Number in this sample	Number in all of Tlama	Percent represented
Number of individuals	189	6034	**3.13%**
Number of houses	25	1231	**2.03%**
Number of families	39	1394	**2.80%**
Number of children (0-5 years)	19	833	2.28%
Number of children (0-15 years)	74	3890	1.90%
Number of adults (16 years and older)	115	2144	5.36%
Number of females (all ages)	97	3133	3.10%
Number of males (all ages)	92	2901	3.17%

TABLE 3.2 CHARACTERISTICS OF POPULATION INCLUDED IN STUDY SAMPLE AND CHARACTERISTICS OF OVERALL POPULATION FROM 2005 CENSUS DATA

	Total number		Percent of overall sample	
	This study	2005 census	This study	2005 census
Housing Type				
Houses with walls of stick, palm or adobe	17	719	68%	58%
Houses with wall of brick or block	8	512	32%	42%
Housing location				
Santiago (# of people)	105	3469	55%	56%
San Lucas (# of people)	50	1164	26%	19%
San Juan (# of people)	36	1539	19%	25%
Sanitation				
Latrine with enclosed tank	2	90	10%	12%
Hole in the ground	1	29	5%	4%
Dry toilet	13	37	65%	5%
Open air	3	606	15%	80%
Age and sex distribution				
(0-5 years) Male	9	412	5%	7%
(0-5 years) Female	10	421	5%	7%
(6-10 years) Male	15	338	8%	6%
(6-10 years) Female	11	330	6%	5%
(11-15) Male	19	327	10%	5%
(11-15) Female	11	316	6%	5%
(16-20) Male	13	369	7%	6%
(16-20) Female	12	360	6%	6%
(21-50 years) Male	29	1030	15%	17%
(21-50 years) Female	48	1256	25%	21%
(51-65 years) Male	4	228	2%	4%
(51-65 years) Female	5	253	3%	4%
(66+) Male	3	197	2%	3%
(66+) Female	2	197	1%	3%
Children (0-15)	75	2144	39%	36%
Adults (16+)	116	3890	61%	64%
Female (all ages)	99	3133	52%	52%
Male (all ages)	92	2901	48%	48%
Adult literacy				
Literate female (16-70yrs)	19	509	29%	26%
Illiterate female (16-70yrs)	47	1447	71%	74%
Literate male (16-70yrs)	20	810	43%	48%
Illiterate male (16-70yrs)	27	883	57%	52%
Literate (total 16-70yrs)	39	1319	35%	36%
Illiterate (total 16-70yrs)	74	2330	65%	64%

3.2 Response rate

Calendars were collected monthly. Occasionally, calendars would be lost or water damaged. There were 14 months in which at least 90% of all calendars were collected, seven of which had a 100% response rate. Response rates for other months ranged from 70% of calendars collected. Table 3.3 shows the percent of calendars collected each month. Aggregate data descriptions omit missing data points and calculations are performed within a smaller sample size for those months.

TABLE 3.3 PERCENT MONTHLY RESPONSE RATE OF WATER CALENDAR JOURNALS

Month	Number of calendars collected of possible 20 households	% collected
Jan-07	20	100%
Feb-07	19	95%
Mar-07	20	100%
Apr-07	18	90%
May-07	19	95%
Jun-07	19	95%
Jul-07	19	95%
Aug-07	19	95%
Sep-07	20	100%
Oct-07	15	75%
Nov-07	14	70%
Dec-07	16	80%
Jan-08	15	75%
Feb-08	18	90%
Mar-08	13	65%
Apr-08	16	80%
May-08	15	75%
Jun-08	17	85%
Jul-08	17	85%
Aug-08	20	100%
Sep-08	18	90%
Oct-08	20	100%
Nov-08	20	100%
Dec-08	20	100%

3.3 Water sources

Tlamacazapa residents get water from one or a mix of several sources. During the rainy season from May to October, residents primarily collect rainwater, reducing their dependence on the formal water infrastructure and alternate informal water sources. This study focuses on sources other than rainwater and volume descriptions omit rainwater quantities.

When it is pumped, tap water is available to residents for a cost and accounts for the greatest total volume of water collected by survey participants during 2007 and 2008. Some residents have their own tap installation while others purchase water from a neighbour's tap or a public tap.

The second most important water source in terms of volumes collected are the unprotected groundwater wells scattered throughout the community. There are four principle wells that follow a fault line through the limestone. In addition there are four wells that capture surface runoff during the rainy season but are quickly depleted once the rains stop. There is also a stagnant lake in the valley below town where residents often go to wash laundry and, occasionally, to collect water.

Bottled water can be purchased from local stores. Generally, residents who purchase bottled water pay an eighty pesos (~8USD) deposit to a local store for the 20-litre bottle and then exchange the bottle for another that has been filled and sealed.

Finally, trucked water is occasionally available to residents. This water arrives from nearby communities for purchase if the resident's lot has road access or if the resident is able to intercept the truck and carry the water in portions back to their home, as they would for well water.

3.3.1 Overall volumes accessed

The water calendars provide detailed information about the overall water accessed by households throughout 2007 to 2008. During the dry season, the water calendar provides a comprehensive picture of all water being accessed, although families with water tanks also supplement their water with stored water during dry season months. During the rainy season, residents collect a substantial amount of water at their homes and these volumes were not recorded.

For every month through 2007 and 2008, 75% of participating households obtained less than 15 litres of water per person per day. Median values in the dry season ranged from 4.8 litres per person per day to 9.1 litres per person per day. At the lower extreme,

minimum values were as low as 0.4 litres per person per day. Twenty-five percent of participating households obtained less than or equal to 6.5 litres per person per day every month throughout the two years. At the upper extreme, one household obtained up to 74.8 litres per person per month (February, 2007). Figure 3.1 shows the distribution of water obtained by each household each month as a function of average litres per person per day.

The information that was collected during 2007 and 2008 from the twenty participating households was analyzed according to the water source so as to increase understanding of the volume collected from each source and their respective monetary and opportunity costs.

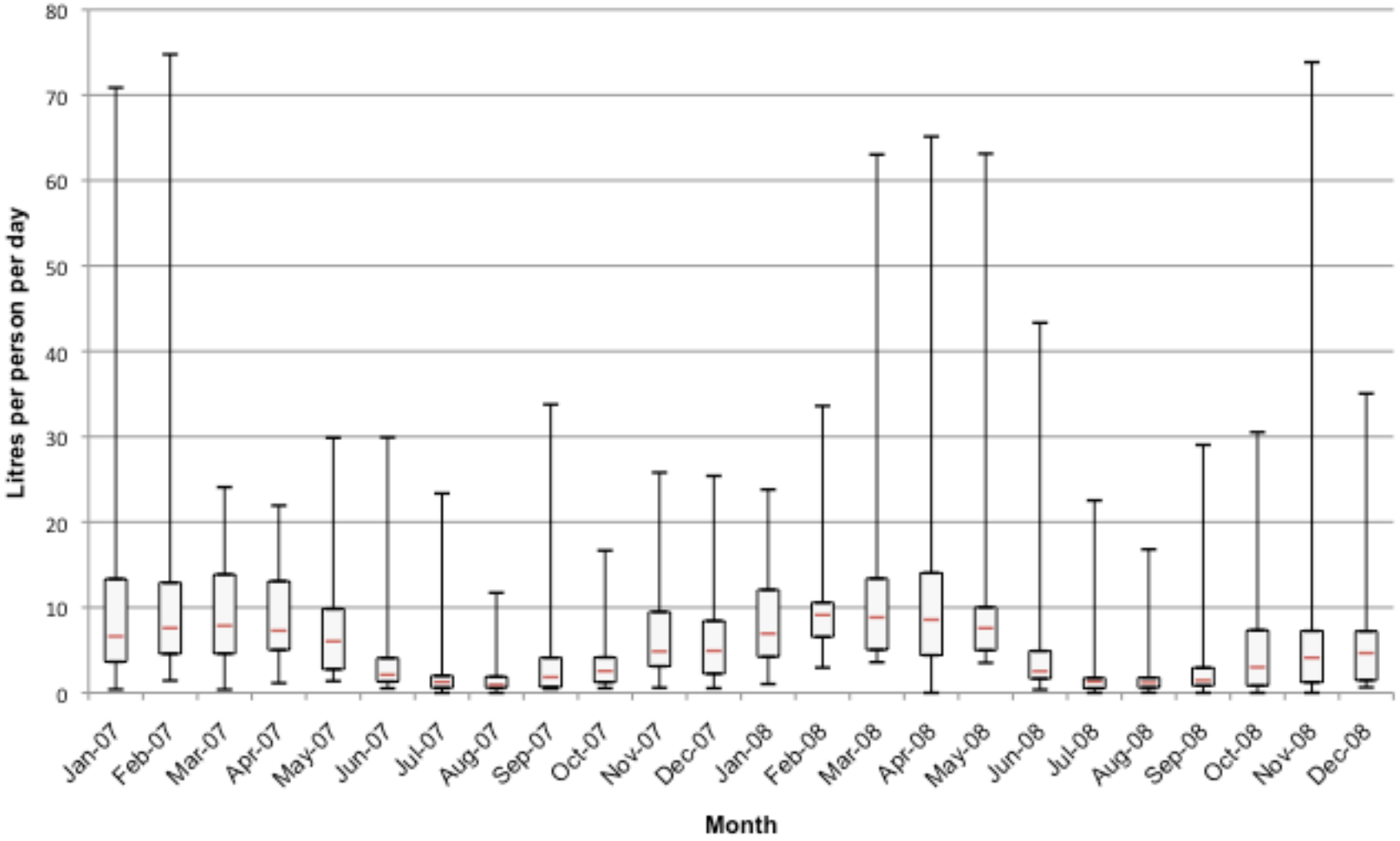

FIGURE 3.1 CUMULATIVE DISTRIBUTION (QUARTILES) OF TOTAL MONTHLY VOLUMES ACCESSED PER PERSON PER DAY (AVERAGED WITHIN HOUSEHOLDS) FROM ALL WATER SOURCES EXCLUDING RAINWATER CAPTURED ON PREMISES

3.3.2 Rain water

From May until October each year, Tlamacazapa receives a lot of rainfall. During the other months of the year, it is common that no rain will fall at all. Annual total precipitation rates are high with local annual measurements ranging from 928mm per year to 1396mm per year (see Figure 3.2 for annual rainfall). During the rainy season, rainfalls tend to be torrential with individual events often yielding between 10 and 30mm (Atzin, in progress). It is however, common for several days to pass in between rains and most households must supplement rainwater with additional water sources even during the height of the rainy season. Figure 3.3 illustrates the amount of rainfall in millimetres that fell each month during the years 2006, 2007 and 2008 in Tlamacazapa[10] (Atzin, in progress) and Figure 3.4 details the amount of rain that fell each day during the 2007 rainy season.

During the 2007 dry season, Tlamacazapa residents experienced a severe shortage of water. At the peak of the dry season, the water table at *Los Sabinos*, the valley from which tap water was pumped, had fallen below the intake pipes. Residents were forced to wait for hours at the spring fed wells where water pressure had also declined to the point that water only emerged in slow trickles. The decline in water availability did not seem to be because of less rainfall. Annual rainfall in 2005 (928mm) and 2006 (945mm) is shown in Figure 3.2 and is not remarkably less than previous and subsequent years (993mm to 1396mm). The decline in availability is therefore attributable to substantial additional pressures on water resources during the 2007 dry season. A paved road was being constructed between Taxco de Alarcón and Tlamacazapa resulting in voluminous daily water withdrawals from the pumping station at *Los Sabinos* and from the lake below the community. Additional localized roadwork was also taking place, further increasing the total amount of water being used.

At the time, a new water committee had been appointed and rumours abounded that the old committee was somehow sabotaging the water supply; however, these rumours were never substantiated. Were they true, they would not be the sole cause of the shortage as water tables appeared to be depressed both in the community and in the adjacent valley of *Los Sabinos*[11].

During rainy seasons, all families collected rainwater, substantially reducing the amount of water that they collected or purchased from other sources. Rainwater was usually collected either from existing roofs, by placing containers below low slants of roofs (Figure 3.5) or by

[10] Since 2003, a resident of Tlamacazapa, employed by *Atzin*, has recorded daily rainfall using a rain gauge installed on the patio outside of his home. He records his measurements in a notebook that is occasionally collected, photocopied and returned by *Atzin* volunteers.
[11] Although the *Universidad Nacional Autónoma de México* had begun to map the aquifers surrounding Tlamacazapa, this work was never completed. There is still an incomplete understanding of the size of the aquifers, their connection to one another and their recharge and/or draw down rates.

setting up tarps (Figure 3.6) or tubes (Figure 3.7) that caught additional rain and directed it to the recipient containers.

Eleven of the twenty participating households had water storage tanks that were built by *Atzin* and that captured water from their own roofs. Most of these were built in conjunction with dry toilets and a PVC pipe routed the water from the dry toilet roof to the tank, as is clearly visible in (Figure 3.8). These tanks collect up to 7,800 litres of rainwater. If a household of eight people were to ensure the tank was full at the end of the rainy season and were to withdraw equal amounts of water from the cistern from November 1 to April 30, the tank would increase the water available by 5.3 litres per person.

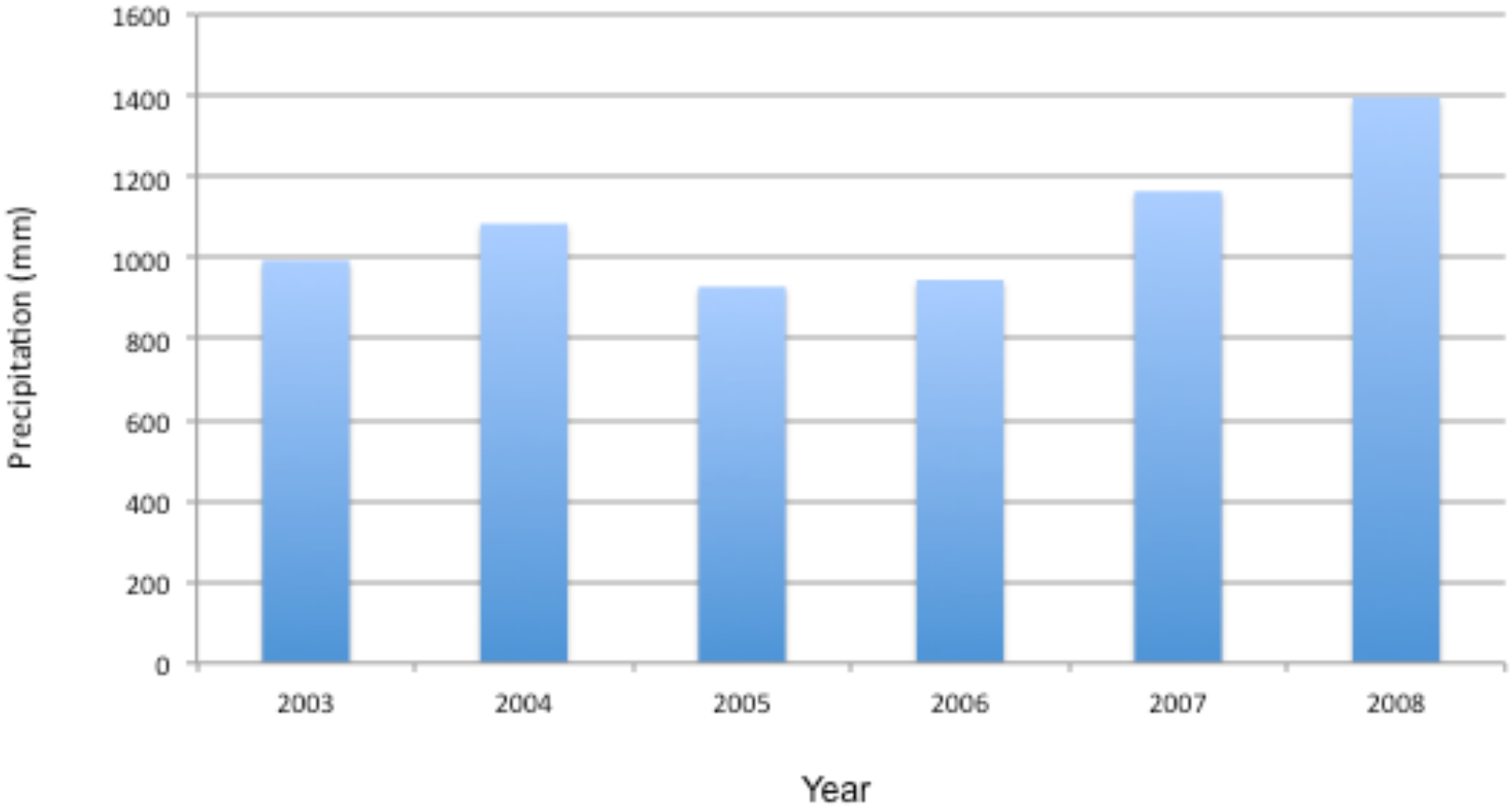

FIGURE 3.2 PRECIPITATION MEASURED IN MILLIMETRES FALLING IN TLAMACAZAPA EACH YEAR 2003-2008

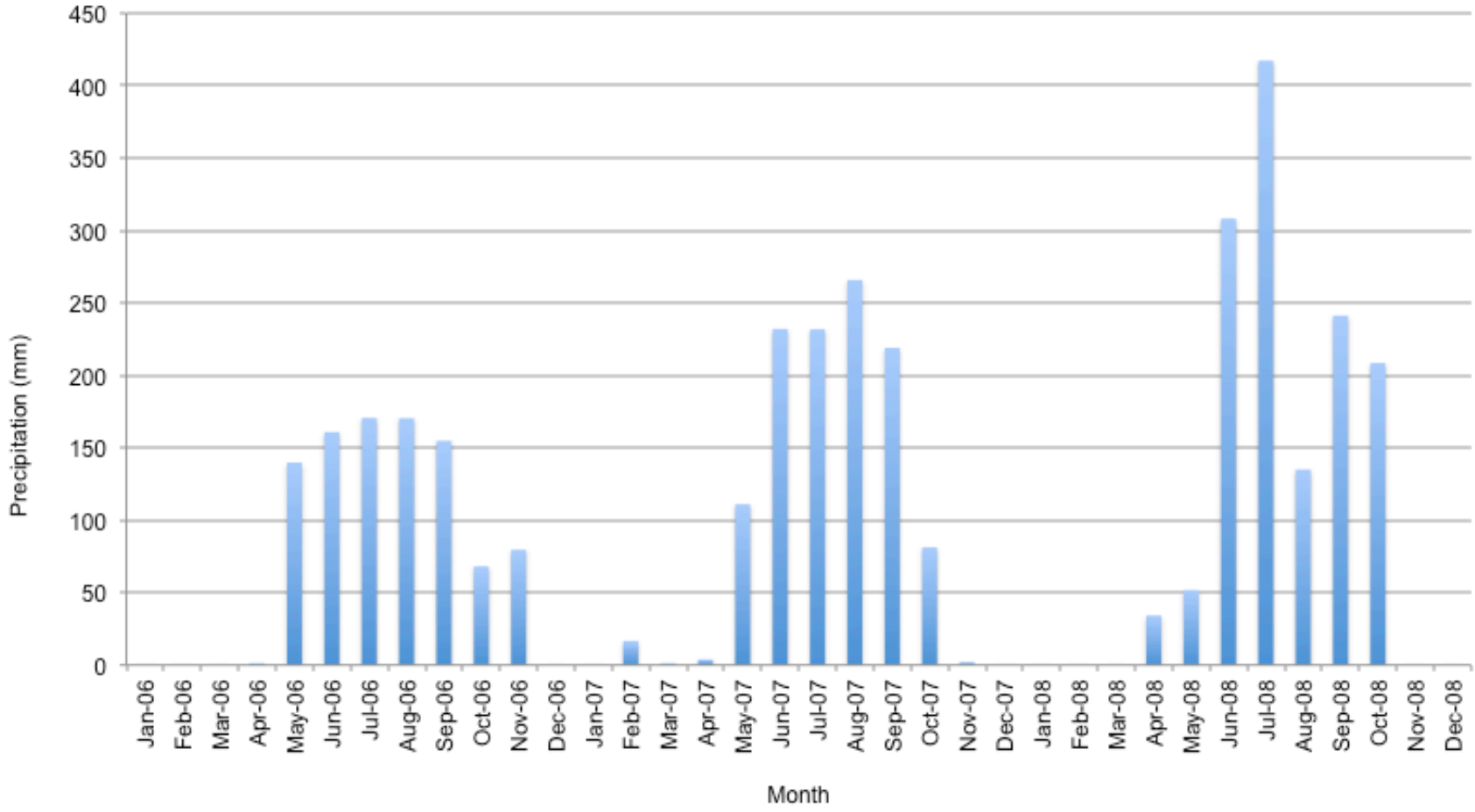

FIGURE 3.3 PRECIPITATION FALLING IN TLAMACAZAPA EACH MONTH IN MILLIMETRES FROM JANUARY 2006-2008

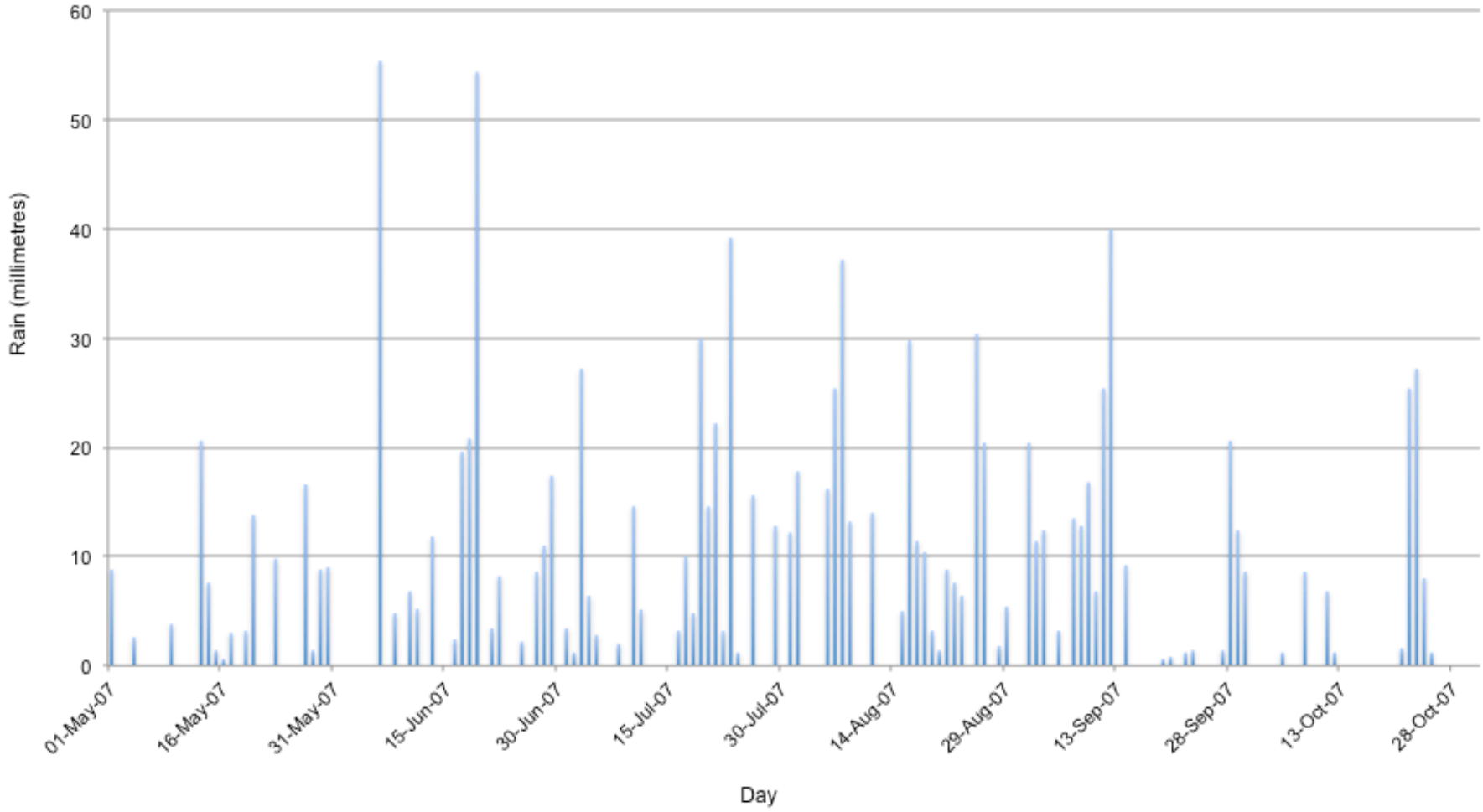

FIGURE 3.4 DAILY RAINFALL DURING 2007 RAINY SEASON

FIGURE 3.5 EXAMPLES FROM 7 PARTICIPANT HOUSEHOLDS ILLUSTRATING RAINWATER CAPTURED DIRECTLY FROM ROOFS INTO VARIOUS CONTAINERS

FIGURE 3.6 EXAMPLES FROM 4 PARTICIPANT HOUSEHOLDS SHOWING HOW FAMILIES USE TARPS OR OTHER PIECES OF PLASTIC TO CAPTURE ADDITIONAL RAINWATER AND DIRECT RUNOFF INTO BARRELS

FIGURE 3.7 EXAMPLES FROM 4 PARTICIPANT HOUSEHOLDS OF TUBING AND HOSES DIRECTING RAINWATER RUNOFF FROM ROOFS TO VARIOUS CONTAINERS

FIGURE 3.8 EXAMPLES FROM SIX PARTICIPANT HOUSEHOLDS OF CISTERNS THAT CAPTURE RAINWATER FROM THEIR OWN ROOFS

3.3.3 Tap water

Tap water is pumped to Tlamacazapa from *Los Sabinos*, a spring located approximately 5km northeast of the community. A series of three electrical pumps bring water from this shallow aquifer to a final 593m^3 holding tank from which it is gravity fed through the community's above-ground distribution pipes. (See Figure 3.9a, a photograph of the pumping station at *Los Sabinos*). The piping network did not encompass the whole community when this study was conducted. Part of the northwest corner and the south part of Tlamacazapa have been excluded to date because these areas could not be gravity fed or because pipes had not been installed (Atzin, 2012).

The construction and installation of the system that brings water from *Los Sabinos* to the community occurred in three stages over an approximate 20-year period. Even though construction of some system components began in the 1970s, a gasoline operated pump burned out a few months after project completion and was not repaired until 1999. From 1999 until 2001, there was sporadic pumping in the dry season only, with delivery to each neighbourhood occurring about once every fifteen days. The system was pumped in stages from one holding tank to another uphill tank, one tank at a time. How much each household received was limited to the size of the smallest holding tank in the pumping sequence and was further dependent on how much water was taken by households that were further uphill on the line of gravity fed distribution. In 2005, the system was switched to an electrical power source, which allowed for more consistent delivery. At this time, water was also delivered during the rainy season, though to this day delivery remains sporadic throughout the year. Since system construction first began, individual connections have been added in a haphazard manner with no guiding master-plan and have been dependent on individual households providing the necessary mix of payment, labour and materials (Atzin, in progress).

Access

Of the twenty participating households, thirteen had tap connections and seven had no tap connections, although one of the seven did have a tap installed during the last month of the survey period. Two of the thirteen had a tap installed that was never properly connected to the main system. In essence, then, eleven households or 55% of participating households had a functioning connection to the community's tap water during the survey period.

Four of the participating households reported that their tap connections were installed in 2001. Additional households connected each subsequent year until 2008. Each household recalls paying different amounts for installation of their tap and the payment required was often a mix of cash, work and materials. Monetary cost ranged from 0 pesos to 1,100 pesos, work days ranged from 0 to 30 days, and materials ranged from

no materials to various assortments of cement, pipes, sand and gravel to a maximum value of 630 pesos. Table 3.4 outlines what each household recalls paying for their tap connection and the year of installation.

Of the eleven households with working connections, four households encountered extended periods of time during the 2007-2008 survey period in which their tap was not working. One household explained that their tap had been disconnected for 16 months of the 24-month survey period because they owed money and refused to pay. They were sometimes able to purchase tap water from a parent who had a tap on the same lot. Another household's tap was not functioning for the duration of the survey period. Household members explained that passing trucks constantly broke the pipes (see Figure 3.9b). They explained that they themselves were held responsible for fixing the situation because the broken pipes were not part of the main system but were rather connecting pipes coming off the main. Occasionally, members of this household were able to purchase tap water from a neighbour.

A third household with a broken connection explained that their pipes had been broken by passing trucks; they were without a tap connection for 6 months of the 24-month survey period and were unable to buy tap water from another source during this time. They believed that it was the responsibility of the water committee to fix their tap. The fourth household, also situated in the high traffic central neighbourhood, had a similar experience with taps being repeatedly broken or clogged. This household's tap was not working for a total of 14 months of the 24-month survey period. One member of this household explained that she was not sure why the tap was broken but thought perhaps children had broken it, although it is also likely, given their central location, that trucks were responsible. She was not certain whose responsibility it was to fix it. This household was occasionally able to purchase tap water from a neighbor when their own tap was broken.

Households that do not have their own tap have the option of accessing a public tap or sometimes purchasing tap water from a neighbor. Accessing the public tap is rare among participating households. Only one household reported accessing the public tap on occasion but admitted that water is distributed at the public tap only very rarely and they do not like the long wait required to get the water. One resident who did not have their own tap and did not access the public tap explained, "There is the public tap but they don't want to sell it to us. We complained about the water and now [the head of the water committee] and his son don't want to give it to us anymore. My neighbours don't want to sell it to me either because [the head of the committee] is going to realize that they are selling the water to us and he is going to get angry at them and close the tap." Another family explained that during the peak of the dry seasons those with private taps got angry with the committee if they gave water through the public tap and so water was not sold at the public taps when it was most needed.

Seven of the nine households without their own tap could occasionally access tap water from a neighbour's connection, on the (often rare) occasions that the neighbour received enough to share. Also, conflicts among neighbours sometimes prevented access. One

household that only once accessed tap water during the 24-month survey period suggested that political views prevented them from being able to buy tap water from their neighbours: “our neighbour's don't let us because they are PANistas and we are PRIistas[12]” (author’s translation).

The nine households that did not have their own private functioning tap were asked why they did not have their own tap. Two of these families had taps installed but water had never been pumped up as high as their houses on the street. They explained that the necessary pumping station had never worked properly. Both of these households were occasionally able to access water from a tap lower on their street. One family responded, “We gave 1000 pesos to [someone on the committee] but she never installed them and now she's given us our money back. We have 7 pipes now but they just don't want to” (author’s translation). Another explained, “He [father of the family] didn't work all the time on the deposit. He only worked two days and then his son became ill. If he had worked all the time, probably they would have given him a tap apart” (author’s translation).

In summary, 55% of participating households have their own tap. An additional four households (20%) have fairly consistent access to a neighbour’s tap. Three households (15%) have very rare access and two households have no tap access whatsoever (10%).

Even households with a private tap connection only received occasional delivery of tap water. Although the general understanding among residents was that tap water was delivered once per week, the water journals over the two-year survey period indicate that the water was pumped much less frequently. When the water committee did pump and deliver water, it was generally not able to cover the entire neighbourhood in one delivery effort. At times, those nearer the initial distribution point would be able to take tap water while those further down the gravity-fed pipe system would find that there was insufficient water left by the time it reached their homes. For 22 of the 24 months in the survey period there were households with taps that never had tap water delivered. Only one household ever reported receiving tap water five times in one month. Six households reported receiving tap water four times in a month but this only occurred during one month of the 24-month survey period. More commonly, households reported receiving tap water zero to three times per month. Deliveries were most infrequent during the rainy months. Table 3.5 describes each household’s access to tap water, specifying what percentage of months in the survey period the household had zero, one, two, three, four or five deliveries.

Volumes

[12] Refers to two of the three dominant political parties in Mexico. PAN is the acronym for *Partido Acción Nacional* (National Action Party) and PRI is the acronym for *Partido Revolucionario Institucional* (Institutional Revolutionary Party). A PANista or a PRIista is someone who votes for that respective party.

The volume of tap water each household purchased by month fluctuated most greatly between the rainy season and dry season. The frequency of tap water delivery and purchase decreased in the rainy months when all households were collecting their own rainwater. Also, a decrease is evident during the dry season of 2007 when compared to the dry season of 2008. The water tables both in the community and in the adjacent valley of *Los Sabinos* from which the tap water was pumped, were low during the 2007 dry season. At times, the water table was so low that water was no longer entering the pumping station reservoir. Rumours abounded at the time that the lack of water was because the old water committee was angry that a new water committee had been appointed and so had somehow sabotaged the water intake. These rumours were never substantiated. To address the problem, the new water committee dug an open pit deeper than the water table and used hoses to pump the water from the pit to the pumping house reservoir. While these modifications were undertaken, water delivery was interrupted. Figure 3.10(a) shows the pit that was dug to collect groundwater that was then pumped to the pumping station reservoir. Figure 3.10(b) shows that, substantiated or not, the threat of sabotage was perceived to be real. An armed guard manned the pumping station so as to ensure that water delivery would not be further interrupted (though it appears the would-be perpetrators were not keeping him on his toes!)

In the 2007 dry season the total amount of tap water delivered to participant households was substantially less for February, March, April and May than the same months in 2008. The temporal variations in the average amount of tap water per person purchased by each household is shown in Figure 3.11. Median values are less for each month in the 2007 dry season than in the 2008 dry season. In January 2007, the median household purchased 0.92 litres per person per day compared with the median value of 2.14 litres per person per day in January, 2008. This trend was consistent through to May when the median household purchased 0 litres per person per day compared with 3.33 litres per person per day in May, 2008.

Cost

When asked what would happen if they did not pay for their tap water, residents generally responded that their tap would be disconnected or service would otherwise cease, although two households responded that they did not know what would happen. Two interviewees also pointed out that people could go a long time without paying and could pay what was owing later in a cumulated lump sum. Of the households that believed service would stop, some were incredulous. “This is what they say but we always pay so it has never happened to us. But, those that don't pay, they always give them water” one household explained (author’s translation). Another responded, “They get rid of the water but this I think they do only with lots of warning, because I always pay but a neighbour went a year without paying and they were selling the water to our neighbour but they never paid” (author’s translation). One of the participant households however, had had their water cut for not paying. They explained that they had previously

received their water for free from the former water committee and the new water committee wanted them to pay arrears, which they had refused to do.

Residents described two ways to pay for tap water. Generally, households were charged 10 pesos per barrel of water. The shared understanding was that a barrel was about 200 litres. In reality, the precise volume that a family received for their 10 pesos varied slightly depending on the particular volume of their barrel; the large barrels tended to range in volume from 175 litres to 240 litres. Sometimes households would have two smaller barrels of approximately 100 litres and would consider two of these to be a full barrel. On two occasions, residents without their own tap reported paying 12 pesos per barrel when the tap water was purchased from a neighbour. Usually, however, if neighbours had excess water that they were willing to sell they would do so without a profit.

Households with their own tap could opt to pay a flat monthly rate of 75 pesos, which entitled them to as much water as they liked during the month – as long as the water committee delivered the water and sufficient water remained. During months when no water was delivered or purchased, families were not charged the monthly rate. Nine households took advantage of this offer at least once during the survey period. However, it proved to be a cost savings only for households with concrete tanks as only they had sufficient water storage capacity to make the monthly rate worthwhile. The six families without tanks who paid the monthly rate were sometimes paying as low 0.03 pesos per litre but most often were paying more than the 0.05 pesos that they would have otherwise paid had they paid the per barrel rate. Reported rates were as high as 0.37 pesos per litre. On the other hand, the three households with tanks and their own tap connection who frequently took advantage of the monthly rate paid as low 0.004 pesos per litre and never paid more than the per barrel rate of 0.05 pesos per litre. Figure 3.12 shows the distribution of household costs per litre of tap water for each month of the survey period. Variation in cost arose both from the different volumes that each household used when purchasing water per barrel and from the different volumes that households received when purchasing water through a flat monthly rate.

Meters

Of the thirteen participant households that had private tap connections on their lot, eleven also had meters installed. Given residents' reports, the policy of meter installation evidently came into place in either late 2004 or in 2005.

Of the eleven participant households that had meters, all but one reported that the meters were installed at no additional charge. The other respondent recalled paying an additional 50 pesos for installation of her meter at the time that her tap was installed, in 2004. In general, it would seem that the meters were distributed and installed free of charge.

None of the eleven interview participants with meters said that they knew how to read the meters; however, four identified at least one family member that was able to read the meter. Of these, three had been trained to read the meters by *Atzin* volunteers and one had been taught by the man formerly in charge of water distribution. There is no information about how the other resident learned to read the meter. Of the 110 household members living in households with a water meter, five individuals or 4.5% percent knew how to read their water meter.

Interview respondents were generally aware of the purpose of the meters. When asked the purpose of the meter, none responded that they did not know. Six responded that it was to measure how much water was taken, and four responded that it was to prevent people from stealing water. One replied, "*It's just a luxury because they don't come to write down what it reads. We don't understand, they never write it down. Probably [the person in charge of the water] doesn't understand the meter and that is why he charges per barrel of water*." (author's translation).

When asked how the meter worked to measure water, four of the eleven respondents in households with meters responded that they did not know. Seven were able to explain that the numbers on the meter were measurements of water volume in cubic metres and that there are one thousand litres in a cubic metre of water.

Four interview respondents pointed out that although they understood how the meter was supposed to work, they did not believe that it worked properly in practice. One said, "*They say that they charge for each number five barrels of water but we don't take that much water. It happened once that between my brother and I we took three barrels but they charged us five according to the meter.*" (author's translation). Another said, "*One time they charged a lot; they said five metres saying that before it was given to us for free, but this wasn't true*" (author's translation). And a third echoed the sentiment, stating, "*The arrows move showing how much water we took but it didn't work because it marks a lot but we didn't take a lot*" (author's translation). The fourth related a similar story, *"[The person in charge of the water] started to say that we owe a lot based on what the meter reads but it says that we took six barrels when we only took three barrels and a few buckets*" (author's translation).

Comparing recorded amounts of water purchased from the taps to intermittent meter reads, also suggests that the meters exaggerate the amount of water being purchased. The meters are simple mechanical units that record flow pressure. It is likely, given the ad-hoc assortment of pipes that constitute the water delivery infrastructure, that a significant amount of air enters the pipes and that the meters are measuring this air pressure thus exaggerating the amount of water reaching residents. This hypothesis is further corroborated by frequent complaints from residents that by the time the water reaches them there is barely any left or the water is only coming out of the tap slowly, in trickles.

Figure 3.9 (a) Pumping station located at *Los Sabinos* (b) Broken distribution pipes

TABLE 3.4 HOUSEHOLD TAP INSTALLATION DATES AND AMOUNT PAID IN PESOS, LABOUR AND MATERIAL

Year of installation	Household ID	Amount paid (pesos)	Material supplied (items)	Value of material supplied	Labour (person days)
2001	8	1000	0	0	0
2001	19	660	pipes	120	Doesn't remember
2001	16	500	0	0	0
2001	12	485	pipes	350	4
2002	5	250	1 bag cement	70	1
2003	7	300	0	0	30
2004	1	300	0	0	0
2004	17	300	pipes	100	0
2005	3	485	0	0	2
2005	9	0	0	0	3
2006	6	1100	6 pipes	630	1
2006	20	250	1 bag cement	76	2
2007	15	0	tap and pipes	Doesn't remember	0
2008	14	900	unkown	1200	0
No tap	10	-	-	-	-
No tap	18	-	-	-	-
No tap	11	-	-	-	-
No tap	2	-	-	-	-
No tap	4	-	-	-	-
No tap	13	-	-	-	-

TABLE 3.5 FREQUENCY OF TAP WATER DELIVERY FOR EACH HOUSEHOLD WITH ITS OWN TAP CONNECTION

Percent of months with 0,1,2,3,4 or 5 deliveries for each household with a tap

ID	No response or don't know	no delivery	1 delivery	2 deliveries	3 deliveries	4 deliveries	5 deliveries
1	21%	21%	21%	21%	8%	0%	8%
7	13%	29%	13%	25%	17%	4%	0%
20	29%	33%	8%	13%	13%	4%	0%
17	13%	17%	13%	33%	25%	0%	0%
16	4%	0%	21%	42%	29%	4%	0%
3	0%	13%	25%	38%	21%	4%	0%
19	29%	42%	21%	8%	0%	0%	0%
5	46%	29%	0%	21%	4%	0%	0%
6	4%	8%	29%	42%	13%	4%	0%
15	29%	17%	17%	17%	17%	4%	0%

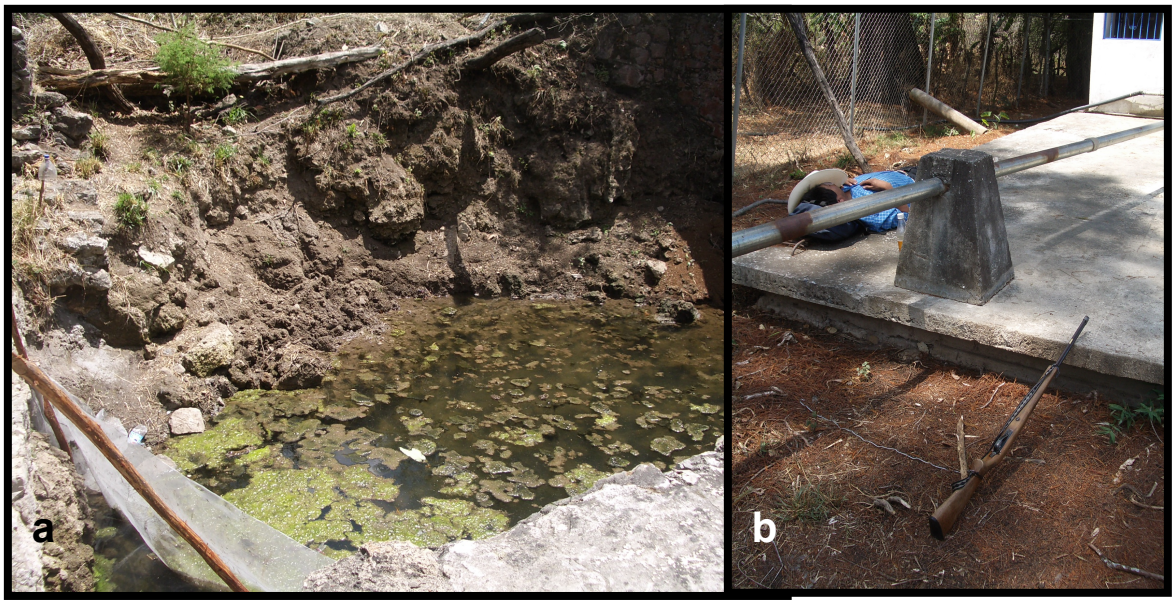

FIGURE 3.10 (A) A TRENCH WAS DUG SO THAT GROUNDWATER COULD BE PUMPED TO THE PUMPING HOUSE AT *LOS SABINOS* DURING THE 2007 DRY SEASON (B) AN ARMED MAN TAKES A REST WHILE GUARDING THE PUMP HOUSE FROM SUSPECTED SABOTAGE

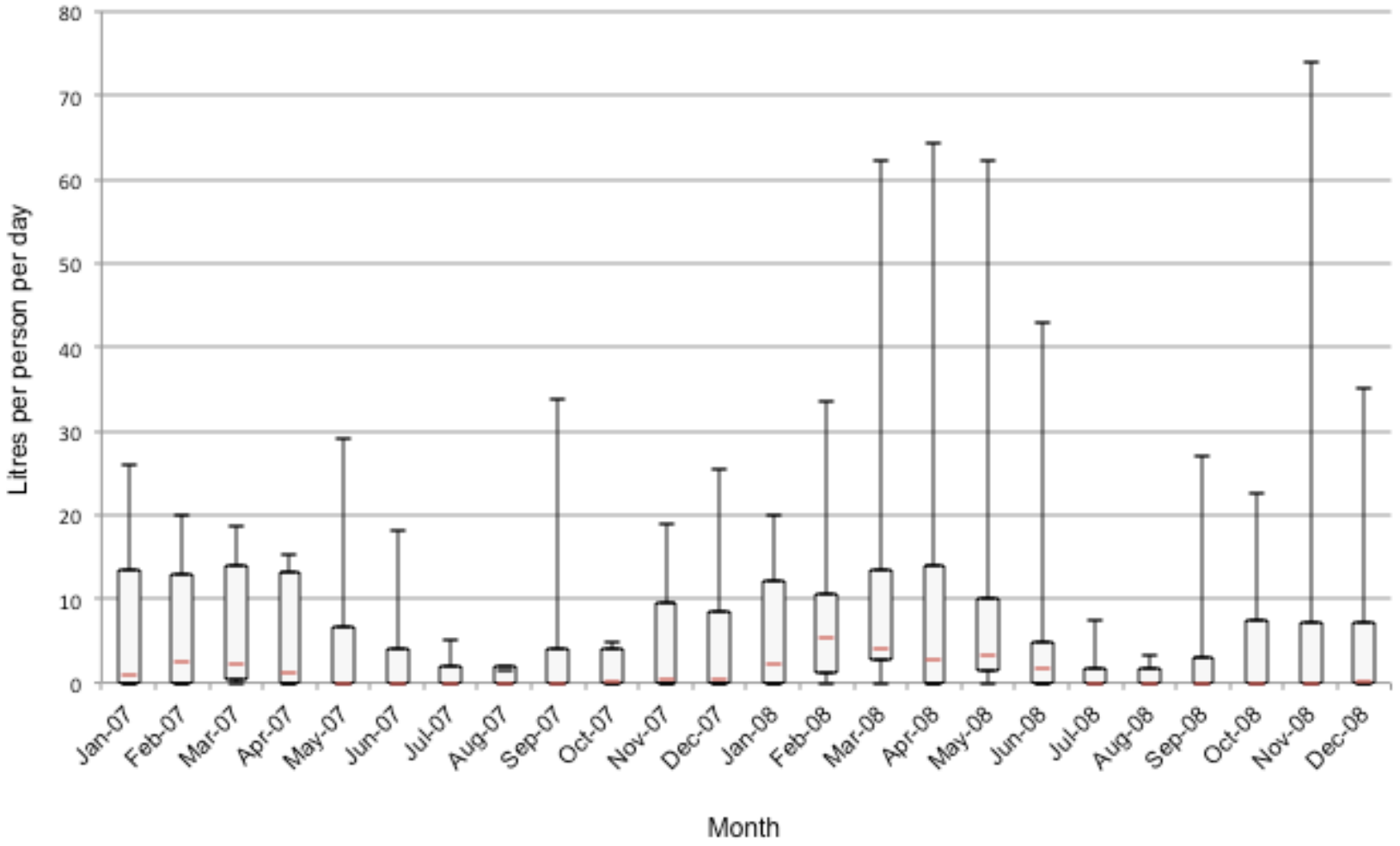

FIGURE 3.11 CUMULATIVE DISTRIBUTION (QUARTILES) OF TAP WATER PURCHASED BY HOUSEHOLDS EACH MONTH AS A FUNCTION OF AVERAGE LITRES PER PERSON PER DAY

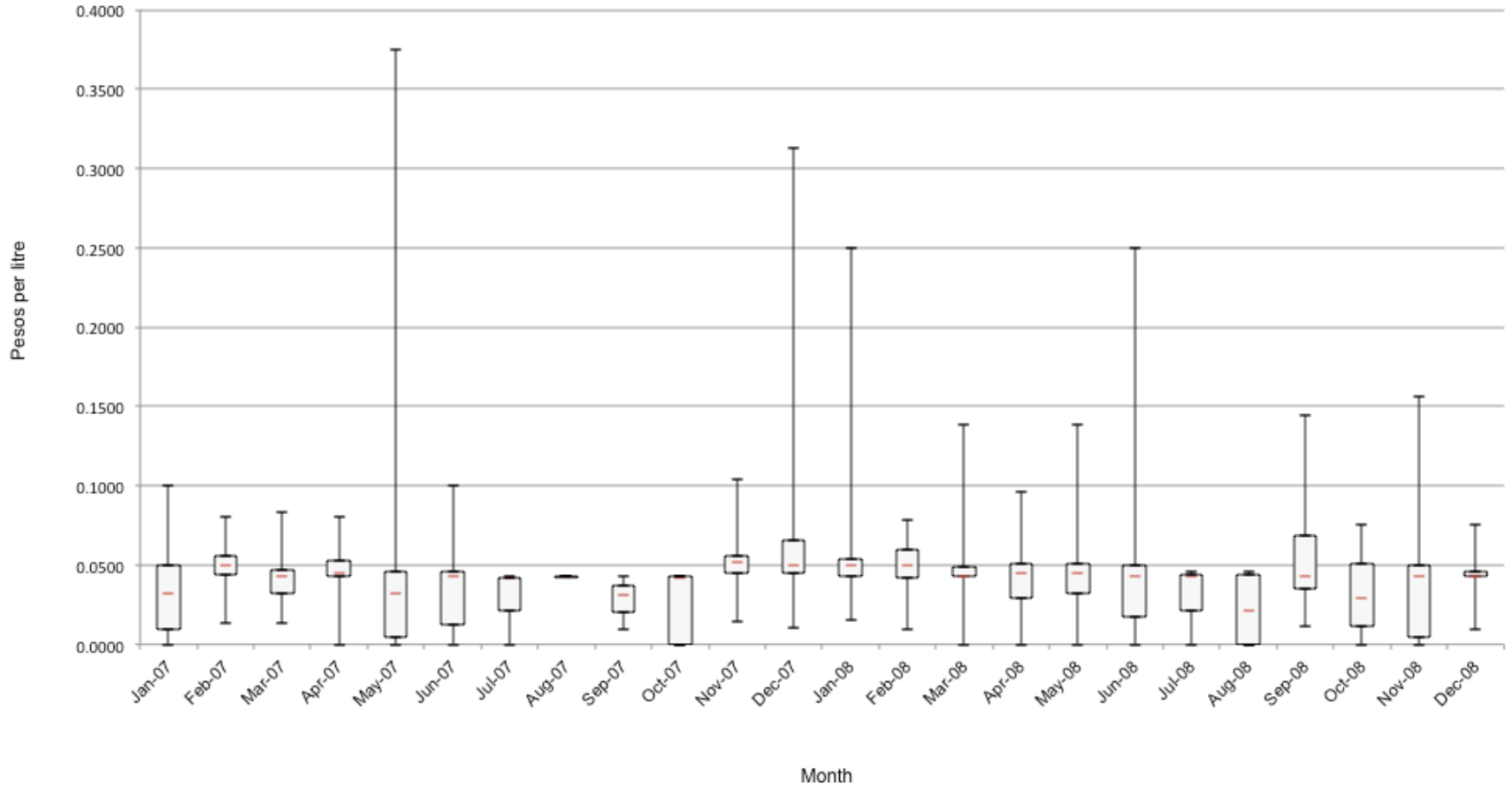

FIGURE 3.12 CUMULATIVE DISTRIBUTION (QUARTILES) SHOWING HOW MUCH EACH HOUSEHOLD PAYS FOR TAP WATER EACH MONTH (PESOS PER LITRE)

3.3.4 Well water

An important source of water is unprotected groundwater wells, or surface water lakes and runoff catchment areas. These sources are grouped together for the purpose of this assessment and referred to as wells. Four primary spring-fed wells constitute the most frequently used well sources and follow a fault in the limestone as they are situated roughly in a line down the hill (Atzin, 2012). Years ago, community members created open wells fed by the springs by dynamiting the rock, excavating loose rock with picks, shovels and by hand and by pouring concrete along the bottoms and sides of the excavations. Each well has a Nahuatl name and has also been assigned a number by *Atzin* for ease of sampling and reporting. Tlamapa (#1) is located at the top of the hill above most Tlamacazapa residents. Coixcapan (#2), Tlajilapan (#3) and Oztocapan (#4) are situated downhill. Figure 3.13 illustrates the spatial distribution of water sources. The wells are approximately ten meters deep, and are open at the top. Wells #2, #3, and #4 have wide openings and stairs have been constructed to reach the shallow water during the dry season. At the most elevated well, community members lower buckets from the top with a rope to reach the water during the dry season. There are also some smaller catchment wells that collect surface water flows during the rainy season and retain water for a period following the cessation of the rains. These include Michacapa, La Pila, Xochitltielpa and Colozintla (see photographs of some of the groundwater and surface water sources in Figure 3.14 and Figure 3.15). Residents obtain this water free of monetary cost although time and effort are required to retrieve the water from its source. Generally, males carrying water from wells will do so using two re-used metal cans attached to a yoke that is carried across their shoulders. Men carry thirty-six litres per trip using this method. Women tend to carry water using a sealed jug that is held within a cloth worn around their foreheads. Using this method, women carry twenty litres per trip. In some cases, residents may pay someone for the service of retrieving water from wells or lakes.

Volume

Although well water is free to all residents, there are some aspects that curbed accessibility. During the peak of the dry seasons, the wells became more difficult to access because the water table fell drastically. The photographs in Figure 3.14 and Figure 3.15 illustrate the pronounced differences between the wells during the wet and dry seasons. During the dry months, community members often had to wait up to several hours to fill one 20-litre bucket while the water slowly trickled into the well.

Political and interpersonal conflict sometimes exacerbated the challenge of finding water. At peak times, women frequently complained that they could not access Tlamapa, the well located at the highest elevation in Tlamacazapa and the well that provided the most volume of water. To access the water during the dry seasons, a bucket is lowered

into a rocky and slippery pit to a second person who has climbed down into the cavern. It is not socially acceptable that a woman lower herself into the cavern so women reported waiting long periods of time, sometimes ultimately in vain, for a man willing to help them. Most women instead frequented Coixcapan (well #2) during the peak of the 2007 dry season when water was most scarce, even though the line-ups at that well were typically longer.

One household reported inter-personal issues as a barrier to well water access. He had fallen into conflict with other men in the neighbourhood and claimed during the 2007 dry period that he could no longer go to the well because others would prevent him from accessing the water. His mother began taking over the chore instead for a time even though this meant she was then subjected to the wait at Tlamapa until a man was willing to help her.

During the 2007 dry period, with tap water delivery interrupted because demand for water for road construction had lowered the water table in the valley of *Los Sabinos*, residents had little option but to access well water in spite of the low water tables and long waits at the community's wells.
Figure 3.16 illustrates the cumulative distribution in quartiles of how much well water each household was accessing each month as a function of average well water volume per household member. Examining the median values and ranges between the first and third quartiles, it is evident that more well water was accessed by households during the 2007 dry period than in the 2008 dry period. In January 2007 the first and third quartile range was 0 litres per person to 7.61 litres per person compared with 0 litres per person to 4.41 litres per person in January 2008. This trend continued through to May. The data suggests that during the 2007 dry period, residents were compensating for the interruptions in tap water by accessing the wells more often.

No household save one ever accessed more than an average of 20 litres per person per day from the well. One household reported accessing an average of 69 litres per person in January 2007 and 74 litres per person in February, 2007. This household consists of one small family with four family members. They are one of only two participant households that had a water-using latrine. They were also the only household that tried to maintain a large garden after the annual rains ceased. They lived within 100 metres of Coixcapan (well #2) and so made frequent trips to the well. It is presumed that this outlier can be explained because the family was trying to maintain their garden before the stress on the wells became so great that the wait no longer warranted the many trips.

As with all sources of water, residents accessed substantially less well water during the rainy seasons than the dry seasons. In fact, many households who would normally use the wells stopped accessing them altogether during the rainy season, particularly in June and July when water was most plentiful. In March and April 2007 there were four to five households who did not access well water at all. In June and July 2007 there were nine to twelve families who did not use well water. The same trend is evident in 2008 when seven households did not access well water in both March and April 2008 compared

with twelve households that did not use water in June 2008 and fourteen households that did not use well water in July.

Another pronounced seasonal difference in groundwater and surface water access was in laundry use. When water was plentiful, most households chose to wash clothes at their homes, although there were four households that did laundry at the lake or at a well throughout the year. When water became scarce, many families took their laundry to the stagnant lake located in the valley below the community, known as *El Lago Grande* or *The Big Lake*. Three additional households used the lake for laundry during both the 2007 and 2008 dry seasons. A further three households began using the lake for laundry during the 2007 dry season when water was so scarce as to leave little option. Ten households never took their laundry to the lake. A mother in one of these households joked, when asked if she did laundry at the lake in April 2007 that no, "now we don't change [my eldest son's] clothes!" Residents occasionally reported bringing water back from the lake though only one household used the lake as a frequent water source. This family had a donkey so was able to hitch 40 litres of water onto the donkey's back which made the relatively long trek and uphill return journey worthwhile. By the end of April 2007, three households reported that they had stopped doing laundry in the lake because it had become too shallow and dirty.

Monetary cost

With few exceptions, residents accessed well water free of charge. However, given the long distances from some households to the wells and long waits at the well during dry seasons, there was an important opportunity cost to Tlamacazapa residents.

Occasionally, a household would pay someone to retrieve the water from the well. Four families did this on at least one occasion during the survey period. Three households did it only once during the 2007 dry season, whereas one household paid someone on several occasions throughout 2007 and once in 2008 to retrieve well water. These households reported paying between 5 and 10 pesos per trip to the well with each trip bringing them 36L of water.

Time (opportunity cost)

Typically, the time required to retrieve well water depended on a resident's proximity to the water source. Although the map of the community shown in Figure 3.13 illustrates a broad spatial distribution of water sources, several of these sources dry up during the dry season, including Tlashilmolco, La Pila, Michacapa, Xochitltielpa and Colotzintla. During dry season peaks, only the four principle wells still produce water and during the 2007 dry season only Tlamapa and Coixcapan (Wells #1 and #2) as well as the lake still had

available water. Residents not living near to those sources therefore had to increase the distance that they travelled to obtain well water with correspondingly increased time investments. Depending on the proximity, time required to get water could vary substantially. Participant households could complete a return trip to the well in as few as 6 minutes or as many as 58 minutes. During the rainy season, distance to the principle well sources ranged from a low of 55 metres to a maximum of 707 metres with a median of 438 metres. The first and third quartile range was between 216 and 500 metres. These distances corresponded with a minimum time of 6 minutes, a maximum time of 27 minutes and a median time of 15 minutes. The range between the first and third quartile was between 9 minutes and 20 minutes.

During the dry season, some families were still able to access their closest well. However, most families had to travel longer distances. Distance to principle well sources in the dry season ranged from 55 to 1,322 metres with a median of 559 metres. The first and third quartile range was between 12 and 28 metres. Corresponding times were 6 minutes to 41 minutes with a median of 23 minutes. First and third quartile ranges were from 12 minutes to 28 minutes.

Of the twenty participating households, only one never accessed the wells. Two households accessed the wells during the dry season only. Of the other seventeen households, only four were able to use the same water source throughout the year. The increased distance travelled to the well for the remaining thirteen households during the dry season when compared to the rainy season was between 149 metres and 1,043 metres with a median of 214 metres representing a difference of time of between 1 and 23 minutes with a median of 9 minutes.

Using the travel times to the well and the number of trips to the well that each household made during each month, the average time per person over sixteen years of age in each household was calculated for each month. The distribution of time spent by each household is illustrated in Figure 3.17. A sharp decline in time spent accessing well water is evident between the dry and rainy seasons as all households greatly supplemented their water use with rainwater captured on premises. A decrease in time spent accessing the wells is evident in the 2008 dry season compared to the same months in 2007. The range between the first and third quartiles is similar in January of the two years but begins to diverge from February through to April. The difference is most pronounced in April when the first and third quartile range in 2007 was between 17 and 228 minutes per month per person compared with the April 2008 range of 0 to 83 minutes per month per person.

Time calculations greatly underestimate the actual time spent retrieving well water, particularly during the dry seasons when there were line-ups at the well and particularly during the 2007 dry season when the water table was so low. These time estimates only take into account travel time but do not include time spent waiting at the well in line-ups or for water to slowly trickle into the bucket. In February, 2007, one household explained that to get well water, the father of the family would wake two of his young sons and they would make a couple of trips to the well between 5am and 7am before work and school

began. One household explained their frustration in April of 2007, “We did not go to the well for the whole month because we are tired of waiting. There isn’t any water left in the wells. We bought more bottled water this month because there isn’t other water available.” The next month, the same community member described the waiting, “My mother went to the well for three hours but wasn’t able to get any water. On another day, my sister went and after two hours, she returned with twenty litres of water.” Families began to adapt to the situation by accessing water later and later into the night. One family with eight children explained their evolving routine. In January 2007, during the first four days of the month, the mother and father would wake up at 4am and make two trips to the well. They would then wake up their three eldest daughters at 6am to do the third trip with them. Later on in the month, the father began to do all of the trips himself to let his family sleep. He would wake at 2 or 3 in the morning to complete 8 trips before the beginning of the day. In February, he began to work more and became tired of getting up early so his wife again began going with her five eldest daughters. By the beginning of March, five family members would go to the well at about 6 in the morning and were there until the afternoon. By the end of March, even more time was demanded. On one occasion, five family members went to the well at two in the morning and returned at 1 in the afternoon. This household’s experiences were echoed by several participants, who described spending entire nights in the well or collecting water nonstop for up to 36 consecutive hours. Though consistent time measurements were not taken nor recorded, by February, 2007 the repeated reports from Tlamacazapa residents were that the best possible situation was a one hour wait to collect one round (20 litres or 36 litres) of well water. Frequently, and certainly as water tables fell even further through to May, typical waits were much longer.

To provide a more accurate representation of the time residents were taking to access well water during dry seasons, the calculations were repeated adding 60 minutes per trip from February 2007 through to May 2007. An additional 10 minutes was added to each trip from February 2008 through to April 2008 to account for a less drastic waiting time – but a waiting time nonetheless. Even in a typical dry season, short line-ups form at the well as residents wait to access a small pool of water or lower buckets into a deep crevasse at Tlamapa (the most elevated well). The distribution of times spent by households in accessing well water per month, including these standardized wait times, as a function of average minutes per adult (16 years and older) is illustrated in Figure 3.18.

Vast differences are evident across households each month because of differences in household sizes, distances to well and inequitable access to the tap water. With wait times added into the calculation, the differences between time invested in collecting well water between the 2007 and 2008 dry seasons became even more pronounced. At the 2007 peak, in April, the range between the first and third quartiles of households was between 116 and 1,368 minutes per month (between 3.9 and 45.6 minutes per day, on average). It is important to note that to account for differences in household sizes, the calculations average the time spent over the number of people sixteen years and older in each household. More frequently, the task of retrieving well water was borne by one or

two individuals, so likely somebody or a few people in each household were dedicating more time to retrieving water than what is reflected here.

There are five families in particular that are reflected in the upper reaches of Figure 3.18, with maximum values reaching as high as 5,170 minutes per month in April, 2007 (2.8 hours per person per day, on average), and 5,102 minutes per month in February, 2007 (approximately three hours per person per day, on average). More frequently, the time for these five households during the 2007 dry months were below 3,500 minutes per person per month but in excess of 1,000 minutes per person per month. This equates to approximately between 30 minutes and 2 hours per person per day. These families tend to be large families with several smaller children and no access to tap water at all or no access to tap water during the months in which they frequently access the wells. The one exception to these commonalities is the small household of four people previously discussed, who were maintaining both a garden and a water reliant latrine into the dry season and who did not have access to sufficient tap water during February, 2007.

Going to the lake to do laundry was also time consuming. The lake is located more than a kilometer from the last area of homes at the bottom of Tlamacazapa's hills and is a steep return ascent. Several households described weekly laundry as a full 12-hour day event for two or three female household members.

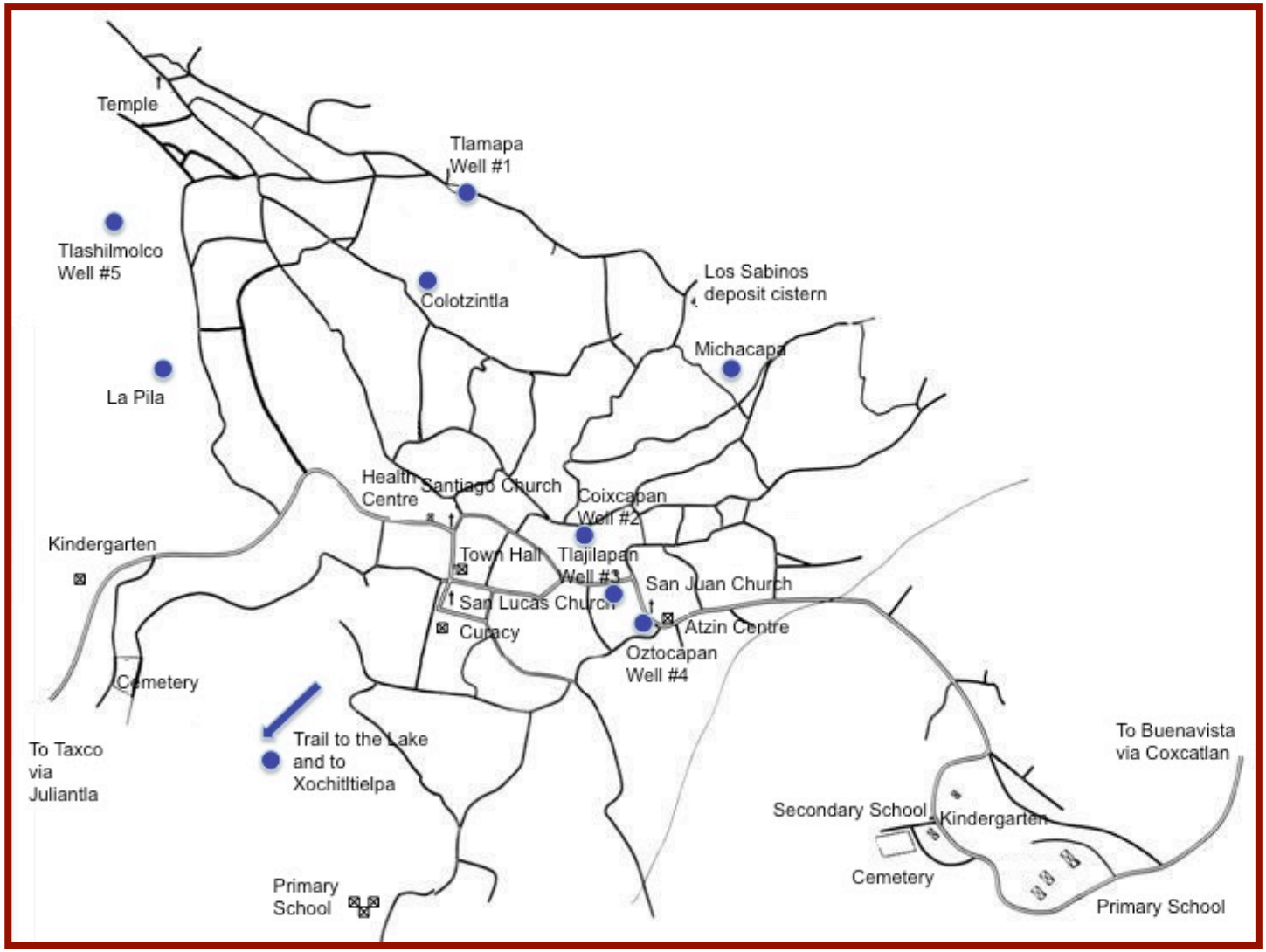

FIGURE 3.13 MAP OF TLAMACAZAPA SHOWING GROUNDWATER AND SURFACE WATER SOURCES

FIGURE 3.14 EXAMPLES OF WELLS IN BOTH THE DRY AND RAINY SEASONS

(A) MEN LOWER BUCKETS INTO TLAMAPA (WELL #1) IN MARCH, 2007. (B) TLAMAPA IN THE EARLY DRY SEASON. (C,D AND E) IN THE 2007 DRY SEASON, RESIDENTS WAIT FOR HOURS FOR A SINGLE BUCKET OF WATER AT COIXCAPAN (WELL #2). (F) TLASHILMOLCO (WELL #5) WHILE RAINWATER REMAINS.

FIGURE 3.15 COLLECTING WATER AND WASHING LAUNDRY
(A) LA PILA, A WATER SOURCE DURING THE WETTER MONTHS WHERE SURFACE WATER IS COLLECTED. (B) TINY BUCKETS ARE PLACED IN AZTOCAPACA (WELL #4) TO COLLECT DROPS OF WATER FROM THE WELL DURING THE 2007 DRY SEASON. (C) COLLECTING WATER DURING THE RAINY SEASON FROM MICHOCAPA. (D AND E) WHEN WATER IS SCARCE, MANY RESIDENTS TAKE THEIR LAUNDRY TO THE LAKE. (F) A FAMILY BEGINS THE HIKE BACK UP THE HILL FROM THE LAKE TO THE COMMUNITY.

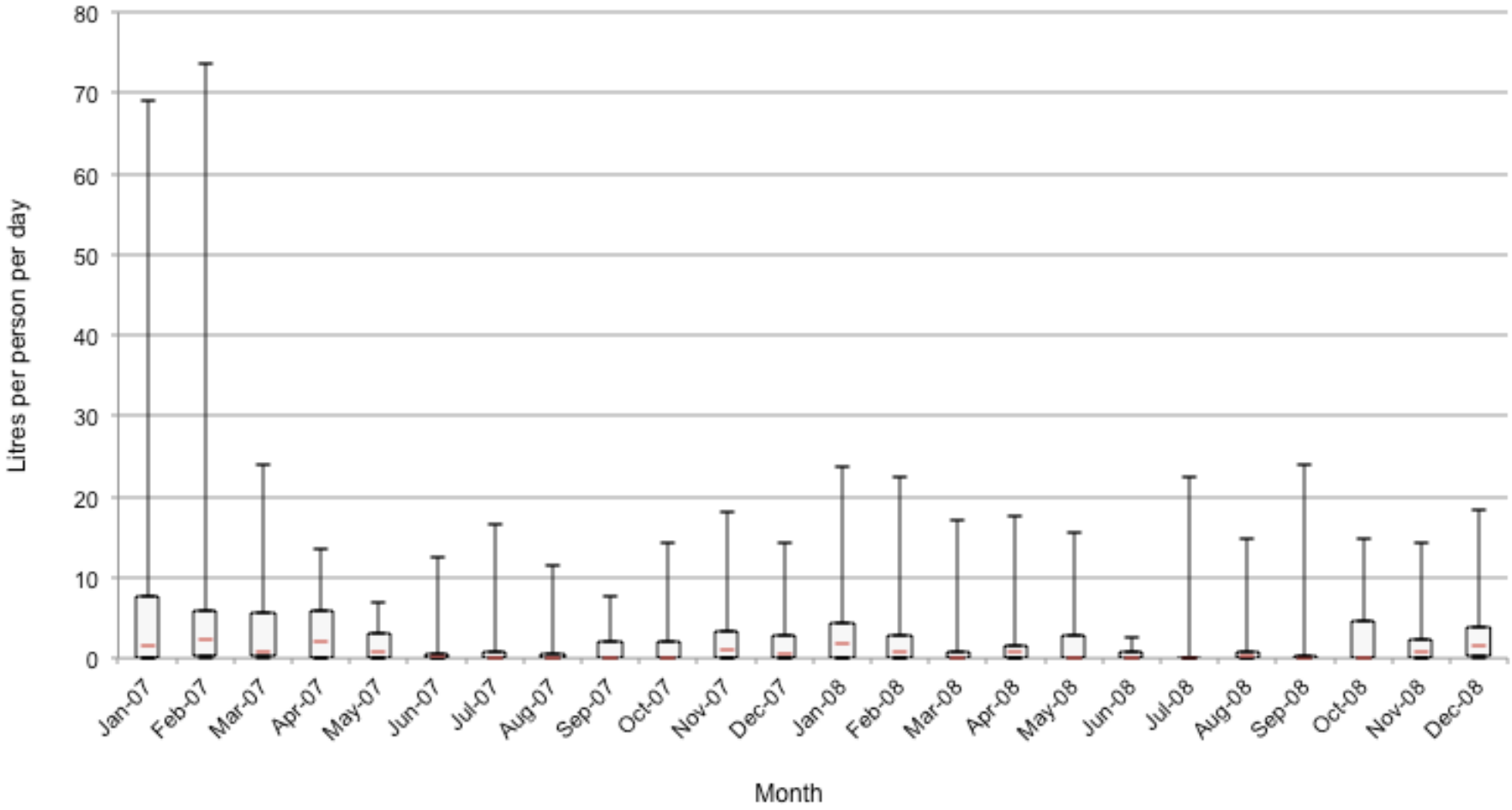

FIGURE 3.16 CUMULATIVE DISTRIBUTION (QUARTILES) OF AVERAGE WELL WATER COLLECTED PER PERSON PER DAY IN EACH HOUSEHOLD BY MONTH

TABLE 3.6 TIMES FOR EACH HOUSEHOLD TO COMPLETE A RETURN TRIP TO EACH OF THEIR WELL SOURCES

	PRINCIPLE RAINY SEASON SOURCE			PRINCIPLE DRY SEASON SOURCE			TERTIARY SOURCE (rare occasions)		
ID	Source	Distance (m)	Time (mins)	Source	Distance (m)	Time (mins)	Source	Distance (m)	Time (mins)
1	Coixcapan	97	6	Coixcapan	97	6	n/a	n/a	n/a
2	Michacapa	471	22	Tlamapa	771	30	n/a	n/a	n/a
3	Colotzintla	60	6	Tlamapa	535	29	n/a	n/a	n/a
4	Tlashilmolco	457	19	Coixcapan	671	28	Tlamapa	754	30
5	Coixcapan	279	11	Laguna Grande	1322	42	Escuchapa	951	38
6	Michacapa	566	27	Tlamapa	725	35	n/a	n/a	n/a
7	La Pila	531	26	Tlamapa	681	28	n/a	n/a	n/a
8	Tlashilmolco	500	18	Tlamapa	680	23	La Pila	398	14
9	Tlashilmolco	500	15	Tlamapa	681	20	La Pila	399	11
10	Tlamapa	438	21	Tlamapa	438	21	n/a	n/a	n/a
11	Tlajilapan	216	8	Coixcapan	365	9	n/a	n/a	n/a
12	Coixcapan	55	6	Coixcapan	55	6	Tlamapa	679	58
13	Tlashilmolco	503	20	Tlamapa	683	25	La Pila	397	15
14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
15	n/a	n/a	n/a	Coixcapan	133	8	n/a	n/a	n/a
16	n/a	n/a	n/a	Coixcapan	430	10	n/a	n/a	n/a
17	Coixcapan	244	9	Tlamapa	498	28	Colotzintla	145	8
18	Tlamapa	402	14	Tlamapa	402	14	n/a	n/a	n/a
19	Coixcapan	211	10	Tlamapa	559	27	n/a	n/a	n/a
20	Coixcapan	707	19	Tlamapa	1206	41	n/a	n/a	n/a

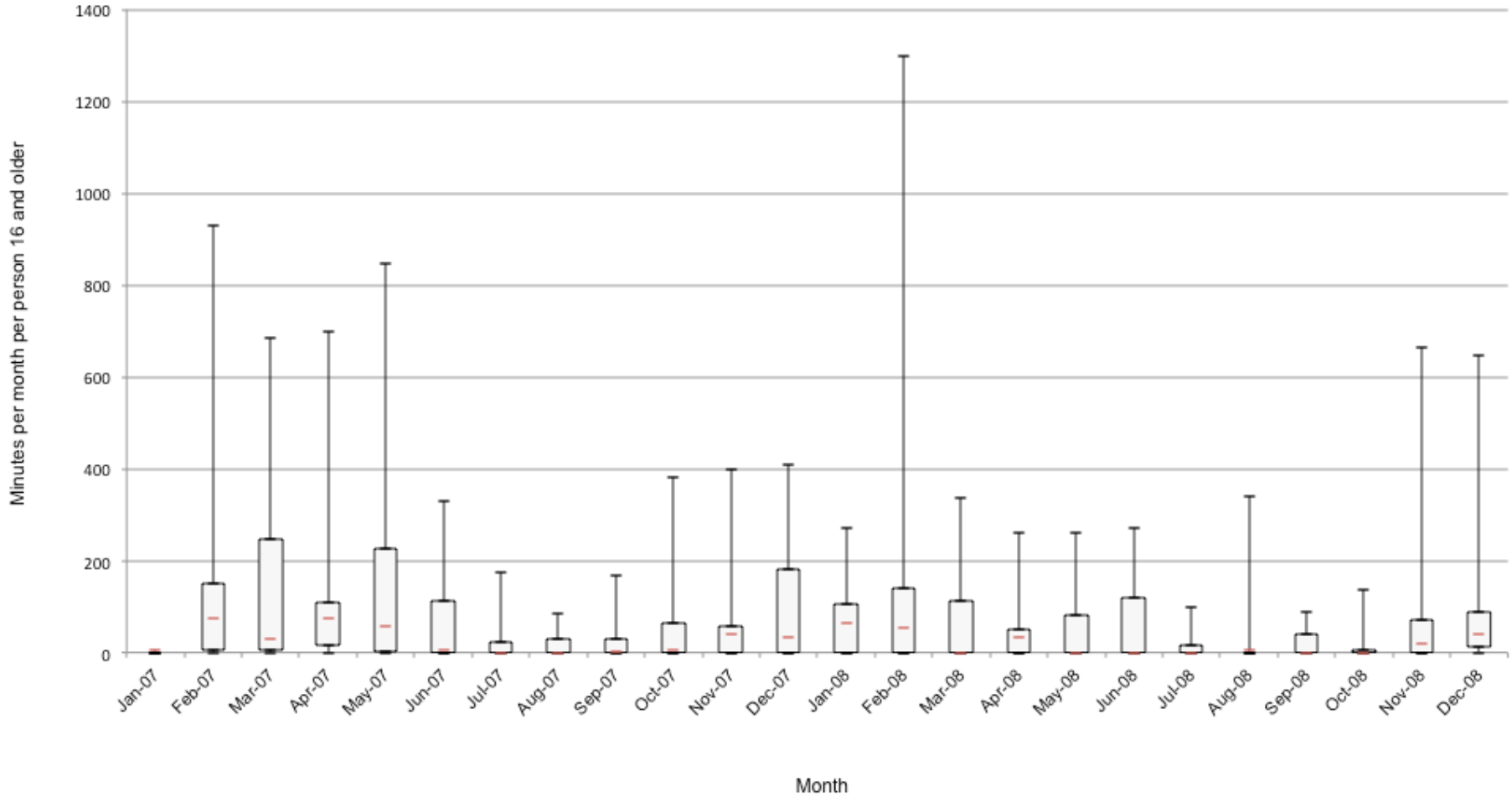

FIGURE 3.17 CUMULATIVE DISTRIBUTION (QUARTILES) OF AVERAGE MINUTES PER PERSON IN EACH HOUSEHOLD SPENT RETRIEVING WELL WATER BY MONTH (TIME EXCLUDES WAIT TIMES AT WELL)

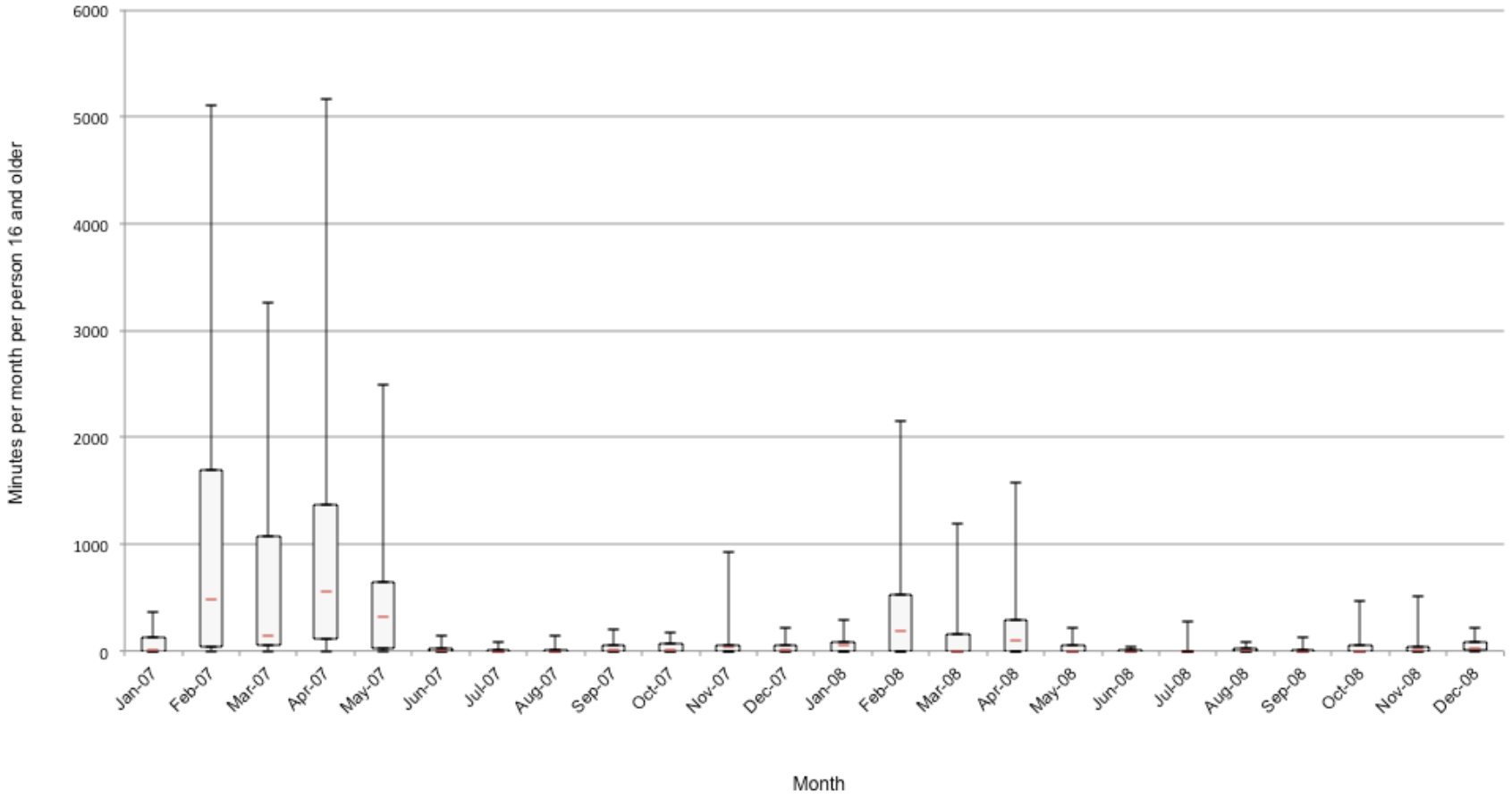

FIGURE 3.18 CUMULATIVE DISTRIBUTION (QUARTILES) OF MINUTES SPENT AS AN AVERAGE TIME PER PERSON IN EACH HOUSEHOLD (16 YRS AND OLDER) PER MONTH INCLUDING WAIT TIMES

Times include a standardized waiting time of 60 minutes per trip during the 2007 dry season and 10 minutes per trip during the 2008 dry season

3.3.5 Bottled water

Due to the elevated levels of naturally occurring lead and arsenic in Tlamacazapa's groundwater (and thus also in the tap water) bottled water was one of the few sources of water in Tlamacazapa during the study period that was potable. Captured rainwater, if boiled or solar distilled, was also likely to be potable.

Bottled water is one area in which the households samples were likely to be skewed from broader community averages. The households that were included in this study had either worked with Atzin closely or increasingly worked with Atzin as the study progressed. As a result, they were more likely to be aware of the negative health risks associated with consumption of untreated tap and well water than residents who did not work closely with Atzin. Or, and perhaps more importantly, they were more likely to trust and give credence to the available information.

Of the twenty households sampled, 16 (80%) were in the habit of routinely purchasing bottled water. Of the five that were not in the habit, they nonetheless purchased bottled water on occasion (one to five months of the possible twenty-four). Reasons were different for each household. One household had a very sick family member who passed away during the course of the study. This family purchased bottled water for two months prior to his passing in an effort to improve his health, on the advice of Atzin volunteers and health staff at the community health centre. A second family chose not to purchase bottled water except for one family member who often worked out of town and who preferred to drink bottled water. He therefore purchased water when he was in the community (five months). One family tended not to purchase bottled water but a young family member, who was increasingly earning her own wage, tried on occasion to direct her earnings to purchase bottled water.

Use of bottled water did not fluctuate greatly between months and seasons, although there was a slight trend during 2007 that is visible in Figure 3.19 for consumption to decrease slightly during the rainy season and increase again as rainfall subsides into the dry season. This corresponds with interview results in which families identified that they use rainwater as drinking water and cooking water in addition to bottled water.

Cost

The cost of bottled water increased dramatically during the course of the study period. In January, 2007, when the survey period began, households were all paying 17 pesos for a 20 litre bottle. They had two options of name brands to purchase, which were priced the same: *Los Angeles*, owned by *CocaCola*, and *Electrapura*, owned by *Pepsi*. By February 2007, the price had begun to rise in some stores to 18 pesos and by July 2007 all stores had followed suit. Prices continued to rise, however. All stores were charging 20 pesos by December 2007, 22 pesos by March 2008 and 24 pesos by December 2008. The increase in prices for bottled water reported in Tlamacazapa were far in

excess of the changes in the Mexican consumer price index over the same period and so cannot be explained by inflation (Banco de México, 2011). Figure 3.20 compares the monthly changes reported in the price of bottled water compared to the January 2007 cost with the monthly changes in the Mexican consumer price index compared to the January 2007 rate.

In June, 2008, a third bottled water alternative began to appear in households throughout Tlamacazapa, called 'Agua de Taxco' translated as meaning *Water from Taxco* – Taxco is a town about an hour's drive from Tlamacazapa and the shared understanding among residents was that the water was bottled in Taxco and then trucked and sold to stores or directly to households in Tlamacazapa. There were conflicting reports suggesting that the water was from a different nearby town and it was not confirmed whether one understanding was incorrect or whether two entrepreneurs from different locations had both begun to bottle and deliver their tap water. One person said that she had witnessed the truck water being filled from a groundwater source outside of Taxco, without any form of filtration or purification. From June to December 2008, six participating households began to purchase this alternate, cheaper (12 pesos) water. Two households switched entirely while the others purchased both types. Most households explained that they used the cheaper bottled water for cooking, but, not trusting its origins as much as the more expensive water, continued to use *Electrapura* or *Agua de Los Angeles* for drinking water.

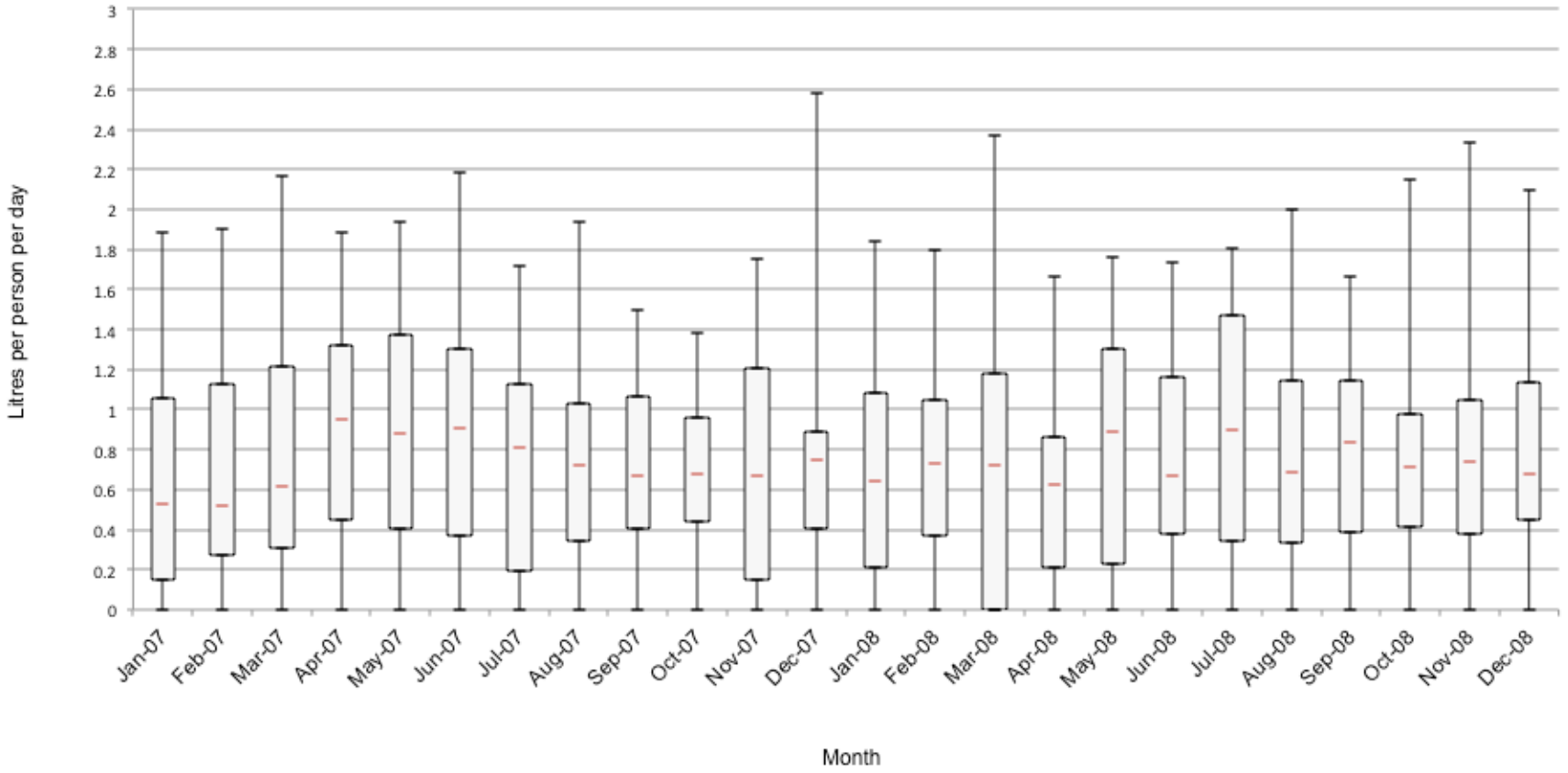

FIGURE 3.19 CUMULATIVE DISTRIBUTION (QUARTILES) OF CONSUMPTION OF BOTTLED WATER BASED ON HOUSEHOLD AVERAGES PER PERSON PER DAY

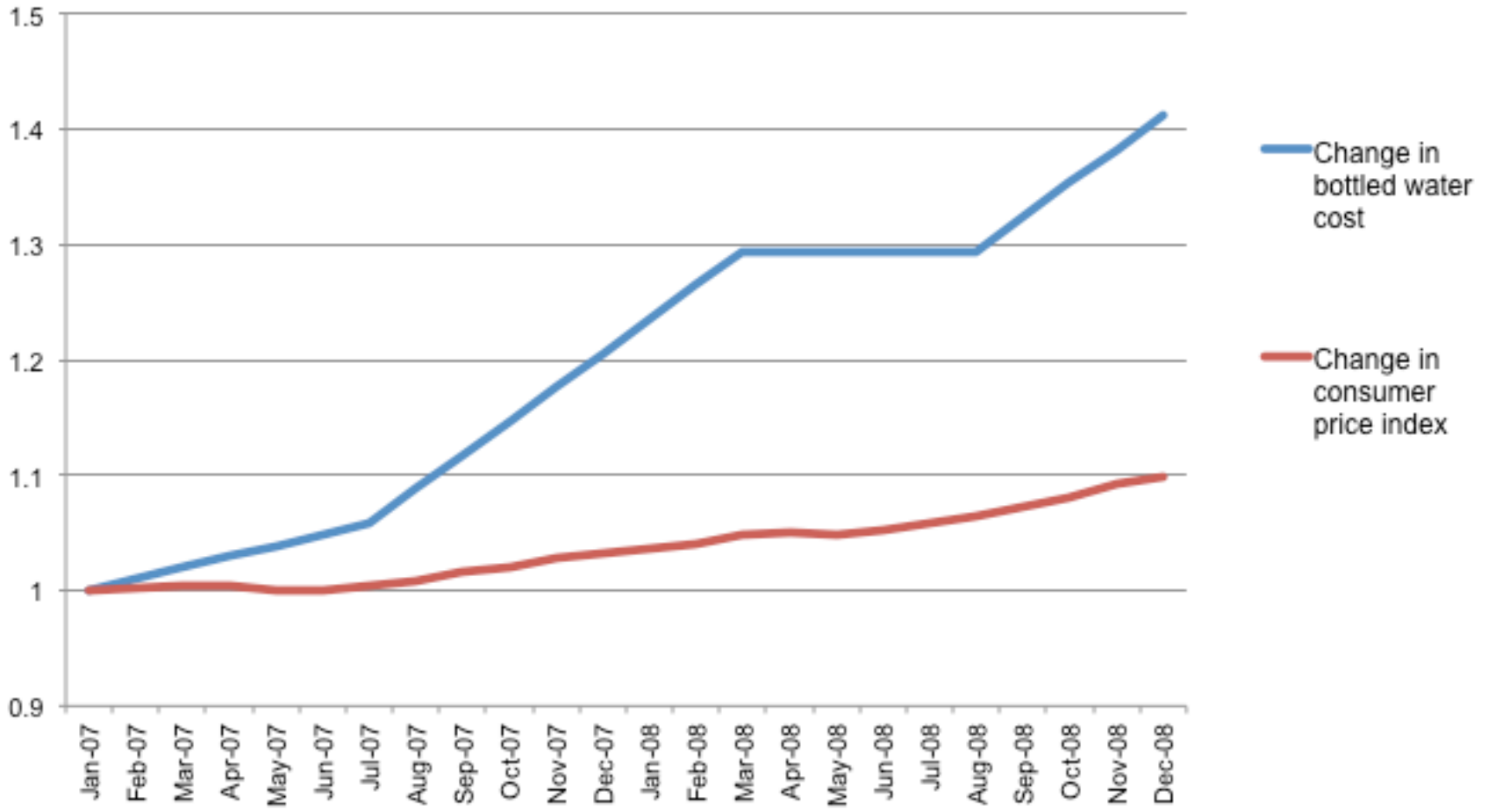

FIGURE 3.20 CHANGE IN BOTTLED WATER COST IN TLAMACAZAPA COMPARED TO CHANGE IN MEXICO CONSUMER PRICE INDEX OVER THE SAME PERIOD.

3.3.6 Trucked water

Trucked water was the least commonly used source of water in Tlamacazapa. However, trucked water was frequently available in the community and was brought in from a neighboring village. In times of scarcity, more families took advantage of this source as is evident in Figure 3.21, which shows a peak in use from January 2007 through to June 2007 and in April and May 2007 in particular when water availability was at its lowest point through the 2007-2008 period. In fact, throughout the study period only one household consistently purchased trucked water and did so every month except when rainwater was plentiful (no household purchased trucked water in July through October 2007 nor from June through December 2008). In April 2007, when the dry season was reaching its peak, four additional households purchased trucked water. During the next month nine households in total purchased trucked water.

Cost

Trucked water was evidently the last resort for all but one participant household. The average cost per litre of trucked water varied throughout the survey period from $0.12 pesos per litre to $0.23 pesos per litre. In January, February and March 2007 the household that was purchasing trucked water was paying $0.15/L. However, this increased to $0.18/L in April and $0.19/L in May as demand increased. The price remained erratic as the year continued and the family that consistently purchased trucked water paid between $0.12/L and $0.23/L from June 2007 to May 2008.

Some households noted that they were unable to purchase trucked water because the limited supply would run out before arriving at their house. The household that regularly purchased trucked water lived on the main street into town in the community's centre. This household also had the most total water storage compared to other participant households (11,301 litres) and so was able to routinely purchase large volumes (1600L to 5200L) of water from the truck which would arrive at their door and siphon the water directly from the truck into the tank. In contrast, several of the other households that supplemented their water during peak dry periods still had to carry the water from downtown and purchased only small amounts (as little as 200L). Trucked water was thus not regularly available to all residents.

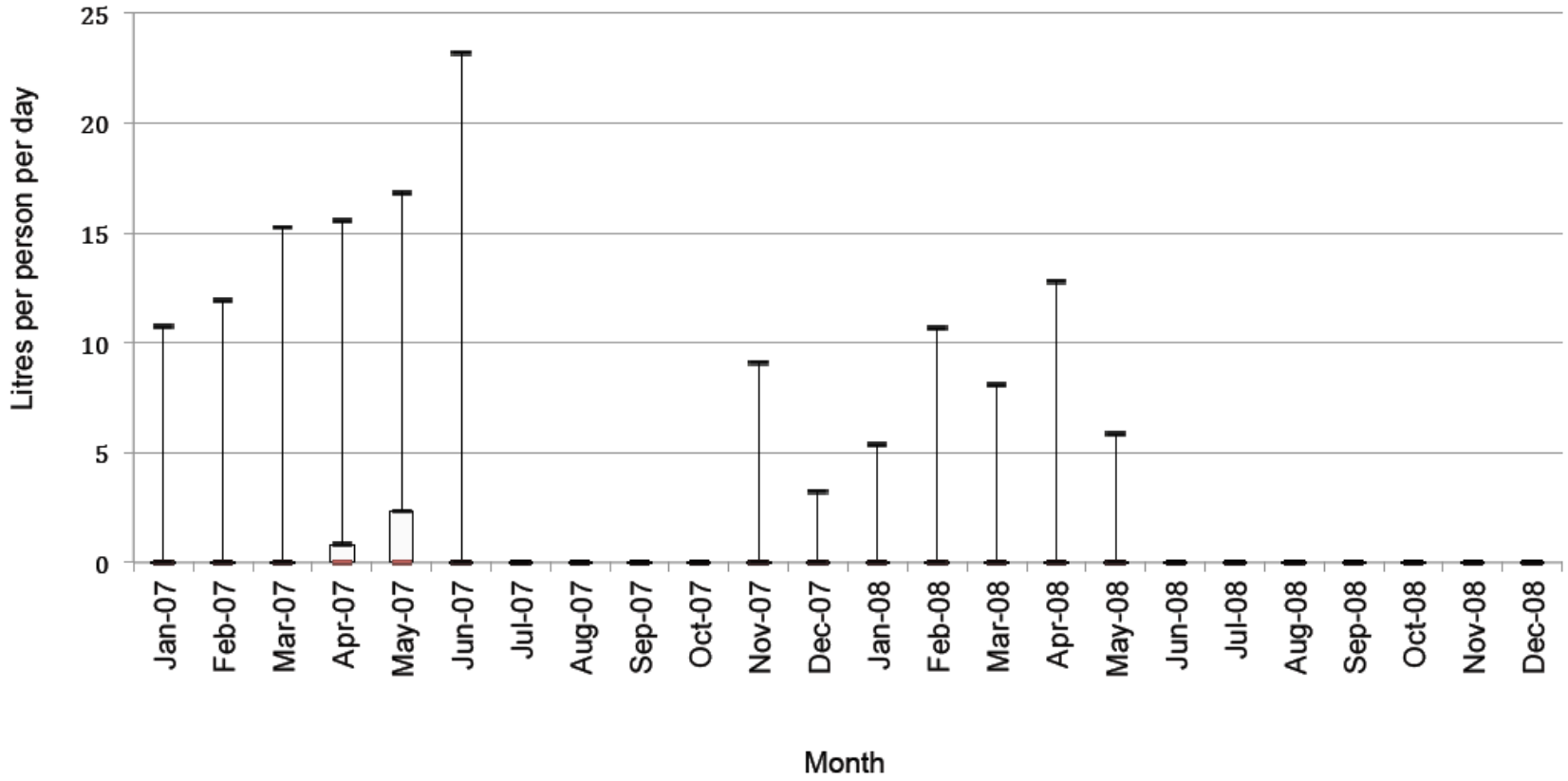

FIGURE 3.21 CUMULATIVE DISTRIBUTION (QUARTILES) OF TRUCKED WATER PURCHASED BY EACH HOUSEHOLD AS AVERAGE LITRES PER PERSON PER DAY

3.4 Cost relative to income

3.4.1 Cost relative to income

Participating Tlamacazapa households spend between 0.22% and 12.77% of average individual income on water from all combined sources. Table 3.7 displays each household's spending on water relative to income. Two households spend less than 1% of average individual daily income, eleven households spend more than 1% but less than 5%, five households spend between 5 and 10% and two households spend more than 10% of daily income per individual on water. The four households who spend the least percentage of their income are the four households that generally do not purchase bottled water.

TABLE 3.7 PERCENTAGE OF AVERAGE DAILY INCOME PER PERSON (16 YEARS AND OLDER) SPENT ON WATER FOR EACH PARTICIPANT HOUSEHOLD

Household ID	% of daily income per individual spent on all water sources	% of daily income per individual spent on bottled water	% of daily income per individual spent on tap water	% of daily income per individual spent on trucked water
9	**0.22%**	0.01%	0.14%	0.06%
18	**0.49%**	0.07%	0.06%	0.34%
6	**1.33%**	0.16%	1.18%	0.00%
16	**1.75%**	0.17%	1.58%	0.00%
20	**2.57%**	2.10%	0.47%	0.00%
15	**3.18%**	2.66%	0.35%	0.00%
11	**3.35%**	3.25%	0.10%	0.00%
5	**3.95%**	3.83%	0.12%	0.00%
7	**4.42%**	3.57%	0.76%	0.09%
14	**4.67%**	3.12%	0.01%	1.53%
4	**4.82%**	4.64%	0.18%	0.00%
13	**4.86%**	4.18%	0.40%	0.27%
2	**4.95%**	4.86%	0.09%	0.00%
19	**5.58%**	5.33%	0.23%	0.00%
3	**6.51%**	5.65%	0.82%	0.04%
12	**6.72%**	6.62%	0.06%	0.03%
1	**7.38%**	5.27%	1.06%	1.05%
10	**8.37%**	7.95%	0.43%	0.00%
8	**10.15%**	8.00%	1.45%	0.70%
17	**12.77%**	11.33%	0.84%	0.46%

3.5 Storage

How much water a household can access from each water source was determined not only by availability and cost but also by how much water storage the household had available. Of the twenty participating households, total volumes of water storage varied vastly, ranging from 44 litres per person to 1367 litres per person. Five families had less than 100 litres per person available for storage and half of the participating households had less than 500 litres per person of available water storage. Precise household storage volumes are listed in Table 3.8. The eleven households with the most available storage per person (ranging from 338 litres per person to 1,367 litres per person) all had concrete storage tanks of 3,500 litres or more). In contrast, the nine families with 271 litres per person or less did not have tanks and only used an assortment of metal and plastic containers.

Households tended to use a diverse assortment of containers to store water. Occasionally sealable jugs were used or tanks with lids; however in many cases open barrels, pails and tins were used to store water. Typical assortments of water containers are shown in figure 3.22. The eleven households who had concrete tanks had total available tank volumes of 3,500 litres (two households), 7,800 litres (seven households), 14,500 litres (one household) or 22,000 litres (one household) available storage in their concrete tanks alone. The various designs of tanks used by families are shown in Figure 3.8. All tanks except for one were constructed by *Atzin*.

TABLE 3.8 TOTAL WATER STORAGE CAPACITY PER HOUSEHOLD AND HOUSEHOLD WATER STORAGE CAPACITY PER PERSON

Household Identifier	# of people (averaged over 24 months)	Total storage volume overall (litres)	Total volume storage per person (litres)
8	8.1	11071	1367
20	6	8057	1343
4	6.8	8940	1315
13	7.1	8277	1166
9	8.2	8483	1035
16	8.7	8452	971
11	9.2	8913	969
5	8.9	8301	933
14	12.4	11301	911
15	7	4614	659
2	9.8	3317	338
1	3.8	1031	271
10	3.6	459	128
6	10.8	1152	107
17	7.2	755	105
7	9.2	863	94
12	23.1	2145	93
18	5.2	449	86
19	8.1	604	75
3	9	394	44

FIGURE 3.22 EXAMPLES OF VARIOUS TYPES AND SIZES OF CONTAINERS USED BY HOUSEHOLDS TO COLLECT AND STORE WATER

3.6 Use

When piloting the interview tool and during dialogues around the monthly water calendars, several routine uses of water were identified. In Tlamacazapa water is routinely used:

- to drink
- to prepare food
- to wash floors in houses that have cement floors
- to dampen floors inside houses that have dirt floors as this reduces airborne dust
- to water an array of plants on the lot
- to bathe
- to wash laundry
- to 'flush' toilets in households that use septic pits
- to give animals water to drink
- to mix with dyes that tint the palm leaves used for weaving
- to boil and soak the palm leaves in preparation for weaving.

In addition, occasional uses of water that can create peaks in household use include 1) holidays in which a number of family members return for several days or weeks at a time, or 2) house constructions or renovations through which a great deal of water is used to mix concrete and for the construction workers to eat and drink.

Interviewees were asked to estimate how much water was used for each activity and if this differed between seasons, between years (2007 and 2008) or between household members. Households used the vast majority of their water for laundry and for bathing. Based on the results, the average volume used for laundry per person per day changed little for most households between the rainy and dry seasons except when families chose to do their laundry at the lake or well.

In the rainy season, the median volume of water used per person per month for laundry was 142 litres, which fell to 99 litres in the dry season. Similarly, households tended to use consistent volumes for bathing between the rainy and dry seasons. Where differences were reported, they were increases in water volume or frequency of bathing in the dry season, when the hotter weather and resulting dust motivated some people to bathe more. Median volumes used for bathing were 166 litres per person per month in the rainy season and 180 litres per person per month in the dry season.

Only two of the twenty households had a pit latrine requiring water. One of these households reported that they only used greywater from laundry with a bit of chlorine added to flush the toilet. The other household estimated that about five litres were used every time a household member used the toilet.

No household watered plants during the rainy season; however in the dry season, all but five families used some freshwater (as opposed to used water) to water some plants. Of the five families that did not use freshwater to water their plants during the dry season, three watered their plants but used grey water. Though one household reported using up to an estimated 200 litres per person during one month on their garden, most households used no more than 31 litres per person per month with a median volume of

14 litres per person per month. Of the fifteen families that used freshwater to water the plants, one reported supplementing the water with grey water when available[13].

Households used much smaller volumes for other uses including washing floors, dampening floors, other household cleaning, boiling palm and dying palm. Fourteen households used water to dampen their dirt floors to settle the dust. Of these, four did so during the rainy season only when water was not scarce, five did so during the dry season only when the dust was at its worst, and five households maintained the routine throughout the year.

Six households never dampened their floors because they had concrete floors throughout their homes. These households instead used water to mop and used no more than five litres per person per month for this purpose. Two households only washed floors during the rainy season. Of the six households that washed their floor throughout the year, three used less water during the dry season and three used consistent volumes throughout the year. Another family noted that they did use water to mop their floor but that it was always dirty water left over from bathing or other uses. They estimated using approximately 5 litres a month for this purpose. Respondents were asked if they used water for any other purpose not specified and no other uses were identified.

Although water use habits appeared to differ little between rainy and dry seasons, the method used for this section (recall interview only) was likely not appropriate for capture differences in volumes. Participants' tendency to generalize as well as insufficient attention paid to water reuse during the dry season, limits the resolution of these volumes. It is much more likely that water use increased substantially during the rainy season.

[13] For all households, plants were small collections of potted flowers or an occasional fruit tree growing on the property. Subsistence agriculture does not occur in any household in Tlamacazapa limited not only by water but also thin soils and steep slopes. Some corn is grown in fields outside of the community or on household lots during the rainy season when the rain itself is sufficient to water the crop.

4 Discussion

4.1 Water in Tlamacazapa: comparison of indicators to thresholds

Officially, Tlamacazapa is “served” in terms of water supply. By 1999, the community had a state-funded piped water network that supplied it with groundwater from an adjacent valley through private and public taps. The additional water supply alleviated the pressure on the local spring-fed wells and significantly reduced the work and time needed to acquire water. Reduced it, that is, for those able to pay the price of tap installation and volumetric water costs and for those with sufficient storage capacity to take advantage of the piped system.

Water is insufficient in abundance, frequency and quality to meet public health objectives in Tlamacazapa. Nonetheless, according to national and international standards of reporting and monitoring, the community would be and is counted as one covered by potable water infrastructure and thus contributing towards improved public health goals. It is important, given the broad definitions used to identify ‘improved’ water supply, that the situation of water access and delivery is understood in more context-specific detail.

Two years of household data compiled from Tlamacazapa shows that 1) households are not attaining sufficient water to meet basic consumptive, sanitation and hygiene needs and that 2) the water available is not clean and presents a health risk.

Current infrastructure management further hinders availability of water. Once built, management of the infrastructure was handed to appointed local authorities. The system has subsequently been managed by individuals wholly ill equipped to operate and maintain a water supply system with evidence of political patronage and lack of transparency in accounting. The resulting situation in Tlamacazapa could be compared to the phenomenon referred to in the literature as “elite capture,” wherein service infrastructure, though public, is managed to the benefit of privileged groups at the exclusion of others.

The situation could be presented as an example of state failure. As Mexico’s regulatory and legislative environment seems mobilized to not only allow for but also to foster private sector participation in water service delivery (Hearne, 2004; Marañón, 2005; Ozuna and Gomez, 1998; Tortajada and Contreras-Moreno 2005; Rowland, 1998) the example of Tlamacazapa warrants close analysis to recognize the challenges to delivery and how these would need to be addressed in any governance structure regardless of the precise nature of public or private sector involvement (Bakker et al., 2008; Budds and McGranahan, 2003).

4.1.1 Water sources

Tlamacazapa community members attain water from a variety of formal and informal sources: rainwater, well water, lake water, tap water from their own tap, a neighbour's tap or a public tap, trucked water and bottled water. The relative importance of each source changes seasonally depending on availability and associated economic and opportunity costs. Rainwater is the most important source in volume when it is available during the rainy months and is collected from roofs, pipes and hanging tarps into barrels, buckets and cisterns. Tap water accounts for the second largest total volume of water accessed followed closely by water carried by residents in buckets and jugs from underground springs, lakes or runoff catchment ponds. Bottled water also accounts for an important amount of water used, though this is reserved for drinking water and cooking purposes. Finally, water purchased from water trucks that bring water from an adjacent town provides an additional source for some, though much fewer residents.

4.1.2 Water volume

Residents of Tlamacazapa subsist on less water than even the most conservative benchmarks. During the driest month, March, in 2007 and 2008, the median fifty percent of study participants accessed only between 4.6 and 13.9 litres of water per person per day. Households facing the most severe challenges to water access subsisted on as little as 4.6 litres per person per day in March 2007.

These figures are startling when compared with average daily uses reported elsewhere in Mexico, with averages from other countries and with benchmark indicators of what would constitute enough water for basic needs.

CONAGUA (2011b) reported average daily uses per person from 33 Mexican cities ranging from 128L to 548 L per person per day[14]. Chilpancingo, Guerrero's capital, has a reported average daily provision of 175 litres per person per day. Even the families with the greatest access in Tlamacazapa in March 2008 had 12.5 times less water than their neighbours in the State's capital.

The average volume of water used by the vast majority of Tlamacazapa residents is nominal compared to the 20-50 litres per person per day recommended as minimum basic access (Howard and Bartram, 2003; Gleick, 1998). According to the framework to assess access published for the WHO by Howard and Bartram (2003), less than 5 litres per person per day of water is considered to essentially be *no access* and to constitute a *very high* level of health concern. Basic hygiene, they reasoned, could not be assured

[14] This measurement appears to be at source and so may include commercial uses and leakage, thus actually overestimating the actual use per person per day.

unless practiced at source and even basic consumption needs could not be met at this level. In March 2007, 30% of study participants in Tlamacazapa accessed less than this 5 litres per person per day threshold and 25% of study participants accessed less than 5 litres per person per day in March 2008. Using the same framework for assessment, less than 20 litres of water per person per day is considered basic access, with consumption needs being met and some hygiene possible such as food and hand-washing; however bathing and laundry could only be adequately accomplished if practiced at source. Distances, cultural norms and time limitations would not allow for laundry and bathing to be practiced at source and so it is clear that adequate hygiene standards were jeopardized for all participating households. In March 2007, 100% of participating Tlamacazapa households fell short of meeting *basic water access* defined by this standard. In March 2008, 92% of participating households lacked even *basic access*.

Although March is the most severe month of water shortage in Tlamacazapa, it is the most accurate month to use for comparison from the data collected because families generally had access to absolutely no rainwater captured on premises with which they could supplement tap, well, trucked or bottled water. In earlier months after the rain ceased (November, December, January) families with tanks would also be able to use water stored from the rainy season. During the rainy season, late April to September, families are able to supplement purchased or fetched water with intermittent rainfall.

Water use does not appear to change dramatically between seasons, suggesting that habits (such as bathing and cleaning) established during the long periods of water scarcity are generally maintained throughout the year. The most commonly reported change in habits was that when water was plentiful shortly after the cessation of seasonal rains, a number of households used extra water to water potted plants or fruit trees, a habit that would waiver as scarcity became more severe. The interview questions used to elucidate household water use, are not, however, at sufficient resolution to determine small changes in habits. Conceivably and presumably, during seasons of less scarcity consumption and hygiene would have improved.

4.1.3 Economic cost of water

Although scarce evidence can be found in the literature to link costs to specific health or socio-economic objectives, a threshold of 5% of net household income is the most commonly cited level for maximum acceptable expenditures for water (WHO, 2004; OECD, 2003; Whittington et al. 1990) though some benchmarks are lower (World Bank, 2002). All benchmarks assume adequate and universal supply.

In Tlamacazapa, if purely economic cost (as opposed to opportunity cost) of water is considered, 35% of participating households exceed this 5% threshold on average. The reason why so many families are able to avoid the cost, however, is by compensating

through additional work (by using the free but time consuming well source over tap sources) or by foregoing safe potable water (bottled water). The three households consuming the lowest proportion of overall income are not, for instance, the wealthiest families. Rather, they are among the poorest included in the study but their poverty excludes them from being able to afford bottled water or to access tap water. Indeed, the 20% of households that pay the least proportion of household income on water are the only four households that do not purchase bottled water on a regular basis.

At the other end of the scale, the top three proportions of household income spent on water are 13%, 10% and 8%. These ranges are within the vicinity that the lowest 1% of income earners in OECD countries spends on water and wastewater services (10.5%, OECD, 2003).

In Tlamacazapa, there is evidence of the trend reported elsewhere (Gulyani et al., 2005; Bakker, 2007b; Mehta, 2000), that the poorest of the poor households not only pay the most for water in a relative sense (as proportion of income, see for instance Frankhauser and Tepic, 2007) but also in an absolute sense (as price per unit of water).

For instance, those able to pay for tap water on a monthly basis rather than a per barrel price, consistently pay less per unit of water. However, only families with sufficient storage are able to take advantage of this offer. Given that the construction of a water tank represents such a large up front capital cost as well as space on land and land title, poorer or more marginalized households can be excluded from achieving this investment. In Tlamacazapa, the presence of so many tanks is largely the result of a program operating within the non-governmental organization *Atzin,* which subsidizes the construction costs of tanks from between approximately 50% and 95%, the sliding scale being dependent on an assessment of the household's ability to contribute financially. Of the twenty participating households, thirteen households have at least one large water storage tank but only one of these households has a small tank that was not constructed through this subsidized program.

Of the six families that do not have tanks, five cite a lack of space as the primary obstacle illustrating that even in the face of subsidies, lack of economic resources to access land still presents an obstacle and indirectly results in poorer families paying a higher absolute price for water. Similarly, on a number of occasions, households reported not having sufficient money at a given time to purchase a regular 20-litre bottle of water. These families, intent on drinking clean water and some with severe underlying health issues that tend to be exacerbated if other sources are consumed, reported purchasing smaller bottles of water to carry them through until additional monies were found. These smaller bottles were reported to be more than twice as expensive per litre as the regular twenty litre jugs.

Rates for piped domestic supply in Tlamacazapa are either a flat monthly rate of 75 pesos or a charge of 50 pesos per cubic metre. A number of tariffs charged in urban centres for 2007 and 2008 throughout Mexico, ranged in 2007 from a low of 0.74 pesos per cubic metre (Oaxaca) to a high of 13.60 pesos per cubic metre (Acapulco)

(CONAGUA, 2009, p 53). In 2008, most tariffs were raised, resulting in a range of 1.26 pesos per cubic metre (Oaxaca) to 14.29 pesos per cubic metre (Acapulco). The most common rate of 50 pesos per cubic metre paid by Tlamacazapa residents is 3.5 times the highest rate reportedly charged elsewhere in Mexican urban centres. The rate paid in Tlamacazapa is roughly equivalent to $CDN 5 per cubic meter.

It has been observed and documented that volumetric water costs are lower in Latin America and Africa than, for example, North American or European counties. However, even compared to OECD countries, the rate paid by Tlamacazapa residents is staggeringly high. Compare $5 USD/$m^3$, for instance, to the rates paid in USD per cubic meter by OECD countries from data taken from a single year between 1997 and 2001 (OECD, 2003). There are only two countries that pay a comparable rate: Norway, paying 5.10 USD/m^3 and Denmark paying 4.10 USD/m^3, yet these two countries are among the most affluent in the world such that the value of the payment relative to income pales in comparison to what residents pay in Tlamacazapa. The median volumetric tariff paid by OECD countries documented in the referenced review is 1.44 USD/m^3 implying that Tlama residents pay roughly 3.5 times more than the median rate paid by OECD countries, in absolute terms.

4.1.4 Opportunity cost of water

In fact, considering the purely economic cost of water in Tlamacazapa obscures the true cost, since so much of water is accessed free of money but at a considerable cost in time, energy and duress.

Even during seasons when water is relatively plentiful, the majority of Tlamacazapa residents require substantial time to fetch water from wells. During the rainy season a resident would travel a median distance of 438m in order to complete one trip to the well resulting in 20-36 litres of water. Corresponding time investments for these trips were 6 to 27 minutes with a median duration of 15 minutes. In the dry season these distances and times would increase to a median of 559 metres (23 minutes) and up to 1.3 km (41 minutes).

Howard and Bartram (2003) included time and distance in their rule of thumb framework for assessing acceptable water access, suggesting that anything farther than 1 km or requiring more than 30 minutes to access would likely result in very low quantities of water (<5 litres per person per day) and would constitute *no access*. They rated a distance of between 100 and 1000 metres or 5 – 30 minutes of time to be *basic* access and constitute a *high* health risk. If distance alone is considered, then almost all of the participant households in the wet season and all of the households in the dry season would be rated as receiving *basic access* only with a corresponding *high* health risk

while the households furthest from the sources essentially had *no access* and very high resulting health risks.

Distance alone is generally only an adequate proxy of time during the rainy season when waits at the well are not required. As the rain subsides and the water table slowly lowers throughout the dry season, this wait increases exponentially. Indeed, during the height of the 2007 dry season, households were waiting a minimum of 1 hour to collect a single jug of water. Typical dry season waits are shorter but still expected because fewer springs are producing water and so lineups are longer as individuals wait to fill their small buckets with ground water that is slowly trickling into otherwise empty wells. When these waits are considered, the opportunity costs become much more severe. In April 2007 average waits per individual 16 years and older in each household was as high three hours per person per day. The 25% of households that spent the most time retrieving water tended to spend on average between 30 minutes and 2 hours per person per day during the driest months in 2007.

4.1.5 Politics and governance of water

Water access in Tlamacazapa reflects policy decisions at national and global levels as they were implemented on the ground.

Tlamacazapa residents largely relied on well water and captured rainwater until 1999 when the system of pumps and pipes was installed, bringing water from an adjacent valley into taps on private and public property. Consistent with the dominant policy of the time (Hearne, 2004; Ozuna and Gomez, 1998; Rowland, 1998) the infrastructure was paid for with state money but management was left to local control.

The situation that then arose could be said to represent an example of *capture of the elite*. Two men took control of the distribution of water and collection of payments. Examples of stories shared by study participants suggests that access to the infrastructure both in terms of whether a connection was possible or what price would be paid for the connection was variable and dependent on any number of arbitrary whims of those with the power to make the decision. Political affiliations and friendships all seemed to be sufficient reason to pay variations for upfront connection costs and on-going payments for services.

The system lacked transparency. Operating costs were not public knowledge nor was it clear how people were paid or how much profit was being generated.

In around 2005, consistent with policies promoting full cost accounting (Hearne, 2004; Ozuna and Gomez, 1998; CONAGUA 2009, 2010, 2011) metres were installed with all new tap installations, and slowly over a period of a number of years, old taps were retrofitted with new metres. These water meters were never actually used to measure water. Very few (<4% of study participants) were able to read the meters and by all

accounts, the readings were not accurate when they were considered. Indeed, low and irregular water pressure flow would confound the ability of the meters to measure water flow, a challenge that has been encountered in other poor locations where metering has been applied (Budds and McGranahan, 2003). With the appointment of the new water committee in 2006, a brief attempt to use the water meters met with strong resistance as residents insisted that the meters were not an accurate reflection of use. Resistance was so strong that the water committee soon chose to abandon the idea, instead resorting to an optional flat monthly rate to simplify accounting. The meters remained thus, as one study participant observed “just a luxury,” a grim reminder of money poorly spent and misdirected policy. The black mechanical devices protruding from the disorganized web of pipes that feed into dirt floor, cornstalk constructed, crowded homes appear bleakly comical in juxtaposition to the realities that they inhabit. Meters installed in areas of extreme poverty and water scarcity have been similarly critiqued elsewhere. Says Goldman “township homes replete with fancy new French meters are otherwise ill-equipped: toilets are outhouses, there are few sewage connections, and homes are constructed from either thatched materials, concrete slabs, or collected pieces of scrap metal” (2007:2).

In October 2005, an article appearing on the front page of Mexico’s national newspaper about the lack of access to potable water in Tlamacazapa (Norandi, 2005) caused a reaction in the municipal government of Taxco de Alarcón, to which Tlamacazapa belongs. In early 2006, municipal officials removed the existing water operators and appointed a new committee of three people, choosing those with the highest education levels who were willing to perform the service.

Interestingly, little changed and the data collected through this study was all collected during a period in which the new committee managed service delivery. Service levels did not increase; nor did transparency. Service accessibility and associated connection costs appeared to remain a function of pure discretion influenced by association with those capable of making the decision. The only consistency appeared to be one of poor service, dangerous water quality and political patronage. Any improvement was clearly hindered by capacity limitations. Indeed, a number of capacity issues are evident through the information collected in this study.

Technical capacity issues were constantly prevalent. The haphazardly lain, above-ground pipes were constantly being broken by passing trucks interrupting service to three of the participant household for between 6 and 24 months during the 24-month study period. The diversion channels and intake pipes for the tap water were not sufficiently deep so as to divert water during the driest months in 2007 resulting in long periods of interrupted service when additional water was most needed.

The pumping system itself had been designed to function in stages with one deposit filling at a time until the top deposit was full and gravity distribution could be used to deliver the water to households. The result was a labour intensive distribution system providing only intermittent delivery.

The documented water contamination problems with high periodic levels of arsenic and lead were, and remain, well beyond the technical ability of a local government to solve. State and federal departments responsible for addressing such issues were not conducting adequate monitoring and follow-up and indeed, even denied the issue when it was brought to their attention (Cruz and Norandi, 2005). After the first article published in the national newspaper exposing the contamination issue and resulting health impacts on Tlamacazapa residents (Norandi, 2005), staff of the Federal Commission for Protection Against Sanitation Risks (Cofepris for its acronym in Spanish) publicly denied that arsenic levels in Tlamacazapa's water sources were above acceptable guidelines or that residents showed any health impacts that could be attributed to metal toxicity (Cruz and Norandi, 2005). An official from CONAGUA admitted the problem and added that the contamination is probably regional, affecting other neighbouring communities (Habana, 2005), but no improvements have been initiated since.

The history of water delivery in Tlamacazapa has been highly political, influenced by global and federal policies and complicated by uneven power dynamics at the local level. Technical and administrative capacity has been wanting throughout and has never been addressed.

4.1.6 Water scarcity

Tlamacazapa sits within one of the wettest regions in Mexico. With annual rainfalls between 928 mm and 1396 mm per year recorded in Tlamacazapa, the community's rainfall closely mirrors the average of the basin as a whole (760mm per year on average between 1971 and 2000, CONAGUA, 2011a). The basin unit (Balsas basin) is among the basins that receive the most rainfall in Mexico. Of the thirteen basins, only 4 receive more annual average rainfall. However, with severe seasonal variations between rainfalls – the wet months from May to September bring torrential rains while the dry seasons from October to April bring scarcely a drop of water – water is not consistently distributed temporally.

Water scarcity is thus a reality that is experienced to varying degrees for one half of the year. In Tlamacazapa the seasonal scarcity has fostered a culture of extreme conservation (Smith and Marin, 2005). Even when availability is not particularly restricted, residents use comparatively little water. The mean water use for bathing is 5.5 litres per person per day in the wet season and 6 litres per person per day in the dry season. Plants are frequently watered in the dry season until water scarcity becomes too great of a challenge to overcome as it did from January to April, 2007 and frequently greywater is used. Almost negligible amounts are used for household cleaning though a bit more is needed during the dry dusty season. On the rare occasion that water is used with latrines, greywater is typically used and or multiple toilet uses will be conducted with one flush. Most families with toilets however, own dry toilets that separate urine and feces and do not require water for flushing. Interestingly, according to reported use,

more water is actually required and used during the dry season when it is more scarce because the hot weather requires more bathing, more cleaning to control dust and more water for thirsty gardens.

Estimated use slightly exceeds measured volumes of water accessed; most probably households underestimate the amount of water that is reused because the survey was not designed to sufficiently address water recycling. For instance, families speak of reusing bath water for multiple children and using grey water for many uses including cleaning, watering gardens and flushing toilets. Recall with generalization has also been shown to be a less accurate method of measuring use than journaling (Rindfuss et al., 2007); it is assumed that the water calendars infer the most accurate indication of total water volumes used.

What is clear is that water use is extraordinarily conservative in Tlamacazapa and remains so even when water is more plentiful.

4.2 Water access, health and vulnerability

The scarcity of water in Tlamacazapa surely has an impact on health that would be difficult to quantify; nonetheless, probable impacts can be inferred based on the data available about Tlamacazapa's context and experience reported in the literature.

The scarcity of water and challenging conditions of access are likely to render residents vulnerable in many ways: insufficient water consumption to provide for basic hygiene and sanitation renders residents vulnerable to bacterial, viral and protozoan infections with resulting increased morbidity and mortality indicators. The prevalence of insufficient water even for basic consumption experienced by many households increases the risk of chronic mild dehydration with associated health impacts. Tlamacazapa's inconsistent delivery of improved water supply may nearly negate any potential health improvements. Additionally, insufficient supply for productive purposes perpetuates poverty and not having water readily available beyond a couple of days deepens insecurity.

4.2.1 Water quantity, quality, health and hygiene

Improved water and sanitation are strongly linked to improvements in public health and important indicators such as reduced child mortality. Recent estimates are that 1.87 million global deaths annually are attributable to diarrhea in children under five years, which accounts for approximately 19% of total child deaths (Boschi-Pinto et al. 2008).

Though the situation in Mexico has improved over the years, it is still among the world's countries where 90% of child deaths occur (Black et al. 2003) with 70,000 deaths under

5 years reported in 2000 (ibid.). Health impacts associated with lack of water access (in terms of quantity) or inadequately treated sources can impact health in multiple ways. Inadequate quality can increase bacteria, viral or protozoa loads either through direct consumption if levels are high enough or through food preparation (Esrey 1986). Even low doses of some pathogenic bacteria can incubate and multiply on food, infecting humans indirectly from contaminated water, while viruses and protozoa do not multiply outside of the host but can infect humans at much lower levels (ibid.) With insufficient quantity, individuals may have reduced access to adequate sanitation and hygiene, increasing risks of disease transmission by insufficient washing of food and hands and by making it difficult to achieve effective disposal of excreta (Black et al. 2003, Esrey, 1986).

Several authors have pointed out that the contribution of water supply and sanitation to health outcomes, although drastic, may actually be underestimated because of comorbidity — single causes of fatalities are recorded for statistical purposes but in many cases existing diseases such as pneumonia, malaria, or measles are further complicated because of diarrhea (Black et al. 2003). Improvements to water and sanitation result in improvements to health indicators both in the short term, and also, importantly, in the long term as they constitute systemic long-lasting environmental interventions (Briscoe 1985). With 75% of Tlamacazapa residents routinely subsisting on scarce water, they are clearly at high risk of bacterial, viral and protozoan infection.

In addition to the health risks described above associated with diarrhea and acute dehydration, Tlamacazapa residents at the documented level of water access, many subsisting on less than 5 litres per person per day, do not have sufficient water to meet consumptive needs for adequate health (Howard and Bartram, 2003; Gleick, 1996). This is exacerbated by the warm temperatures and the frequent strenuous exercise demanded by many local employments (construction, wood gathering, palm cutting) and daily tasks in a rough and steep terrain (fetching water, doing laundry, selling goods at market). The situation puts community members at risk of chronic mild dehydration. Health impacts of chronic mild hydration have not been strongly documented because symptoms are diffuse, fluid intake is difficult to reliably recall, and there are no agreed upon markers of hydration status (Maughan, 2003). Some links have been made to cancers of the bladder and colon, though evidence is not strong (ibid). Subjective self-analysis, however, consistently results in links to fatigue, lack of focus and headaches and some research has shown decrease in cognitive function (ibid).

Importantly, research has also linked urinary volume, daily urinary excretion and excretion of 7 heavy metals to reduction of these metals in the plasma and erythrocycte (red blood cell) concentrations (Araki and Aono, 1989). Among these 7 heavy metals are lead, cadmium, manganese, chromium and zinc, all metals to which Tlamacazapa residents are exposed via water, dyes used to colour palm, local dust and glazes from clay pots used for storing and cooking food. It is probable that insufficient water thus exacerbates the health impacts from exposure to metals (Atzin, in progress).

In Tlamacazapa, the arsenic and lead contamination in the water sources has been linked to the presence of sewage with elevated levels of lead and arsenic coinciding with pulses of organic substances, including human and other animal fecal matter, washed in during rainfall events (Cole, 2004 and Cole et al., 2005). The phosphorus appears to outcompete the arsenic for adsorption on ferric surfaces thus liberating the arsenic into the water column. As such, inadequate sanitation practices results in increased water contamination and further exacerbates health impacts to residents.

Food security is also rendered challenging with insufficient water. In Tlamacazapa, household garden plots are scarce with next to no food grown. Little soil is available on Tlamacazapa's steep and rocky slopes and the community does not have a culture of gardening. Growing is restricted to cornfields usually not located on household lots. Households host a smattering of drought-tolerant flowers, such as geraniums rather than fruits and vegetables for consumption. Nonetheless, building up workable soil would be possible but there is certainly not sufficient water available at current access levels to sustain household gardens during the dry season.

4.2.2 Consistency of delivery

In Tlamacazapa, tap water overall has lower levels of arsenic and lead than well water (though levels still sporadically exceed acceptable levels for consumption). Furthermore, disinfection with controlled and appropriate levels of residual chlorine is only possible in the tap water distribution system (though rarely and inconsistently practiced). Also, work burden is reduced for those who can access tap water when it is available. Tap water does, therefore, constitute an "improved supply" in Tlamacazapa when assessed by several indicators. However, with distribution occurring at best once per week though typically less often, not at all in the rainy season and never with any consistency nor reliability, the degree to which an occasional and unpurified supply could really be expected to improve health outcomes comes into question.

Proxies of "improved supply" in some case study situations (Esrey et al. 1991) and some statistical analyses of large datasets (Fewtrell et al. 2005, Fink et al. 2011) have shown improved health outcomes, but this has not always been the case (Esrey 1996). In a study using 1992 Demographic Health Survey (DHS) data from eight countries, Esrey et al (1996) found no effect of improved water without concurrent improvements in sanitation. Fink et al. (2011) merged DHS data that included complete birth histories and water and sanitation information, and found that improved water sources alone provided beneficial effects only for children 1 month to 1 year of age. Although much of the discussion in both studies focused on the interaction between the two interventions, the discussion did not address the adequacy of the proxy being used to differentiate between unimproved and improved access. Recent studies have emphasized the

importance of consistency and reliability of improved delivery to contribute to improved health outcomes (Hunter, 2009) by demonstrating cases in which the purported benefits of treated improved water supply were nearly entirely lost within a few days of interrupted service and a return to raw water consumption.

In Tlamacazapa's case, tap water is neither pure nor consistent, begging the question, has installation of tap water had any positive impact on health effects whatsoever? The documented situation certainly suggests that the current supply renders the population extremely vulnerable to high morbidity and mortality, especially infant and child mortality.

Lack of water storage further renders community members vulnerable to increased disease burden. VanDerslice and Briscoe (1983) argued that in-home storage may not significantly contribute to increased pathogen loads (in spite of increased total coliform loads) but their review of the literature did show increases in viral and parasitic burden. In the context of Tlamacazapa, insufficient water storage limits residents' access to tap water because without a large tank they are unable to store enough to meet household needs. Moreover, households with little storage are unable to access bulk rates and so pay more in absolute terms per unit of water. These households are more vulnerable to absolute scarcity in times of drought as they do not have a backup supply.

4.2.3 Security

The lack of adequate, fair and consistent access to water contributes to substantial stress and insecurity in the life of many residents. Residents typically do not have sufficient water to last beyond a day or two. Costs to purchase bottled water are taxing but many residents are acutely aware of the health impacts if they do not find suitable sources. For instance, two members of separate participating households both suffer from diabetes and, understanding that clean water is vital to maintaining good health, go to great lengths to ensure that bottled water is always available for consumption. In at least two situations documented over the course of the study, the primary water fetcher became gravely ill or injured so that they were unable to work and contribute both to household finances and chores. In these cases, the work of fetching water fell to other household members as did the additional burden of caregiving and trying to make up for lost income.

Many participants, especially women but also men, spoke of conflict and bullying at the wells, influencing their choice of sourcewater and even motivating them to travel farther in order to find water. Such community conflict further exacerbates feelings of vulnerability and helplessness. Hours, and even at times, entire nights spent carrying water from wells adds additional emotional and physical stress to residents already living with only enough to carry them through from day to day (Smith and Marin, 2005).

Finally, financial costs of water to residents are substantial. In Tlamacazapa, residents, if able to afford to do so, would prefer to live in cement or brick housing with cement floors and metal sheeting or cement roofs rather than in houses built from sticks, corn stalks with dirt floors and tarpaper or palm roofs. In spite of the quaint, romantic appearance of the latter, these are unable to keep out floods, the cold, wind and bugs. Of the study families 17 or 68% live in primarily stick housing, and most of these with dirt floors. Only two of the households have refrigerators and these are in a home store business, which supplements household income.

Although eating habits were not specifically examined in this study, in most cases households eat two meals a day dominated by tortillas and occasionally complemented with eggs and/or salsa or some vegetables but generally lacking in vitamins and proteins, satisfying only hunger with large starch contents. These dominant eating patterns have been documented in Tlamacazapa and contribute to ubiquitous malnourishment (Smith and Marin, 2005).

Money is at a premium and most households constantly making decisions that sacrifice one basic need for another. When spending money on water, households are not foregoing a luxury item but basic needs and security – nourishment, sanitation, medication, education and safe, adequate housing. It is therefore misleading to use a flat threshold to benchmark an appropriate proportion of income that can be spent on water and sanitation service delivery. This discussion is not dominant in the literature. A benchmark of 5% of *disposable* income, once basic needs are met, would be a more appropriate benchmark if equity is an objective being sought, given the wide distribution in incomes that are being considered in the debate on water pricing.

4.2.4 Vulnerability and gender

To consider the ways in which water management and lack of access to safe sources can perpetuate vulnerability requires particular attention paid to gender. In Tlamacazapa, a gender analysis will both reveal specific ways in which women are rendered disproportionately vulnerable by inadequate water supplies and also a critical analysis of the rhetoric underpinning the delivery system as a whole, wherein feminine values such as equity and care are undervalued in comparison to masculine emphases of efficiency and infrastructure.

Women and water in Tlamacazapa

In Tlamacazapa, women are particularly vulnerable to cycles of poverty for a number of reasons. They are largely excluded from purchasing land and land is generally inherited

by male children. Women tend to stay in Tlamacazapa for work purposes, traveling less than their male counterparts to find better employment in nearby cities or to sell their woven goods in tourist centres. As a result, women are more likely to be lower wage earners. Women are, almost without exception, responsible for the care of children and the home including routine chores such as laundry, cooking, cleaning, childcare and often retrieving firewood, water and harvesting the palm used for weaving. A substantial opportunity costs associated with such work also renders women dependent on men for the principle income source or if the woman is single or the principle wage earner, more likely to have insufficient income to meet basic needs.

Such gendered cycles of poverty and disempowerment are further exacerbated when water access is considered. Restrictions to obtaining land title impede women, particularly single women, from investing in taps on their own property or from building a tank for increased storage capacity. With fewer income options, women are likely to be disproportionately excluded from accessing improved water sources such as bottled water and tap water. Such patterns are well documented in the literature (Harris, 2008) and emphasize the need to adopt a gender sensitive lens when investigating water management options. In particular, women should likely be the focus of research and dialogue about improvements to water delivery, as they have been in this study. Disaggregation of impacts to women as opposed to men may further unveil considerations of delivery, management, and monitoring that should be considered so as to ensure that vulnerabilities of marginalized groups are not being further perpetuated.

Dissecting the rhetoric, a feminist analysis

Gender analysis at the policy level provides a useful lens through which to critique the dominant rhetoric. Concrete, easily quantifiable indicators have been preferred in the literature and the sector has traditionally been dominated by perspectives from economics and engineering (Sneddon et al. 2002). Far less easy to quantify and often less demanding of respect and consideration are ‘softer’ more feminine considerations such as equity, ethics and care (Davidson and Stratford, 2007; Harris, 2009). Although a gendered analysis was not an explicit intent of this research, adopting a feminist lens for subsequent work will likely provide a useful tool for analysis. Certainly, by emphasizing the need to consider more widespread indicators and by focusing on women’s access on the ground, this work has provided substantial support for the argument that a focus on infrastructure, rather than people’s experiences perpetuates inequalities and provides insufficient improvements in real terms as lived by poor residents.

A gendered analysis would likely help to reveal the underlying value systems that have dominated policy at national and international levels and have caused simplified principles of efficiency to so greatly overshadow other goals such as equity and even other indicators of improved wellbeing. Critical analysis is certainly needed to reveal the underpinnings of self-referential analyses and subsequent policies (Goldman, 2007) and invite more nuanced discussions from simplified dichotomies (Bakker and Bridge, 2006).

4.2.5 Identifying clear objectives

The case study has detailed the challenges encountered by individual households and residents in attaining clean, sufficient, consistent, affordable water. Water in Tlamacazapa is rarely any of these things and never all of them at the same time.

The literature seeks to set a basis for quantity, quality, access and cost in order to achieve equity and health objectives. In Tlamacazapa, these objectives are not being achieved. In fact, the current situation of water access perpetuates cycles of poverty and marginalization, excluding the poor from access to sufficient volumes and quality of water. These systemic inequalities include mechanisms (compiled in Table 4.1) by which the poor have to pay more for water both in a relative and absolute sense. As well, mechanisms by which the poor are excluded from access to the piped network altogether (compiled in Table 4.2) are identified. With top-down policy driven infrastructure initiatives in lieu of locally based planning informed by community context and people-centred priorities, so called “improved infrastructure” may perpetuate insecurities and inequalities rather than reduce overall vulnerability. Mechanisms of the direction of impact to vulnerability by the networked infrastructure are compiled in Table 4.3.

The gap evidenced in various sides of the dichotomized water debate (liberalized markets to provide financing for universal access versus publicly protected, rights based universal access) is vast precisely because authors and decision-makers are not explicit about the objectives to be achieves. Rather, much of the literature and indeed much of the policy appears to be ideologically driven (Goldman 2007, Bond,2006; Budds and McGranahan, 2003; Bakker et al., 2008). Objectives must be established openly, prioritized and analyzed for potential trade-offs.

Given the documented challenges in Tlamacazapa, universal access, equity, and achievement of health outcomes should be prioritized. To achieve these, infrastructure investments will have to be substantial and much more attention over the long-term will need to be made to local and municipal governance structures and institutional and administrative capacity building. Water delivery service systems cannot run themselves and a truly efficient, accountable and transparent system will be achieved with long hard work.

Efficiency objectives for domestic household provision, including full cost accounting, cost recovery and water conservation from domestic use, should be explicitly abandoned altogether. The indirect health benefits of providing truly improved, safe, consistent water supply are enormous and would achieve much lower morbidity and mortality levels in Tlamacazapa as well as a more efficient use of resources. Tlamacazapa’s water scarcity exists temporally, exacerbated by politics and inequities on the ground. Locally

appropriate technologies, developed to consider Tlamacazapa's substantial but seasonal annual rainfall, could no doubt achieve universal access.

Some of the objectives evidently driven by ideology in global and federal policy have no apparent bearing on this context. For example, discussing domestic water conservation and full cost accounting in a community where the majority of residents are not accessing even enough for basic consumption needs let alone basic hygiene and sanitation is not only misdirected, it is absurd. Surely residents using less than 5 litres per person per day do not need price incentives to use less water!

This incongruence of policy with grounded realities has been emphasized in other cases. Smith (2003) paints a clear picture of how policies motivated by rhetoric of scarcity can put the poor at greater risk, needlessly creating an emphasis on metering and restricted access when the focus should be on increased usage so that families can meet basic needs of nutrition and hygiene (Smith, 2010).

Goldman (2007) paints an ironic picture of sleek water metres adorning houses with squalid living conditions that are unlikely to work anyway given weak and inconsistent water pressure (Budds and McGranahan, 2003). Conservation should be a consideration of system delivery more broadly, however in this context it is clear that conservation is a question both of governance and infrastructure maintenance. Given the age of the water pipes it is probable that a significant amount of water is lost in delivery, although this has not been measured and documented. Further, systems of water allocation and payment according to types of use would be appropriate given the stress on the system that apparently occurred during the 2007 dry season when water was insufficient to meet domestic needs but was being removed out of the community by truckloads for local and regional roadwork. This would require differentiating between commercial and industrial uses. A goal of fostering domestic conservation is nonetheless egregiously misguided.

Further, this case study has illustrated the complexity of water provision: seasonal scarcity, poverty, complex and violent local dynamics, a dearth of institutional and administrative capacity at both local and regional levels and naturally occurring contamination. This context will be challenging and costly to address even with state and federal resources.

In the grounded reality of Tlamacazapa, the objectives to be achieved are clear:

1) improved infrastructure;
2) a focus on rainwater harvesting;
3) adequate sanitation; and
4) substantial attention and resources over the long run to institutional capacity building and local governance.

These, in particular the latter, will be needed to achieve equitable, universal, safe water access.

TABLE 4.1 MECHANISMS THROUGH WHICH THE POOR CAN PAY MORE FOR WATER

Type of cost	Source of water	Mechanism by which poorer households pay more for water
Relative cost	General	Poorer households pay a larger percentage of overall income per unit of water. Substitution choices are greater for poorer families; water is purchased at the expense of other basic needs.
Absolute cost	Tap water	Those unable to afford to build large water storage facilities cannot benefit from bulk water purchase. Tap water can be up to five and half times more expensive purchased using volumetric rates rather than bulk rates.
	Bottled water	Neighbours occasionally will charge more per unit of volume to sell water that they purchase from their tap. If a household cannot find enough money for a large jug of water they may choose to buy partial volumes at ~2x the volumetric rate.
Opportunity cost	General	The poor can generally escape economic costs by accessing free supplies (ex. well water) but at a substantial cost in time and energy. Income foregone is often much more than the cost of tap water, leading to the perpetuation of poverty.

TABLE 4.2 MECHANISMS THROUGH WHICH THE POOR ARE EXCLUDED FROM NETWORKED SUPPLY

Type of exclusion	Mechanism of exclusion
Political patronage	Infrastructure can fall into elite control favouring distribution to particular groups.
Costs	Initial capital costs range from 0 to 2100 pesos (cash and value of material provided) and can restrict access for poorer households. Households may not be able to afford volumetric rates. Poorer households may struggle to afford building large storage options and so cannot reap as much benefit from intermittent tap water supply.
Spatial	Piped network does not reach peripheral areas of town, which are above or beyond the distribution cisterns. These areas are disproportionately inhabited by poorer households.
Land title	Households may not have title so forego right to install a tap or investment would increase land value that is not theirs. Households may not have sufficient space to build adequate water storage to benefit from bulk water sales with intermittent tap water supply.

TABLE 4.3 MECHANISMS THROUGH WHICH THE POOR MAY BE MORE OR LESS VULNERABILITY FROM INADEQUATE NETWORK SUPPLY

Direction of impact	Mechanism of impact
Increased vulnerability	Increased inequity between those able to access supply and those not able to access supply.
	Increased inequity as poor groups maintain high opportunity costs while others save time and energy.
	Increased inequity as some may access sufficient water for productive purposes while others struggle to achieve basic access for domestic supply.
	Improvements in some households' hygiene and sanitation may not improve community level outcomes as much as anticipated because benefit is reduced by households with unimproved sanitation.
Reduced vulnerability	Networked supply reduces pressure on the wells, improving global availability of water supply even for those unable to access the piped network.
	Increased variety of sources and thus increased resiliency.
	Increased competitive pressures because increasing the options for formal and informal supply creates pseudo-competition keeping prices low (as opposed to a situation of a monopoly supplier.)
	Improvements in households' hygiene and sanitation may have broader indirect public health benefits.

4.3 Assessing the efficacy of global and federal water policy

Through examining trends of global water governance policy and corresponding trends in Mexican policy, it is apparent that Mexican policy has been strongly influenced by dominant trends encouraged and even required by international lending agencies.

Although specific laws and policies have opened doors for in Mexico for decentralization, commodification, commercialization, marketization and privatization, these have not been applied uniformly across states, regions nor municipalities. Rather, unique situations have arisen out of local contexts.

In Tlamacazapa, decentralization has certainly occurred, with a local committee appointed by the Municipal Government of Taxco de Alarcón managing water delivery. Assessing whether commodification and commercialization have occurred is perhaps more challenging. Borrowing from the definitions detailed by Bakker (2005), commercialization "entails changes in resource management practices that introduce commercial principles (such as efficiency), methods (such as cost-benefit assessment), and objectives (such as profit-maximization)" (p544). Commodification, on the other hand involves applying mechanisms to allow the good, in this case water, to "be sold at a price determined through market exchange" (p544).

In Tlamacazapa, commercialization has occurred as water was priced when the infrastructure was introduced in the late 90s and a local water committee was appointed with the responsibility of delivering water and collecting corresponding payments. Efficiency and accountability were sought through the installation of domestic meters, which were intended to ensure user pays and full cost accounting principles could be achieved. Indeed, in Tlamacazapa the utility is demand-led, rather than supply-led as the network itself does not reach all residents but those most willing to pay for it.

Commodification appears also to have been intended. The utility is expected to be financially independent with the full price of maintaining, expanding and managing the infrastructure financed by user fees. Bakker (2005) describes commodification usually as being transient and on-going, as governments balance market liberalization goals with equity principles. In Tlamacazapa, full commodification has likely not been achieved – little suggests that sufficient revenues are raised in order to maintain infrastructure in perpetuity and expand the network to provide for universal access, thus the scenario likely falls short of one of effective full cost accounting.

Tlamacazapa is not an example however, of privatization. Although the water committee consistently fails to operate transparently and equitably, it is in fact a public institution.

The following examines to what extent decentralization, commercialization and commodification have been achieved in Tlamacazapa.

4.3.1 Exploring the intentions and results of decentralized essential services

Proponents of decentralized service delivery propose a number of reasons why decentralized governance is a preferable and more efficient model for water service delivery. In actuality it is difficult to disentangle claims of efficiency attributed to decentralization from claims of efficiency attributed to privatization. In many contexts, and certainly the Mexican one, the two go hand in hand with the main intent of decentralization being to provide space for private actors to be involved (and thus contribute investments, expertise and efficiencies) to one or several components of delivery whether that be ownership, operation, delivery, tariff collection or infrastructure maintenance, building or expansion.

For the purpose of this analysis, the purported benefits of privatization are teased out from those solely arising from decentralization. Decentralized governments, argue proponents of decentralization, are:

1) Closer to the citizens that they are servicing and therefore more responsive to their constituents both in terms of understanding contextual needs and in their ability to be held accountable and responsive (Salazar, 2007; Robinson 2007a and b).

2) More likely to empower individuals at local levels, not only by making local governments more responsible but by providing opportunities for end users to be engaged in service delivery (Wilder and Romero Lankao, 2006; Robinson 2007a and b).

Have these objectives been achieved in the case of Tlamacazapa?

An underlying assumption is that those locally responsible will have the capacity to be responsive and accountable to the public that they are serving. There is evidence that this occurs on occasion somewhat informally. For instance, when the new water committee took over responsibility to manage the utility, they attempted to use the meters in order to base their charges for water, at least in those households where meters existed and were not broken nor disconnected. However, they met with an outcry from many residents who quite justifiably recognized that the metres did not provide accurate records of their water use. The push to use the metres was quickly abandoned and the water committee instead adopted an optional flat monthly rate that would simplify accounting. Similarly, the evident reticence of the water committee to cut connections for non-payments is likely attributable to community connections and social accountability.

However, substantial anecdotal evidence also speaks to the *disempowerment* that was perpetuated through the networked system. While one resident and study participant during the course of the study connected to the system for free because of her close ties with the water committee another had to wait over two years to receive her connection in spite of her willingness to pay 1000 pesos. Three households were cut off from the system for between 4 and 24 months during the 24-month study period because of

broken pipes; response from the water committee was extremely slow with little accountability evident. Frequency and consistency of supply has been poor since the infrastructure was introduced. Cost inequities have also plagued the system since its inception.

Fewer than 4% of participating residents knew how to read the metres. Receipts were distributed consistently for water payments, but were not distributed for water delivery. Overall expenditures, including maintenance costs, worker salaries and overall revenues with net profits were not communicated.

All this in spite of the fact that the female heads of all households participating in this study were able to name one or two people on the local water committee. One might imagine that in this size of community some accountability would be inevitable. However, there are four assumptions that do not hold true in this situation. The first is that community members have an expectation of service that is not being met. The second that those delivering the service have the technical, administrative and financial capacity to do so with transparency and accountability. Thirdly, that mechanisms are in place for redress. Fourthly, that power imbalances and politics at local levels will not cause and perpetuate inequities.

Tlamacazapa is somewhat limited as a case study for decentralization in that it is not an example of a location where utility governance was once centralized. The utility has been locally governed since it was constructed and prior to the existence of the piping network, residents relied (as they all still do to varying degrees) on a host of informal water supplies dominated by the free, unprotected and unregulated groundwater wells. In essence, Tlamacazapa was then and has remained since, an example of general neglect on the part of governments – whether they be national, state or municipal. As such, community members do not necessarily have an expectation of a better system. Not that they are not cognizant of better systems (many have travelled to cities with widespread distribution of networked connections and constant purified water flow) but this has never existed in Tlamacazapa.

Secondly, it can be easy in a case in which the responsibility to manage infrastructure has fallen to a small group of people, to consider resulting patronage and lack of transparency to be nefarious. In the case of Tlamacazapa, this may or may not be the case; the fact that service delivery did not noticeably improve once the new committee began to manage the infrastructure in 2006 suggests that, in fact, the committee simply did not have the tools — in terms of administrative, technical and financial capacity — to manage the system efficiently and transparently. Although the second water committee was explicitly chosen so as to involve those residents with the highest level of education, these residents still did not have pertinent training. The committee was arguably additionally constrained in how it could deliver the service because the extant infrastructure was poorly built and poorly maintained. The committee further did not have access to appropriate technologies to facilitate book keeping and communications.

Proponents of the theoretical benefits of decentralization are at risk of romanticizing the local unit when gross inequities and power imbalances may exist between citizens within a small spatial unit. Several authors write about situations in Mexico (Salazar, 2007; Wilder and Romero Lankao, 2006) and elsewhere (Bakker, 2007b, 2002, Kooy and Bakker, 2008; Mehta, 2000, 2003) in which the decentralization of utilities without corresponding mechanisms for regulation and accountability result in the elite capture of a resource and its use and distribution to benefit a narrow array of interests. Certainly in the case of Tlamacazapa, there is no transparent and open process for appointments of those in the water committee, which in turn makes it difficult for citizens to hold the committee accountable. Without accountability in place, existing power dynamics and inequities present at the local level play out in water service delivery.

The example of Tlamacazapa is a stark one of the risks of focusing purely on infrastructure at the expense of people and processes. Without appropriate institutions, mechanisms and processes to administer the infrastructure, residents of Tlamacazapa have, from the beginning of the infrastructure project, been set up for failure. This is most decidedly not the makings for citizen empowerment.

The lessons about decentralization from Tlamacazapa echo those that have been voiced by others who bring perspectives from grounded case studies. Decentralization will not infer its purported benefits without substantial investments in the individuals and institutions that are to manage infrastructure. As Wlider and Romero Lankao (2006) argue, “the creation of new forms of water institutions requires not the retrenchment of the state but rather its involvement to ensure accountability, transparency, equity, and sustainability.” Unfortunately, as we shall examine further, existing mechanisms for reporting achievements in water and sanitation improvements focus solely and crudely on infrastructure. The case of Tlamacazapa illustrates that without the focus on people, the benefits of these investments are likely to be grossly overestimated and the investment itself may be essentially wasted. Others have documented that this is illustrative of much broader challenges in Mexico in which institutional capacities at the state and municipal levels remain weak (Salazar, 2007).

It is also worth noting, that in Mexico, the decentralization project can be considered incomplete. Decentralization can be said to be administrative, in which tasks related to the management and operations of the utility are devolved, fiscal with financial responsibility for revenues and expenditures existing locally or political with authorities for decision-making also resting at the local level. In Mexico, while administrative decentralization appears to have occurred, CONAGUA at the federal level still collected water user fees from the municipalities and controls their expenditure. User based fees are expected to cover operations and maintenance of the infrastructure and the water fees to federal government. As such, authors argue that funds are still centralized at the national level perpetuating a strong dependency by lower levels of government on the federal government (Salazar, 2007) and that the existing system of federal transfers disadvantages the poorest states (ibid). Moreover, operations and maintenance may have been transferred to municipalities but political decentralization has not entirely happened. Decision-making, regulatory and monitoring powers lie elsewhere and remain

poorly defined. As Salazar notes and as we have clearly seen in the situation of Tlamacazapa where health concerns have been routinely brought to the attention of municipal, state and federal levels of government, “each level of government can blame the other for not doing its part (p74)”.

The purported benefits of decentralization: accountability and local engagement, are certainly relevant and appropriate to the context of Tlamacazapa. However, examining the case of local water management, they have not been achieved. As Mexico continues to undergo processes of decentralization and democratization, the trajectory may continue towards full decentralization including administrative, fiscal and political. However, the expectation that accountable, efficient and transparent systems can flourish from a void is naïve and misguided. The intended improvements of decentralization can only be achieved with a focus on people and processes which will require a renewed commitment by state and federal levels of government, not a retrenchment of governance.

4.3.2 Commercialization and commodification

Commercialization has also evidently been an objective imposed on Tlamacazapa’s water sources through top-down mechanisms. Mexico’s Water Law makes the intent of of cost recovery explicit.

> *Article 109. Public investments in federal hydraulic works will be recuperated in the manners indicated by the Contribution for Federal Public Water Infrastructure Improvements Law, through establishing cost-recovery fees that should be covered by those persons directly benefiting from the use or exploitation of the given infrastructure.*
>
> *Article 110. The operation, conservation and maintenance of water infrastructure is the responsibility of the users of the respective services. Cost-recovery fees will be determined based on the costs of the services, considering the value of the costs in terms of economic efficiency; equally taking into consideration the economics and financial health of the entity that distributes the service*
>
> Ley de Aguas Nacionales, p 83 (author’s translation).

The literature examines two tools that contribute to planning and managing infrastructure according to commodity principles: planning infrastructure according to what can be afforded based on documented local willingness to pay and then pricing water accordingly so as to ensure full cost recovery. Both tools are examined here to see to

what degree they may have been applied in Tlamacazapa, to what extent they have been successful and if they are appropriate.

Requirements associated with IMF loans have included provisions implemented into law to ensure water pricing and full cost accounting of municipal water provision. The objective, again, is efficiency through multiple means: allowing cut-offs will increase payments so as to increase revenues and allow for the most efficient operations possible (Andwater and Ozuna, 2002) while also ensuring an ethic of conservation – allocating scarce resources as efficiently as possible. In Tlamacazapa, the policy is seen on the ground in terms of payments made for water resources and no further investments (beyond the preliminary infrastructure) at the municipal level. The utility is expected to pay for itself as is the common expectation throughout Mexico. Residents are charged through volume use or a flat monthly rate.

The objective to foster a culture of domestic water conservation, as has been discussed, is misplaced. In a community where three quarters of residents are consistently using less than even a very conservative basic amount of 20 litres per person per day and often less than five litres per person per day, promoting water conservation through price incentives is both absurd and dangerous. With seasonal water scarcity jeopardizing the security of supply and thus the health of the resident, conservation to reduce leakage and prioritize uses will no doubt be available and again points to the need for improved technical and financial capacity. Foregoing domestic conservation, however, does not preclude maintaining the goal of conservation through the system as a whole. With aquifer recharge rates unknown and seasonal water scarcity issues persistent, options for conservation should be examined, but domestic water use is certainly not the problem.

Recuperating costs in order to ensure the sustainability of the infrastructure is, however, an appropriate objective. Tlamacazapa's piping network requires, but does not receive, constant repair: connections are frequently broken throughout the network, the current pump system does allow for continuous provision and the low pressure when water is running presents a risk of contamination. More funds for infrastructure improvements are likely needed.

Policies promoting metering (which have been implemented on the ground in Tlamacazapa) and laws allowing for cut-offs in case of non-payment are mechanisms to achieve these objectives of cost recuperation for long-term infrastructure sustainability (Andwater and Ozuna, 2002). However, in the case of Tlamacazapa, we can clearly see that using pricing mechanisms to achieve the objective of financial sustainability may have trade-offs with the objective of equity and universal access.

Is universal and equitable access achievable with full cost accounting in this context of poverty? Although residents do pay more for some water from other sources (bottled water and less frequently trucked water) suggesting that there could be some funds redirected towards public infrastructure, with the current state of infrastructure and the particular challenges caused by seasonal scarcity and trace metal contamination, true

accounting of the full costs of adequate infrastructure into perpetuity seems unlikely without outside intervention, at least in early stages.

Experiences elsewhere suggest that in some cases, cost recovery to both deliver the service and maintain the existing infrastructure (let alone expand service where the existing network is incomplete) is not economically feasible.

In developed countries that have since adopted full-cost accounting principles, the initial infrastructure had already been built through heavy subsidization. Whether or not full-cost accounting is actually achievable alongside universal access warrants investigation. Few countries have successfully implemented full cost accounting measures. Buenos Aires, Chile and South Africa are all examples where some redistribution to the poor occurred after initial attempts at full cost recovery pricing (Bakker 2003a). In many cities the increasing rate of network disconnections to the poor become too politically unpalatable and in some cases health impacts (cholera in South Africa, increased diarrhea reported in England and Wales) force the government's hand (ibid).

The South African experience is telling. There the government explicitly seeks to attain two clear objectives: cost recovery and human right to water through their free basic water policy in which 25 litres per person per day are supposed to be provided for free. In spite of good intentions, notes one researcher, the costing of water for cost recovery includes a law to support disconnections in cases of non-payment. This paradox is one example of why "in poor regions, dual commitments to both rights and markets can fail to provide the intended outcome" (Mehta, 2005:9). Expecting to achieve both objectives simultaneously and equally simply may not be feasible in some contexts. Connecting additional poor households can raise fixed costs without complementary increases in revenues per unit volume, creating disincentives for providers (whether public or private) who are trying to attain cost recovery or a profit from connecting poor consumers. (See for example the case of Jakarta, Indonesia: Bakker, 2007b). The Asian Development Bank, in a recent study examining urban service delivery, states that "the private sector is not willing or able to solve the problems of unserved areas on its own" (Asian Development Bank, 2003:56). In examining other case studies from developing countries and in observing a withdrawal of private capital investments in water in the south, Mehta and Mirosa Canal (2004) conclude in one analysis that the poor do not constitute a profitable market both because they do not consume enough and because they cannot afford to pay the prices that would be necessary for cost recovery.

How can the possibility that a geographic area simply does not have enough resources to conceivably pay for universal access be anything but subjective and does this premise stand up to empirical testing? A substantial component of the water governance literature concerns itself with quantitatively defining residents' willingness to pay for water and sanitation services such that this information can be used to plan for the most appropriate and efficient technology within the limits of available resources. Much of this literature portrays an incredible willingness to pay for water, even in locations of extreme poverty. Willingness to pay range from lows of around 2% up to and exceeding 10% of total income (Whittington et al., 1990; Briscoe et al., 1990; McPhail, 1993) suggesting a

substantial amount of financial resources available for system expansion, maintenance and delivery. In the present case study, we see that residents pay up to 13% of per person income and rates that would be considered staggeringly high, in an absolute sense, when they are compared to rates paid elsewhere in Mexico and globally.

Critics of this methodology warn, however, that the willingness to pay tool disguises the challenges and health dangers associated with the poor paying so much for water. Essential for life, the poor will, of course, pay what is necessary if that is the only option. Faced as they often are, with a monopoly commodity the poor "are price takers not price setters" warns Bakker (2007b) a fact that is too often obscured by using the willingness to pay tool. Opponents of the methodology contrast willingness to pay with ability to pay noting that the former measures an objective of financial efficiency and full cost recovery while the latter is a more appropriate measure of equity. Willingness to pay is an assessment approach based on economic equity or the 'benefit principle' in which individuals are all expected to pay the cost that they impose on the system. In contrast, 'ability to pay' has been proposed in the literature as a theoretical response that emphasizes social equity based on rights based perspectives in that each individual should pay what they are able to afford (Bakker, 2001). Yet ability to pay remains a theoretical notion and undeniably, willingness to pay is a useful tool in estimating the amount of financial resources that might be available for a water and sanitation project. The two viewpoints remain largely isolated in the literature but decision-makers are grappling with two, both valid, objectives.

In Tlamacazapa, the price of both bottled water and tap water evidently exceeds some residents' willingness to pay, as 20% of households choose not to buy bottled water and 25% families never or rarely access tap water. Presumably, this choice is influenced by their ability to pay. Does this mean that those households choosing to pay the high bottled water rates, for instance, are able to do so? Let's examine an example of one particular family. A mother and father with one adult child and one young child. The youngest is diabetic and the family frequently speaks about how much they need to pay to finance the medication that is given to the child each week. So as not to aggravate his symptoms the family is dedicated to purchasing bottled water for consumptive purposes routinely. On average, they pay 8% of income on water. They have only 450 litres of water storage through an assortment of pails and they have no form of adequate sanitation, using a vacant adjacent lot. They cook on an open fire using rocks and a grill and they have no refrigeration. Income is earned entirely through contributions of each family member to weaving; every weekend the whole family or sometimes the father alone will go to Taxco to Alarcón to sell their goods. They live in a single-room house made from corn stalks with a dirt floor and tarpaper roofing. The family is an example of one that is struggling to meet even basic needs of shelter and food security. Income foregone for water is income not available to ensure their basic security and certainly they come up short by any measure of adequate sanitation, housing or assets. If income paid for water detracts from a family's ability to pay for basic needs, the family is then exceeding their *ability-to-pay*. An assessment of the extent to which a household is meeting basic needs would provide a criterion by which to judge if water payments are

coming from *disposable* income, rather than detracting from what is needed for basic survival. In the case of Tlamacazapa, where 84 percent of residents do not have access to basic sanitation, it is clear that the vast majority of residents though *willing* to pay for water are doing so at an expense to their livelihoods, far exceeding any ability that they have to do so.

Willingness to pay would thus be a useful tool if in its calculation, policy makers recognized other objectives in water supply – improved health outcomes, poverty alleviation and equity. One simple way to do so would be differentiating between willingness to pay based on disposable income versus willingness to pay from income that is needed to meet the most basic of needs.

Forging ahead with conversations about full cost recovery and using willingness to pay as a tool for planning without consideration of ability to pay will no doubt confound the ability to meet any objectives at all. Equity measures would not be attained, health benefits will not accrue and full cost recovery or profit will not results, confounded by the fact that the poor do not consume enough to provide for a profit given capital costs of infrastructure provision and they are likely to search for less costly informal alternatives.

Dialogues, research and policy that is not explicit about *all* of the objectives being sought will not adequately consider the trade-offs inherent between them and narrows the possibilities of what can be achieved. The Mexican Water Law (LAN) explicitly provides for local cost recovery but more dialogue needs to empirically analyze to what extent this is possible, what the trade-offs are in terms of public health and equity and whether the policy does not unnecessarily close the doors to greater opportunities of regional solutions, networking, and cross-subsidizations not only in financial terms but also in the terms of sharing knowledge, technical and administrative capacity, all of which we have seen to be so integral to effective water service provision.

4.4 Defining and monitoring sufficient water access

The Millennium Development Goals have become iconic targets to reduce global poverty. Appropriately, improved water and sanitation is included as a target within the seventh goal of ensuring environmental sustainability. The target is certainly well placed given the widespread implications that clean, sufficient water has for health and well-being. The goal to improve water and sanitation also directly impacts the fourth goal of reducing child mortality with the target of reducing by two thirds, between 1990 and 2015, the under-five mortality rate.

Specifically, the water and sanitation target calls to “halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation”. Though few could argue with the intention of such a goal, a closer look reveals that in terms of

monitoring, the wording leaves a great deal open to interpretation. How does one define the words “access” and “safe”?

Currently, monitoring of the indicator at the international level is conducted by the WHO and UNICEF joint monitoring program for water supply and sanitation (Sullivan et al. 2003). The indicator that is used to proxy access is the number of people who use piped water, public tap, borehole or pump, protected well, protected spring or rainwater as a ratio to the total population, expressed as a percentage (UN Development Group, 2003). Sources not included as improved are: unprotected wells, unprotected springs, vendor-provided water, bottled water and tanker truck-provided water. Although the *Global Water Supply and Sanitation Assessment 2000 Report* defines reasonable access as “the availability of 20 litres per capita per day at a distance no longer than 1,000 metres,” volume is difficult to monitor and so the type of drinking water source is used as an indicator.

Applying the indicator to the present case study, the implication, of course, is that all residents in Tlamacazapa have access to “safe drinking water” as those without a tap in their yard still have access to a public tap, should they so choose. Yet, the survey results and on-going water quality monitoring conducted by *Atzin* clearly indicate that the majority of residents do not have access to even basic amounts of water and that the tap water, which would be considered the ‘improved source’ according to the indicators most commonly used worldwide, is most certainly not safe for consumption.

In Mexico, CONAGUA defines potable water coverage as including those who have piped water in their homes, outside their homes but on their property, from a public tap or on another property (CONAGUA 2011b, p 66). Incredibly, CONAGUA notes in this definition that those with coverage do not necessarily have access to water of sufficient quality for human consumption, though the institution nevertheless uses the term ‘*potable* water coverage’. Indeed, by this contradictory definition, all residents of Tlamacazapa are also considered to have “potable water coverage” within national statistics.

The case of Tlamacazapa clearly depicts one in which the current indicators are wholly inadequate and, in fact, dangerously misleading. If that is the case in the current study, how misrepresented might the statistics be at national and global levels? Although a substantial body of work has shown improved health outcomes correlated with water supply interventions (Fink et al, 2011, Fewtrell et al., 2007) these improvements are often minimal or not statistically significant when improvements in water quality and water supply are isolated from corresponding improvements in sanitation (Esrey 1986, 1991 and 1996). As has been previously discussed, it is important to recognize that these correlations might not be as strong as anticipated precisely because the ways in which statistics for improved water sources are collected overestimate their actual impact on health and well-being indicators (Fink et al. 2011, Fewtrell et al. 2007). The inaccuracies that may be hidden within these proxies have been shown to be grossly misleading. If the study showing that interruption to safe tap water supply of only a few days within several months can almost entirely negate the positive impacts of that safe

water supply (Hunter et al. 2009) then it can be quite safely inferred that tap access once per week or less, as is the case in Tlamacazapa and a common situation described in contexts of poverty elsewhere (see for instance Bakker, 2003a), then the possibility for improved health with so-called improved infrastructure but inconsistent access, could well be nil.

Similar discrepancies at local levels have been highlighted in case studies and some authors have harshly criticized what are clearly "nonsense statistics" that would characterize some of the world's most impoverished countries as having nearly complete water and sanitation coverage. For instance, Satterthwaite (2003) writes,

> *Around half the population of Kenya's capital, Nairobi, live in informal settlements, under conditions so challenging that 150 out of every 1,000 children die before they are five years old. How is it possible to say, then, that only 1.2 per cent is poor? Only a small proportion oft the households in these informal settlements have their own toilets, and it is common for 200 people to share each pit latrine. How can 96 per cent of the population be considered to have adequate sanitation?*
>
> p.184-185

Researchers and policy makers have begun to identify that the impact of such crude indicators are enormous. The blunt proxy, focusing solely on *type* inaccurately portrays the amount of financial resources that will be required to address the challenge (Toubkiss, 2006) and also underestimates realistic timelines that would be needed to achieve the institutions and mechanisms that can ensure sustainable access into the future. The focus provides misleading incentives for governments to focus solely on infrastructure in lieu of efficacy, health indicators and governance parameters that we have seen to be vitally important to *true* improved water and sanitation. The focus also allows for misrepresented feedback in monitoring, egregiously overestimating the rate of improvements in water and sanitation delivery and again risking that governments and international donors invest in misguided efforts. Authors have pointed out that the Millennium Development Goals are more than theoretical notions – they have in fact driven the agendas, policies and plans of international aid organizations, nation states and aid delivery organizations. The consequence of the focus on pure infrastructure as proxies has no doubt been one in which infrastructure has been prioritized in lieu of corresponding attention to long-term training and development of strong institutions with efficient mechanisms of management, monitoring and communication that could ensure that the infrastructure is maintained and service delivery is achieved.

The focus also risks limiting the array of responses that could be developed to address challenges in local contexts. A pure focus on infrastructure creates a policy bias towards top-down large investment projects that jeopardize participation of end-users, specifically the kinds of genuine learning opportunities that proponents of decentralization suggest is one of the primary positive outcomes (Satterthwaite, 2003). Whereas local participation in development of water and sanitation infrastructure solutions would promote locally

appropriate technologies, reduce costs through savings of using local labour and ensure long term transparency and accountability by reducing information asymmetries between producers and end-users – these indirect though valuable benefits are difficult to measure and so excluded from the equation in Millennium Development Goals and reporting. Sadly, not only are they excluded, but it is conceivable, if not probable, that resources may be steered away from such initiatives as reporting for spending is entirely reliant on a crude and inaccurate infrastructure proxy. The indicator also focuses entirely on new additions of infrastructure and excludes any analysis of maintenance and sustainability of existing infrastructure. Widespread documentation suggests that in most cases globally this infrastructure is not being funded sufficiently so as to ensure its adequacy into perpetuity. The result is that total funds needed to sustain (rather than just expand) infrastructure in OECD countries alone has likely been underestimated by EU 7 billion, which is roughly double the amount of current financing (OECD, 2006).

The dangers of focusing solely on infrastructure should also be examined in light of the dominant rhetoric that supports increasing investments via privatization. If the existence of certain kinds of infrastructure alone are the only indicators being included in equations of potential for profitability at the exclusion of the true costs of capacity building, then the ability for the private sector (or any sector, for that matter) to deliver services without subsidies using full-cost accounting principles, is likely to also be greatly exaggerated. Indeed the trend has been documented that the optimism shown only a few years ago to the impact that private company ownership and or delivery could play in promoting universal access has been greatly subdued with examples of private sector companies withdrawing from contracts citing inabilities to maintain failing end-of-life infrastructure and connecting poor neighborhoods still excluded from networked delivery (ABD, 2003; Bakker, 2007a)

The case of Tlamacazapa is an example of how ineffective infrastructure alone can be without the capacity, institutions and funds to ensure its maintenance and delivery. Introduction of tapped water service in Tlamacazapa without corresponding initiatives to facilitate end-user participation, water quality monitoring and infrastructure maintenance has resulted in exacerbating power imbalances and inequities at the local level with the poorest further excluded from access, a decidedly disempowering and ineffective approach.

The United Nations Development Group explicitly recognizes that these sources are proxy indicators of water access and quality because specific data about quality, cost, distance and consistency of availability are difficult and expensive to access and monitor (UN, 2003, p65). Although it may be true that the costs of monitoring and reporting more complex indicators are substantial, it is essential that this be considered in light of the cost of basing policy and investment measures on wholly inaccurate information. Arguably, the impact of such inaccuracy and lack of nuance could be in the order of billions of wasted dollars and millions of human lives.

More effective ways to move forward and to consider more nuanced components of truly improved water supplies have been proposed. For instance, Sullivan et al. (2003)

propose an integrated, interdisciplinary index that considers technical, economic, social and environmental aspects to how water access is truly experienced on the ground in contexts of poverty. They propose that indices should consider six separate components: 1) Adequacy of resource 2) measure of access, 3) capacity to manage water 4) use and 5) environmental impacts. They also emphasize that the scale of data collection needs to be appropriate so as not to lose the severity of some local situations in the averaging process across regions. Certainly, Tlamacazapa is located relatively close to a number of cities that would fare much better in terms of consistency, adequacy and quality of access but their existence does not reduce the hardship experienced by residents locally. Indeed, were these measures applied to Tlamacazapa, a much more realistic situation would be painted for policy makers and decision makers to realize that the current situation is far from adequate when measured against any relevant objectives.

Those proposing the water poverty index recognize that the source proxy is not an accurate indicator of water quality and safety. The value of actual water monitoring programs must not be underestimated, as Sullivan's group points out, these must be periodic, consistent and seasonal as water quality parameters can easily change because of human or mechanical error in treatment and delivery or just because of seasonal changes to the chemical parameters of sourcewater. Certainly in Tlamacazapa, a single grab test of water supply sources is insufficient and can (and has) led decision-makers to err in their assessment of water quality. Trace metal levels are dependent on complex chemical interactions between precipitation, organic runoff and consequent speciation (and thus mobilization) of inorganic substances such as arsenic. It is the consistent monthly sampling conducted by *Atzin* that reveals the severity of the water quality problem. Similarly, volume of water available is temporally variable and must be included in any analysis with an understanding of the hydrological and hydrogeological resources available.

Sullivan's team proposes that the measures of access should be more complex with considerations of time that better take into account queues required at public taps and other sources. The WHO and UN joint monitoring group suggests that appropriate access is 20 litres per person per day within 1 kilometre but the use of distance as a stand alone proxy often severely underestimates the time that is required to fetch water and thus also the opportunity costs involved. Certainly we see this starkly in Tlamacazapa where few participating families ever had to travel more than 1 kilometre to their water source; however, because of the inconsistency in which tap water is pumped and because of the low water tables and subsequently low hydraulic pressure in the dry seasons, individuals are waiting hours at a well – at peak scarcity at least two hours for only twenty litres of water and often an entire night in order to collect enough water to meet a household's needs for a few days. Sullivan recognizes additionally that access is influenced not only by physical availability but often also by political factors and power imbalances played out at the local scale. The team suggests that additional indicators of access could include the percentage of water carried by women and reports of conflict over water use. The index also emphasizes the importance of water for food and other

productive purposes, recognizing that the focus on domestic water supply, though important, should only be part of a spectrum. Human health and well-being indicators are most certainly also impacted by the ability of households to engage in economic activities and this can be severely limited by water scarcity. The 20 litres of water per person per day suggested by the WHO and UNDP monitoring task force may meet basic consumptive needs but it likely wouldn't allow for adequate hygiene to be practiced on site (Howard and Bartram, 2003; Gleick 1998) and it most certainly wouldn't allow for any additional productive purposes. In a situation like Tlamacazapa in which economic poverty is a situation underlying many of these other indicators (including the ability to access adequate water and sanitation) the exclusion of water for other purposes limits the ability to comprehensively assess how inadequate water is limiting well-being.

The third proposed component is, as has been illustrated by the case of Tlamacazapa, perhaps the most important to emphasize; that is, the capacity to manage water. Sullivan's group proposes a number of indicators such as: wealth proxied by ownership of durable items, under-five mortality rate, % of households reporting illness due to water supplies, education and literacy levels, presence of water users associations or other organization and adequate institutional structure and % of households receiving an income or remittance. Learning from the case of Tlamacazapa, other appropriate indicators may be the extent to which revenue and expenditure information is made publically accessible or the degree to which users self assess their ability to improve their water access.

Use is the fourth component of Sullivan's team's proposed index as measured by domestic water consumption rate, agricultural use, livestock water use, and industrial water use.

Finally, the team also proposes that indicators of environmental sustainability be included where possible and propose use of natural resources, reports of crop loss during last 5 years and percentage of households reporting erosion on their land as potential indicators. In Tlamacazapa's case more appropriate indicators focusing on a sourcewater protection approach could include livestock grazing and / or domestic development in the vicinity of the groundwater intake pipes.

The water poverty index provides some insight to alternative and certainly more accurate methods that could be adopted to monitor water access. Even incorporation of a few of these key indicators – namely water quality and consistency of delivery would be enormous steps in the right direction of accurate monitoring. Inclusion of these criteria would immediately cause residents of Tlamacazapa to be appropriately recorded as not having even basic water access.

Countries such as Mexico that have relatively high capacities and institutions for data collection and management should not wait for leadership at the global level. More nuanced statistics are necessary for good governance and policy decisions to be made at national, state and local levels. As the case of Tlamacazapa illustrates, the result of 'nonsense statistics' is that in this community alone six thousand people living with

dangerously contaminated and insufficient water supplies will be entirely overlooked. In Mexico, this could be the case for thousands and globally, for millions.

4.5 Recommendations for a path forward

4.5.1 Options for *Atzin*

The results of the study can provide some guidance for *Atzin* for next steps, further research as well as validation of existing directions. Effective paths forward include:

- Continued programming to support construction of rainwater harvesting tanks and ecological dry toilets at the household level and in collaboration with community organizations such as schools and churches.
- Long-term monitoring of simple access indicators to complement on-going water quality monitoring.
- Education and training to residents about management methods and legal jurisdictions and responsibilities in order to raise expectations of residents for service delivery and thereby improve accountability.
- Further research to itemize legislation applicable to water service deliver and associated authorities so that specific departments can approached about their detailed responsibilities.
- Research to investigate options for purification of water from *Los Sabinos* with particular attention paid to removing levels of lead and arsenic below concentrations specified in international guidelines. Research to identify the volume and recharge rate of aquifers in Tlamacazapa and in *Los Sabinos* in order to determine the quantity of water available to residents were infrastructure improvements to be made.

Rainwater harvesting and sanitation

Atzin has included water, sanitation and the environment in its programming for over a decade with incremental, consistent results. Over sixty water catchment tanks, most built concurrently with ecological composting toilets have improved quantity and quality of water for households and local schools. In a context where water is political and conflict-ridden and mechanisms for good governance are weak, *Atzin* has persisted in working with individual households and community organizations such as schools to improve access to basic water and sanitation. The work contained in this thesis establishes further validation to *Atzin's* directions. The construction of water catchment tanks on family lots, for instance, can provide individuals with upward of 5 additional litres of water per day during the dry season, which for many, is twice the water available to them during these months.

Efficacy of rainwater harvesting is well established in the literature and has been researched and implemented at depth in Bangladesh. Bangladesh provides a relevant forum from which to learn for Tlamacazapa because much of the country has similar rainfall patters with a distinct dry season for half of the year and a distinct rainy season during the other half. Moreover, Bangladesh is challenged with naturally occurring widespread arsenic contamination in groundwater Alam et al. 2010; Karim, 2010, Manzurul Islam et al. 2010).

Researchers and practitioners in Bangladesh have been increasingly promoting rainwater harvesting as a solution, though emphasizing that particular attention must be paid to avoiding and mitigating microbial contamination lest the health benefits incurred by reducing arsenic concentrations be offset by pathogen ingestion (Karim, 2010). Roofing materials in harvesting must also be considered to ensure concentrations of heavy metals, polycyclic aromatic hydrocarbons, pesticides, herbicides and microbial contamination are not being unnecessarily elevated because of the choice of roof material (Mendez et al 2011). In further expanding and researching its rainwater harvesting program, *Atzin* could further explore options for first flush diversion, filtration and disinfection so as to ensure optimal quality of the rainwater harvested.

Atzin has identified researching options for community-scale water catchment as a priority. The substantial contribution of tanks to participant households in this study suggests that rainwater catchment at the household level should remain a core part of *Atzin* programming while community-scale options are investigated.

Similarly, given that health improvements associated with water supply improvements are most significant when coupled with concurrent improvements to sanitation (Hunter et al. 2009, Fewtrell et al, 2005), further construction of ecological dry toilets with continuing education in use, maintenance and hygiene should also remain programming priorities.

Monitoring of water access

Although the depth of monitoring to water quantity and cost and access used in this study cannot feasibly be maintained into perpetuity, *Atzin* could consider simple and statistically representative monitoring of some indicators in order to track baseline access information and improvements over time. Access information would complement the water quality monitoring that the organization already undertakes. Such a long-term study would illustrate that meaningful monitoring is feasible within limited budgets and capacity at a community level and would contribute to a case for improved monitoring at regional, nationals and even global levels. Indicators that could be reasonably tracked include:

- consistency of delivery,
- cost, and
- transparency indicators such as frequency of balance sheets published.

Further, specific indicators could be identified by a working group of local women whose grounded perspectives would help to ensure that the objectives being measure are reflective of their gendered experiences.

Atzin could report the findings along with the water quality results, which are currently communicated to authorities annually. By comparing these more accurate indicators to national statistics, *Atzin* can stress that existing monitoring is inadequate and can emphasize the need for greater contributions to service delivery in Tlamacazapa from municipal, state and national government departments.

Education about governance systems

In Tlamacazapa, accessing sufficient clean water is a routine challenge for all households. During times of particular scarcity, residents will spend entire nights waiting in wells for only a couple of hundred litres of water. Although drastic, such measures were routine for residents before the water pumped from *Los Sabinos* reduced the pressure on local wells. In spite of some improvements in availability, water supply has never been consistent nor clean. Governance of any sort at the local level is weak, leaving residents with little experience in holding authorities accountable to their responsibilities. Therefore, even when delivery is entirely absent, there is little sense of outrage. Tlamacazapa residents have no expectation of receiving adequate quantity and quality of water. Providing opportunities for education in administration will no doubt allow some residents to begin conceiving of alternate realities. *Atzin* already realizes this through their integrated programming which includes a scholarship program for teenagers and young adults to continue their education outside of Tlamacazapa. Over time, such initiatives will no doubt support residents in raising expectations and asking critical and pertinent questions to authorities. Residents who participate in *Atzin's* many programs and cooperatives also have weekly meetings and annual education retreats, which provide forums for dialogue about important issues. Beginning to discuss issues of transparency and accountability in water service delivery with residents broadly using these existing forums will likely also help to raise expectations and increase pressure locally for such expectations to be met.

Further research

The infrastructure built to pump water from *Los Sabinos* to Tlamacazapa always relied on an inefficient system in which water was pumped uphill through a series of holding tanks, one tank at a time. Over ground pipes line roads and cross intersections without adequate protection, causing frequent breakages and consequent service deliver interruptions. Conceivable, water could be pumped continuously and consistently were this infrastructure to be improved. However, without an understanding of the aquifer that feeds the system, it is not known how much water could be removed without causing draw down. Further research to map the aquifer and document its recharge rate will

contribute to better infrastructure planning including outlining the volume of water that would need to be provided through alternate sources such as rainwater harvesting.

Similarly, best practices in reducing arsenic and lead levels in water needs to be researched in order to detail the cost and other resources that would be needed to maintain an adequate purification system.

5 Conclusions and reflections

The intent of this paper has been to detail the context of water access in Tlamacazapa. Detailed embedded household case studies were examined to provide insight into how water is experienced by all residents of Tlamacazapa. Maximum variation sampling was used to identify representative households because the conflict-ridden, political nature of water governance prohibited random sampling. Similarly, the time-intensive method of monthly journaling required substantial accompaniment by the *Atzin* team, such that any increases in participant households would have necessitated a decrease in the depth and detail of information collected. The sampling method used was therefore appropriate to the objective – to detail the experience of a number of Tlamacazapa residents.

Although a two by two sampling structure allowing for differentiation of households by the identified indicators: presence and absence of a household tap, presence and absence of a large tank, location by the three neighbourhoods, and distribution of wealth (as low, medium and high income) would have necessitated the involvement of 108 households, as opposed to twenty. This would not have been feasible with the methods used. In the future, such an approach could be considered for ongoing monitoring of community water access using fewer identified indicators. An approach of this type would allow for numerical evaluation of impacts of particular characteristics (income, presence of a tank, possession of a tap, for instance) on the amount of water access and the cost to a household. Detail would be lost, however, in terms of the overall experience lived by the household.

With the empirical evidence outlined here, the case has irrefutably been made that water access in Tlamacazapa is inadequate by several measures including: quantity, frequency of delivery, quality, absolute financial cost, relative financial cost and opportunity cost and that these inadequacies put the health of residents at severe risk. Paths forward should emphasize rainwater harvesting as well as capacity building and governance at a local level.

The case is not only of interest for its value in understanding its specific context and for specific place-based decision making. The case turns out to also be a critical case, in that it calls into question widely held assumptions that guide influential thinking and policy-making about water governance at a global level. In this way, it is, To this end, it adds to a growing body of research including other case studies that call into question leading international policy on water governance as we shall explore later in the thesis.

Truly improving the situation in Tlamacazapa requires acknowledging the specific challenges and experiences on the ground in order to identify appropriate, contextually relevant objectives. Only through such an analysis can appropriate technologies, institutions, legislation and processes become prioritized. In particular, an explicit dialogue about objectives will identify trade-offs between incompatible goals such as those encountered when simultaneously pursuing both full-cost recovery as well as universal access, equity and improved health indicators.

Recognizing the trade-offs will vastly broaden the current debates, which are dichotomized between those prioritizing (albeit not explicitly) economic efficiency and those prioritizing equity. A more nuanced discussion would bridge this gap and allow for more accurate evaluation of effective interventions.

To facilitate such a dialogue, more appropriate monitoring according to more detailed indicators is needed. Infrastructure type alone is not an appropriate proxy for adequate water access and no doubt overestimates safe water provision globally by the millions, if not billions of people. Moreover, reliance on such a crude and inaccurate indicator mobilizes resources in misguided ways, promoting top-down policies and infrastructure programs that entirely ignore grounded realities, embedded values and the very people that they seek to serve.

There is an urgent need to re-create the paradigm through which we discuss water governance, focusing on people at local scales.

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Appendices

Name:_____ Neighbourhood:_____

1. **Write a "G"** in the day in which you purchased a bottle of water. If it wasn't a 20 L bottle, write the size of the bottle and how much you paid for it.
2. **Write a "P"** in the day in which someone in the family went to the well to get water or to wash laundry. If someone brought water, write how many trips he or she did and how much water he or she carried.
3. **Write an "X"** in the day in which there was water in teh taps. Write how much water you received. If you did not receive any water, write "none" and explain if it was because you didn't need any water or because the tap ran out before it was your turn.

G = BOTTLE P = WELL X = TAP

MAY 2008

Monday	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*
TOTAL WATER ACCESSED: _____ TOTAL PAID THIS MONTH: $_____			**1** meter: _____	**2**	**3**	**4**
5	**6**	**7**	**8**	**9**	**10**	**11**
12	**13**	**14**	**15**	**16**	**17**	**18**
19	**20**	**21**	**22**	**23**	**24**	**25**
26	**27**	**28**	**29**	**30**	**31** meter: _____	

A. Water source:

1 ☐ Tap in your family's lot
2 ☐ Tap in a relative's lot
3 ☐ Neighbour's tap
4 ☐ Public tap
5 ☐ Other: _____

B. Number of people using the purcahsed water_____

C. Payment method:

1 ☐ Paid to a neighbour
2 ☐ Paid to a family member
3 ☐ Charged with each delivery
4 ☐ Charged this month by (name)
_____
5 ☐ No charge this month
6 ☐ Other (explain) _____

D. 1 Did you receive a receipt for delivery? ☐ yes ☐ no
2 Did you receive a receipt for payment? ☐ yes ☐ no

E. Other sources of water your household used this month:

1 ☐ Purchased bottled
2 ☐ Well
3 ☐ Rain in buckets / metal cans / containers
4 ☐ Cistern with rain
5 ☐ Cisterna with well water
6 ☐ Cistern with tap water
7 ☐ Other_____

F. Size / volume of containers:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

Notes:

Nombre:_____ Barrio:_____

1. **Escribe un "G"** el día en que compraste un garrafón de agua. Si no fue un garrafón de 20 L, escribe el tamaño de la botella que compraste, y cuanto pagaste.
2. **Escribe un "P"** el día en que alguien de la familia fue a recoger agua del pozo o en que fue al pozo para lavar ropa. Si trajo agua, escribes cuantos viajes hizo, quien la trajo y cuanta agua acarreó.
3. **Escribe un "X"** el día en que "hubo agua" en la llave. Escribe cuanta agua recibiste. Si no recibiste nada, escribe "nada" y explica si eso era porque no necesitaste agua o porque el agua se terminó antes que te tocó.

G = GARRAFON P = POZO X = LLAVE

MAYO 2008

Lunes	*Martes*	*Miércoles*	*Jueves*	*Viernes*	*Sábado*	*Domingo*
TOTAL DE AGUA RECIBIDO: _____ TOTAL PAGADO ESTE MES: $_____			1 **medidor:** _____	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31 **medidor:** _____	

A. Fuente de agua:

1 ☐ Llave en tu lote de tu familia
2 ☐ Llave en tu lote de otro familiar
3 ☐ Llave de un vecino
4 ☐ Llave público
5 ☐ Otro: _____

B. Numero de personas usando esta agua comprada_____

C. Método de cobrar:

1 ☐ Pagado a vecino
2 ☐ Pagado a familiar
3 ☐ Cobrado con cada entrega
4 ☐ Cobrado este mes por (nombre)

_____

5 ☐ No cobraron este mes
6 ☐ Otro (explica) _____

D. 1 ¿Recibiste recibo de consumo? ☐ sí ☐ no
2 ¿Recibiste recibo de pago? ☐ sí ☐ no

E. Otras fuentes de agua que tu familia ocupó este mes:

1 ☐ Garrafón comprado
2 ☐ Pozo
3 ☐ Lluvia en cubetas / botes / contenedores
4 ☐ Cisterna con lluvia
5 ☐ Cisterna con agua de los pozos
6 ☐ Cisterna con agua de las llaves
7 ☐ Otro_____

F. Tamaño / volumen de contenedores:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15.

Notas:

Full name of the interviewee_____

Interview: Source, quantity and cost of water in a context of poverty: a case study of Tlamacazapa, Guerrero, Mexico.

Section 1. Baseline – Lot

1. Name of the interviewee _____

2. Complete name of the owner of the lot_____

3. Relation of the lot owner to the interviewee

   a. the interviewee b. her husband c. relative _____ d. father-in-law or mother-in-law e. other_____

4. Number of occupied houses on this lot:
   NOTE: An "occupied house" refers to any building or room where people regularly sleep. A concrete building with one floor counts as "1", a concrete building with two floors, with people living on both floors counts as "2" houses.

   1 2 3 4 5 6 7 8 9 10

5. How many nuclear families live in this lot?

   1 2 3 4 5 6 7 8 9 10

6. Are you or your husband owners of a piece (or pieces) of land resides this lot?

   a. Yes (What size?)_____ b. No

7. If they answer yes, for what purpose is the other land used?

   a. To plant crops b. A stall / store c. It is rented to others

   d. Nothing e. Pasture land f. Other_____

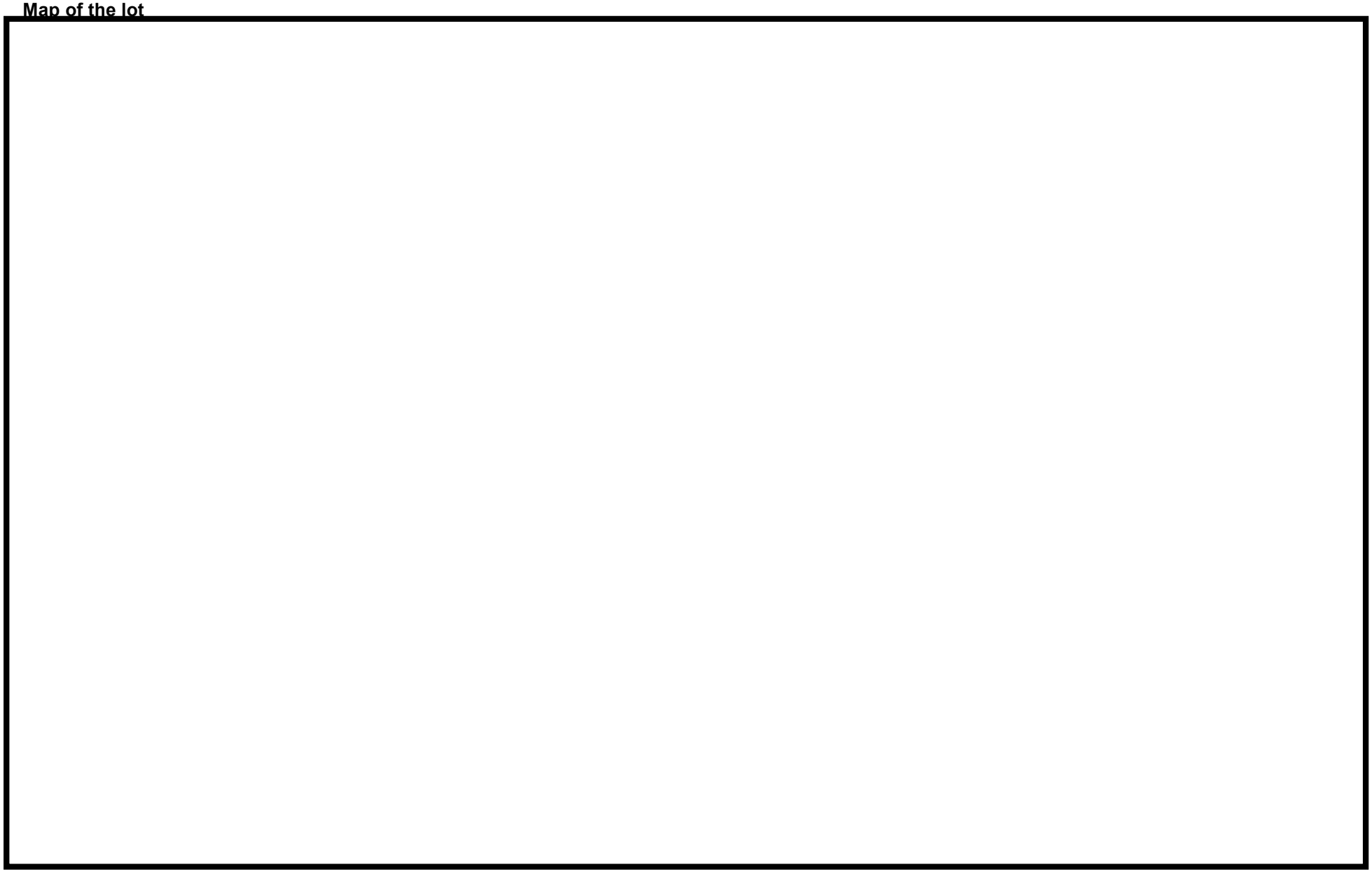
Full name of the interviewee_____

On the next page, please draw a map of the lot, using the codes and examples given here.
(note that codes are hand drawn on final copy and so not shown here.)

Instructions and code / example	√	Instructions and code / example	√	Instructions and code / example	√
1) **Buildings** *(has walls and a roof)* and who uses it (F1, F2, F3 for family 1, family 2, family 3). Show rooms and floors.		7) **Washrooms** (which family uses them and how many people from each family) A latrine with a whole in the ground, that is being used Latrine requiring water with a septic tank A dry toilet: (showing where the urine goes) Made by *Caminamos Juntos* Made by the government Made by the family Made by someone else (a contractor, ex) A privacy wall (with nothing else)		11) Water **taps** and access for each family (F1, F2, F3) never, partial access, always	
2) Number of **people** who sleep regularly in the building (in Tlama **for at least** six months of the year).				12) Water **meters**	
3) **People** who sleep occasionally in the building (are **outside of** Tlama six months of the year or more).				13) Where does each family wash dishes? Where does the **greywater** go?	
4) For each building, what is it made of? **Walls**: cedar, corn stalks, adobe, concrete **Floor**: soil, concrete **Roof**: Palm, metal sheeting, tarpaper sheeting, concrete		8) Water **tanks** and volume (which family owns it?)		14) The **gardens**: do they grow in the dry season (S) or only in the rainy season (L) with flowers and/or edible plants and/or trees.	
				15) **Light bulbs**	
				16) **Electrical connections**	
5) **Beds** in the building and quantity. Mattress on floor Stick bed with a mattress Stick bed with no mattress Hammock		9) ¿All of the places where they **bathe**. Which families and how many people from the family. Inside of a bathroom or another building Behind a privacy wall Outside		17) **Televisions** that work	
				18) **Radios** that work	
6) **Stove** in the building or outside Stove top made with rocks, cook with firewood An oven, where the wood goes inside With gas		10) Where are the **clothes washed**? Which families use the washbasin or washing stone? Where does the greywater go?		19) **Refrigerators** that work	

Full name of the interviewee_____

Map of the lot



Notes:

Full name of the interviewee_____

Map of the lot

Notes:

Full name of the interviewee_______________________

Description of each house on the interviewee's lot. Only buildings where people sleep count as 'houses'.

	9. House 1 (interviewee's)		10. House 2		11. House 3		12. House 4		13. House 5		14. House 6	
a. Number of children (0-5 years)	M	F	M	F	M	F	M	F	M	F	M	F
b. Number of children (6-10 years)	M	F	M	F	M	F	M	F	M	F	M	F
c. Number of children (11-17 years)	M	F	M	F	M	F	M	F	M	F	M	F
d. Number of adults (18-49 years)	M	F	M	F	M	F	M	F	M	F	M	F
e. Number of adults (50-64 years)	M	F	M	F	M	F	M	F	M	F	M	F
f. Number of adults 65 years or older	M	F	M	F	M	F	M	F	M	F	M	F
How many animals? g. pigs												
h. donkeys												
i. horses												
j. chickens												
k. turkeys												
l. cats												
m. dogs												
n. cows												
o. goats												
p. Other animals_____												
q. Do they use clay pots or did they use them before?	i. Yes ii. No iii. Not anymore iv. Other___________		i. Yes ii. No iii. Not anymore iv. Other___________		i. Yes ii. No iii. Not anymore iv. Other___________		i. Yes ii. No iii. Not anymore iv. Other___________		i. Yes ii. No iii. Not anymore iv. Other___________		i. Yes ii. No iii. Not anymore iv. Other___________	
r. If they answer "not anymore," when did they stop using them?	i. Don't know ii. This year iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 or earlier		i. Don't know ii. This year iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 or earlier		i. Don't know ii. This year iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 or earlier		i. Don't know ii. This year iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 or earlier		i. Don't know ii. This year iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 or earlier		i. Don't know ii. This year iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 or earlier	
s. If they answer "yes," how many times do they use them each week, normally?	1 2 3 4 5 6(almost daily) 7 (daily) Don't know		1 2 3 4 5 6(almost daily) 7 (daily) Don't know		1 2 3 4 5 6(almost daily) 7 (daily) Don't know		1 2 3 4 5 6(almost daily) 7 (daily) Don't know		1 2 3 4 5 6(almost daily) 7 (daily) Don't know		1 2 3 4 5 6(almost daily) 7 (daily) Don't know	

Full name of the interviewee_____

15. Do you buy bottled water? a. Yes b. No

16. With which families (houses) in your lot do you normally share bottled water? (Use the house code used on the map and for questions "9" to "14." You can mark more than one response.

a. with no other house (only house 1) b. House 2 c. House 3 d. House 4 e. House 5 f. House 6 g. Other_____

17. With how many other people, apart from those that live in your house, do you share the water that is in your barrels, tanks or buckets?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33+_____

18. With how many people, apart from those that live in your house, do you share bottled water with normally?

0 1 2 3 4 5 6 7 8 9 10 11+_____

19. With how many families (houses) in the lot do you share the water that is kept in barrels / buckets and / or tanks? (Use the house code that was used in the map and in questions "9" to "14." You can mark more than one response.

a. No other house (only house 1) b. House 2 c. House 3 d. House 4 e. House 5 f. House 6 g. Other_____

In the next section about individuals in the house, include all individuals in all houses with whom the interviewee shares water, whether it is bottled water or water kept in buckets, barrels or tanks.

Full name of the interviewee_____

Section 2: Baseline household data – Information about each person in the interviewee's household family. Include all those with whom the interviewee shares water. It may be that this includes two or more families.

ONLY include people who are ALIVE. In column "20," mark "Is elsewhere" for any person that is outside of Tlama for seven (7) months or more per year. Mark "lives in Tlama" for people who are in Tlama for a total of six months or more per year.

1. Complete name	2. Age (Years)	3. Sex (M / F)	4. Living in Tlama or elsewhere	5. Have birth certificate	6. Have electorate card	7. Can read	8. Can write	9. Level of school completed (K, P1,P2, P3, P4, P5, P6. S1, S2, S3, Prep1, Prep2, Prep3	
a.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
b.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
c.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
d.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
e.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
f.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___

1.Complete name	2. Age	3. Sex (M / F)	4. Lives in Tlama or elsewhere	5. Has birth certificate	6. Has elector card	7. Can read	8. Can write	9. Level of school completed (K, P1,P2, P3, P4, P5, P6. S1, S2, S3, Prep1, Prep2, Prep3	
g.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
h.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
i.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
j.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
k.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
l.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___
m.			i. Lives in Tlama ii. Is elsewhere (7+)	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No	i. Don't know ii. Yes iii. No iv. A little	i. Don't know ii. Yes iii. No iv. A little	i. Yes Finished____ ii. Is in_____ iii. Attends CJ	iv. No Never went v. Doesn't go vi. Other___

Complete name	10. Where does (s)he sleep?	11. Does (s)he paint palm	12. Which type of water does (s)he drink?	13. If (s)he drinks bottled water, how often?	14. Social assistance?	15. Pension?	16. Farm subsidy?
a.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month or more) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Only sometimes ii. About half the time iii. Almost always iv. Always (no exception) v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
b.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month or more) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Only sometimes ii. About half the time iii. Almost always iv. Always (no exception) v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
c.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month or more) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Only sometimes ii. About half the time iii. Almost always iv. Always (no exception) v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
d.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month or more) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Only sometimes ii. About half the time iii. Almost always iv. Always (no exception) v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
e.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month or more) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Only sometimes ii. About half the time iii. Almost always iv. Always (no exception) v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
f.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month or more) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year

Complete name	10. Where does (s)he sleep?	11. Does (s)he paint palm	12. Which type of water does (s)he drink?	13. If (s)he drinks bottled water, how often?	14. Social assistance?	15. Pension?	16. Farm subsidy?
g.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
h.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
i.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
j.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
k.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
l.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year
m.	i. On the floor ii. In a hammock iii. On a stick-framed bed without mattress iv. On a stick-framed bed with mattress v. On a purchased bed (with mattress) vi. Other_____	i. no, never ii, very rarely iii. yes, regularly (once per month +) iv. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. Bottled water ii. Well water iii. Tap water iv. Rain water v. Other_____	i. No ii. Yes _____ pesos every two months	i. No ii. Yes _____ pesos every month	i. No ii. Yes _____ pesos every year

Section 3. Sources of water What do you or did you use during:

	a. Rainy season – this year (2008)	b. Dry season – this year (2008)	a. Rainy season – last year (2007)	b. Dry season – last year (2007)
1. To cook, water from:	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____
2. To bath, water from:	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____
3. To do the laundry, water from:	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____
4. To water the garden, water from:	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____
5. For the animals, water from:	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____	i. wells / runoff catchments/ lake ii. tap / Los Sabinos iii. bottles iv. truck v. rain vi. Other_____

Section 4. Attaining water – sources
Only respond to this section if you or someone with whom you share water has gone to the wells during the last two years. If non-one has gone to the wells, skip to section 5.

1. Who normally goes to the well in your household? (can mark more than one response)

a. the interviewee b. her husband c. her daughter(s) d. her son(s) e. other person

Mark an "X" in the row pertaining to the water source and in the column pertaining to the time when the household uses it. Ask them which wells they use now, which they used in the dry season and then, which they used last year, filling the table with their responses. Then, double check that it is true that they never use the other sources.

	a. This year (2008) rainy season (June-October)	b. This year (2008) dry season (Dec-May)	c. Last year (2007) rainy season (June – October)	d. Last year, dry season (Dec – May)	e. Source never used
2. Tlamapa (well #1)					
3. Coixcapan (well #2)					
4. Tlajilapa (well #3)					
5. Aztocapa (well #4)					
6. Tlashilmolco (well #5)					
7, Michacapa (runoff catchment in San Juan)					
8. La Pila (runoff catchment below Tlashimolco)					
9. Xochitltielpa (highway to BVC)					
10. The big lake					
11. Colotzintla (runoff catchment in Santiago)					
12. Other_____					

	a. This year, rainy season	b. Last year, dry season	c. This year, rainy season	d. Last year, dry season
13. Do you or did you take laundry to the well or lake to wash (instead of doing it in your home?)	i. Yes ii. No	i. Yes ii. No	i. Yes ii. No	i. Yes ii. No

Only ask "14" if the answered "yes" to one of the questions "13" "a", "b", "c" or "d".
14. When you take your laundry to wash outside of the house, where do you take it? You can mark more than one response.

a. Tlamapa (well #1)
b. Coixcapan (well #2)
c. Aztocapa (well #4)
d. Tlashimolco (well #5)
e. Michacapa (runoff catchment in San Juan)
f. La Pila (runoff catchment below Tlashimolco))
g. Xochitltielpa (highway to BVC)
h. Colotzintla (runoff catchment in Santiago)
i. The big lake
j. Other_____

15. ¿During the last two years, did someone in the family bath at the wells or at the lake? a. Yes b. No, nobody

Ask "16"and "17" only if the responded "yes" to "15".

16. If yes, how many do it (bath) 1 2 3 4 5 6 7+

17. Who bathes there? (may mark more than one response)

a. Women (18 years +)	b. Men (18 years +)	c. Girls (younger than 18 years)	d. Boys (younger than18 years)

Section 5: Purchased bottles of water. Only ask this section if someone in the household drinks bottled water.

1. What type of bottled water do you normally purchase and how much does it cost right now? (You may mark more than one response)

a. Agua Electrapura $_____ b. Agua de Los Ángeles $_____

c. Agua "from Taxco" $_____ d. Don't know the name $_____

e. Other_____ $ _____

2. When did you start to buy bottled water?

a. This year (2008) b. 2007 c. 2006 d. 2005 e. 2004

f. 2003 g. 2002 h. 2001 or earlier i. Don't know / don't remember

3. Why do you buy / drink bottled water?

a. it is clean water
b. it tastes good
c. it is clear water
d. to be healthy
e. it is healthy water
f. I've been told I should drink it
g. It is said that water from the taps and from the wells is not good
h. the well water is dirty
i. the well water is contaminated
j. Los Sabinos water/ tap water is dirty
k. Los Sabinos/ tap water is contaminated
l. I was advised to do so by Caminamos Juntos / the health centre / the priest
m. Other_____

Full name of the interviewee_____

Section 6. Tap water and water metres

1. Does your family have a tap?

a. Yes b. Yes, but it doesn't work c. No

2. Do you have access to a tap?
   a. No and we never use tap water
   b. No, we use water from the public tap
   c. Yes, a tap on our lot (belonging to another family)
   d. Yes, we can always buy water from a neighbour's tap
   e. Yes, sometimes we can buy water from a neighbour's tap
   f. Other_____

3. Why do you not have a tap?
   a. Because of the cost
   b. Because the pipes don't reach here
   c. Because those in charge of the water / the committee don't want to give one to us
   d. Because the pump isn't able to pump water as far as here
   e. Because we don't want one / we don't see the necessity
   f. Don't know
   g. Other_____

4. If you purchase water from a public tap or from a neighbour, how much do you pay?
   a. _____ pesos per bucket (square 18L)
   b. _____ pesos per bucket (round 20L)
   c. _____ pesos per barrel
   d. Other_____

Skip to the next section

5. For how long has the tap been broken?
   a. less than one month
   b. between 1 month and 6 months
   c. between 7 months and 11 months
   d. between 1 year and 2 years
   e. more than 2 years

g over it
   b. Someone broke it
   c. It was disconnected during street construction / repairs
   d. The deposit tank or the pump doesn't work and they don't serve these pipes
   e. Don't know
   f. Other_____

7. Who is responsible for fixing it?

   a. Us, the family
   b. The water committee / those in charge
   c. Those from Taxco / those in charge fromTaxco / the committee in Taxco
   d. A name _____
   e. Don't know
   f. Other_____

Continue with "8"

8. When was the tap installed?

   a. Before 2004 b. 2004 c. 2005
   d. 2006 e. 2007 f. 2008
   g. Don't know

9. How much did you pay for the tap connection?

a. pesos_____
b. work (days) _____
c. material (list materials)_____Value (pesos) _____
d. Other_____
e. Don't know / Don't remember

10. How is the cost of your water calculated? If it varies, mark all that apply.

a. monthly ($) _____ b. per barrel at $_____

c. as per what is recorded on the metre d. other_____

11 Who collects the amount due?

a. Someone from the committee/ those in charge / those who own the water (name)_____
b. Someone from the committee/ those in charge / those who own the water but I don't know their name
c. We go to the town hall when we are called through the loudspeaker
d. Don't know who
e. Other_____

12. What happens if someone doesn't pay?

a. They cut the connection
b. They no longer give you water
c. Don't know
d. Other_____

13. Who is in the water committee now? (Mark all that apply)

a. Juan Salazar
b. Other name_____
c. Other name _____
d. Other name _____
e. Juan Salazar and others but don't know their names
f. Don't know
g. Other_____

14. Do you have a water meter right now?

a. Yes b. Yes, but it is broken c. No

15. How did it break? ***Skip to the next section***

a. Somebody broke it
b. It clogged and we disconnected it
c. Don't know
d. Other_____

16. Who is responsible for fixing it?

a. Us, the family
b. The water committee / those in charge
c. A name _____
d. Don't know
e. Those from Taxco / from the committee in Taxco
f. Other_____

17. Was the meter installed at the same time as your tap? a. Yes b. No, it was installed in _____

18. Were you charged for the meter separately from you tap? a. Yes b. No

19. How much more did you pay for your meter? $_____

20. What purpose do the meters serve?

a. to measure the quantity of water that we are taking
b. to know how much to pay
b. so that we can't steal the water
c. don't know
d. Other_____

If they answer "a", "b" or "c".

21. How is the cost calculated based on what the meter reads?

a. It shows the water volume in square meters and there are 5 barrels in each meter
b. It shows the water volume in square meters and there are 1000 litres in a square meter.
c. Don't know
d. Other_____

22. Do you know how to read the meter?

a. Yes b. No c. A little d. Don't know

Ask them to try reading it if they responded "yes," "a little" or "don't know

23. Did they read it successfully? a. Yes b. No
c. What he or she said the meter read_____
d. What the meter actually read_____

24. Does anyone else in the house know how to read the meter? a. Yes b. No

25. If they name someone who is in the house, ask them to read it and write if they are able to successfully.

a. _____ i. Not there to read it ii. Yes (s)he can iii. No (s)he can't

iv. What (s)he said the meter reads_____ v. What the meter actually reads_____

b. _____ i. Not there to read it ii. Yes (s)he can iii. No (s)he can't

iv. What (s)he said the meter reads_____ v. What the meter actually reads_____

c. _____ i. Not there to read it ii. Yes (s)he can iii. No (s)he can't

iv. What (s)he said the meter reads_____ v. What the meter actually reads_____

d. _____ i. Not there to read it ii. Yes (s)he can iii. No (s)he can't

iv. What (s)he said the meter reads_____ v. What the meter actually reads_____

26. Who comes to read your meter? (Or who used to come, if the meter is broken)

a. Someone from the committee / those in charge / those who own the water (name)_____
b. Someone from the committee / those in charge / those who own the water, but don't know his/her name
c. No one
d. Don't know who

Section 7: Family water use (in general, rainy season and dry season)

Do you clean the house with water? For each option below, how often do they do it in the rainy season? In the dry season?

	a. Rainy season – frequency	b. Rainy season – volume	c. Dry season - frequency	d. Dry season - volume
4. No, never clean with water	X	X	X	X
5. Yes, they sprinkle water on the ground before sleeping it to avoid dust	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____
6. Yes, they mop	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____
7. Yes, they wash surfaces with a cloth and water	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____
8. Other	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____

Other uses of water – For which of these purposes do you use water, with how much water, how often?

	a. Rainy season - approximate frequency	b. Rainy season - quantity	c. Dry season – approximate frequency	d. Dry season – approximate frequency
9. Laundry	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____
10. Putting water down a toilet bowl (to flush it)	i.Never / don't have a water-using toilet ii. Yes, every time we use the toilet iii. Yes, every time there is excrement but not urine only iv. Yes, twice a day v. Yes, once a day vi. Other_____	i. Container volume_____ ii. How many containers_____	i.Never / don't have a water-using toilet ii. Yes, every time we use the toilet iii. Yes, every time there is excrement but not urine only iv. Yes, twice a day v. Yes, once a day vi. Other_____	i. Container volume_____ ii. How many containers_____
11. Watering the garden	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____
12. Using water to paint palm	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____
13. Using water to boil palm	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____	i. daily ii. every other day iii. twice a week iv. once a week v. every two weeks vi. once a month vii. Other_____	i. Container volume_____ ii. How many containers_____

14. In the rainy season, generally,

Write the names in the same order in which they were written in section 1.2	1a. Household member 1 – **rainy** months _____	1b. Household member 1 – **dry** months _____	2a. Household member 2 – **rainy** months _____	2b. Household member 2 – **dry** months _____	3a. Household member 3 – **rainy** months _____	3b. Household member 3 – **dry** months _____
i. How many times in a week does this person bathe?	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____
Each time that this person bathes, which type of bucket do they use and how many or what fraction *(Ask them to show you)*	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____

Write the names in the same order in which they were written in section 1.2	4a. Household member 4 – **rainy** months _____	1b. Household member 4 – **dry** months _____	5a. Household member 5 – **rainy** months _____	1b. Household member 5 – **dry** months	6a. Household member 6 – **rainy** months _____	1b. Household member 6 – **dry** months
i. How many times in a week does this person bathe?	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____
Each time that this person bathes, which type of bucket do they use and how many or what fraction *(Ask them to show you)*	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____

Write the names in the same order in which they were written in section 1.2	7a. Household member 7 – **rainy** months _____	7b. Household member 7 – **dry** months _____	8a. Household member 8 – **rainy** months _____	8b. Household member 8 – **dry** months _____	9a. Household member 9 – **rainy** months _____	9b. Household member 9 – **dry** months _____
i. How many times in a week does this person bathe?	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____
Each time that this person bathes, which type of bucket do they use and how many or what fraction *(Ask them to show you)*	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____

Write the names in the same order in which they were written in section 1.2	10a. Household member 10 – **rainy** months _____	10b. Household member 10 – **dry** months _____	11a. Household member 11 – **rainy** months _____	11b. Household member 11 – **dry** months _____	12a. Household member 12 – **rainy** months _____	12b. Household member 12 – **dry** months _____
i. How many times in a week does this person bathe?	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____
Each time that this person bathes, which type of bucket do they use and how many or what fraction *(Ask them to show you)*	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____

Write the names in the same order in which they were written in section 1.2	13a. Household member 13 – **rainy** months _____	13b. Household member 13 – **dry** months _____	14a. Household member 14 – **rainy** months _____	14b. Household member 14 – **dry** months _____	15a. Household member 14 – **rainy** months _____	15b. Household member 14 – **dry** months _____
i. How many times in a week does this person bathe?	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____	1 2 3 4 5 6 7 Other____
Each time that this person bathes, which type of bucket do they use and how many or what fraction *(Ask them to show you)*	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____	ii. Container volume_____ iii. How many containers_____

15a. How many fruit trees do you have in the garden? 0 1 2 3 4 5 6 7 8 9 10 11+

b. How many of these do you water? 0 1 2 3 4 5 6 7 8 9 10 11+

c. How many of these produce fruit? 0 1 2 3 4 5 6 7 8 9 10 11+

16. How many edible plants, not including trees, do you have in your garden during the dry months?

0 1 2 3 4 5 6 7 8 9 10 11+

17. How many plants that have another non-decorative purpose (to clean, to heal etc) do you have in your garden during the dry months?

0 1 2 3 4 5 6 7 8 9 10 11+

18. How many flowering plants (not edible) do you have in your garden during the dry months?

a. 0 b. 1-5 c. 6-10 d. 11-20 e. 21-30 f. 31+

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
a.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months
b.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) ____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
	xx. Other_____			xx. Other_____			
c.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months
d.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
	ixx. Teacher xx. Other_____			ixx. Teacher xx. Other_____			
e.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months
f.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
	xviii. Seamstress ixx. Teacher xx. Other_____			xviii. Seamstress ixx. Teacher xx. Other_____			
g.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months
h.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
	xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			
i.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months
j.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
	xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			
k.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months
l.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6

Section 8: Income sources

Full name (each household member)	17. Primary income source (during the last two years). Mark only work for which they receive an income. Mark only one response.	18. Details of the work	19. How much does (s)he earn for this work each week, generally?	20. Other income sources (can mark more than one response)	21. Details of the work	22. How much does (s)he earn for this work each week, generally?	23. How long does (s)he work outside of Tlamacazapa each year?
	xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			months
m.	i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells them elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction worker helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Does not have paid work (no income) ii. Weaves palm iii. Makes bracelets, sells elsewhere iv. Makes aluminium paper purses v. Vendor (what does (s)he sell?) _____ vi. Construction worker vii. Labourer / construction helper viii. Metal worker ix. Street construction x. Carpenter xi. Butcher xii. Field worker (agriculture) xiii. Mine worker xiv. Works in own store / stall xv. Collects and sells firewood xvi. Collects and sells palm xvii. Midwife xviii. Seamstress ixx. Teacher xx. Other_____			i. Never leaves ii. Less than 1 month iii. 1-2 months iv. 3-4 months v. 5-6 months vi. more than 6 months

18. Does someone in the house receive money from relatives who live outside of Tlamacazapa? a. Yes b. No

19. If yes, how many people send money? 1 2 3 4 5 6+

20. How much is received generally each week, month or year? _____ pesos each _____

Using the responses to the income sources section, fill in the calendar for the month of August with the family, asking about each of the income sources and how much money they earned during the month.

****** Names and relation to the interviewee of all who were present during the interview.**

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

AUGUST 2008						
Monday	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Interviewee name_____

Section 9: Storing water

HOUSE 1 (Interviewee's house). Take photos of each container in the order in which they are written here.

# Photo	Volume	Container description

1. Total volume in house 1 _____

2. Total number of containers in house 1 _____

Section 10: Photo history. Also take photos of the water tanks, bathrooms, each place where the household captures rainwater and each garden.

# Photo	Photo description

# Photo	Photo description

Interviewee name_____

Section 11. Time and distance

Accompany the interviewee or another member of the family to each well, catchment or lake from which they get water, asking them to walk at their normal speed while you time the trip using a stopwatch. Try to accompany them when they would normally go. Mark the wells in the attached map with the letters corresponding to the table below "a", "b", "c" etc.

1. Name of the well, catchment or lake	2. How long did it take to arrive there from the interviewee 's house (min:sec)	3. Was the trip direct or did they stop to rest or to chat with someone?	4. Distance to the water source (paced, metres)	5. Was there a wait for water at the water source? If yes, write how long. (min:sec)	6. Was this a typical trip to this water source in terms of time to arrive at the water source? (for this rainy season?)	7. Was this a typical trip to this water source in terms of waiting time at the water source? (for this rainy season?)
a.		Direct Stopped to rest Stopped to chat Other		No Yes _____	Yes, it was typical No it was shorter No it was longer	Yes, it was typical No it was shorter No it was longer
b.		Direct Stopped to rest Stopped to chat Other		No Yes _____	Yes, it was typical No it was shorter No it was longer	Yes, it was typical No it was shorter No it was longer
c.		Direct Stopped to rest Stopped to chat Other		No Yes _____	Yes, it was typical No it was shorter No it was longer	Yes, it was typical No it was shorter No it was longer
d.		Direct Stopped to rest Stopped to chat Other		No Yes _____	Yes, it was typical No it was shorter No it was longer	Yes, it was typical No it was shorter No it was longer
e.		Direct Stopped to rest Stopped to chat Other		No Yes _____	Yes, it was typical No it was shorter No it was longer	Yes, it was typical No it was shorter No it was longer

In this map, mark the route that was taken to arrive at the water source from the house. Mark the water source with the letter "a", "b", "c", "d", "e" according to the list on page "25".

Notes

To help people remember years, you can ask them to remember the year corresponding to the following events that happened in the following years.

Year	Mayor who entered this year	Other events and dates
2008	Saturnino Moreno	
2007	Saturnino Moreno	April 2007, the Father left
2006	Saturnino Moreno (July 2006 - --)	
2005	Bernardo María (July 2005 – July 2006)	October, 2005 the PRI (political party) lost power and PAN took over in Taxco
2004	José Margarito (July 2004 – July 2005)	
2003	Abram Fermín (July 2003 – July 2004)	
2002	José Mantilla (July 2002 – July 2003)	

Fecha_____ Hora empezada_____ Nombre completo de(l) (la) entrevistado/a_____

Entrevista: Fuente, cantidad y costo de agua en un contexto de pobreza: un estudio de Tlamacazapa, Guerrero, México.

Sección 1. Datos de Base del Lote

1. Nombre completo de(l) (la) entrevistado/a _____

2. Nombre completo del dueño del lote_____

3. Relación del dueño del lote a la entrevistada o al entrevistado

   a. la entrevistada b. su esposo c. familiar _____ d. suegro o suegra e. otro_____

4. Número de casas ocupadas en este lote:
   OJO: Cuenta como "casa" un edificio o un cuarto donde duerme gente regularmente. Un edificio de material de un piso cuenta como "1" casa; una de dos pisos con gente viviendo en los dos pisos cuenta como "2" casas.

   1 2 3 4 5 6 7 8 9 10

5. Número de familias nucleares que viven en este lote.

   1 2 3 4 5 6 7 8 9 10

6. ¿Es usted o su esposo dueño o dueña de un terreno (o terrenos) a parte de este lote? a. Si (¿qué tamaño?)_____ b. No

7. Si contestan si, ¿Para qué ocupa el otro terreno (los otros terrenos) que está(n) a parte?

   a. Sembrar hortalizas b. Puesto / tienda c. Rentarlo

   d. Nada e. Para que los animales pasten f. Otro_____

Fecha_____ Hora empezada_____ Nombre completo de(l) (la) entrevistado/a_____

En la próxima página, favor de dibujar una mapa del lote, ocupando los códigos y ejemplos dados aquí.

Direcciones y código / ejemplo	√	Direcciones código / ejemplo	√	Direcciones código / ejemplo	√
1) Un **edificio** (*tiene paredes y un techo)* y quien lo ocupa (F1, F2, F3 por familia 1, familia 2, familia 3). Muestra cuartos y pisos.	___	7) **Baños** (qué familia lo ocupa y cuánta gente de la familia) Letrina de hoyo que está en uso Tasa de agua con fosa séptica Baño seco: (¿y a dónde va la orina?) hecho por Caminamos Juntos hecho por el gobierno hecho por la familia hecho por otro (contratado por ejemplo) Pared de privacidad (nada más)	___	11) **Llaves** de agua y acceso de cada familia (F1, F2, F3) nunca, parcial, siempre	___
2) **Personas** que duermen regularmente en el edificio (en Tlama **por lo menos** seis meses del año.)	___			12) **Medidores** de agua	___
3) **Personas** que duermen a veces en el edificio (está **fuera** de Tlama siete meses o más en un año.)	___			13) Dónde lavan los **trastes** y cuales familias. ¿A dónde va el desagua?	___
4) Por cada edificio, de qué es hecho. **Paredes**: cedro, aguasol, adobe, material **Suelo**: tierra, concreto **Techo**: Palma, Lamina metal, Lamina cartón, concreto	___	8) **Tanques** de agua y volumen (de qué familia)	___	14) Las **jardines**, crecen en la época de sequia (S) o nada más en la época de lluvia (L) con flores o / y comestibles o/y arboles.	___
5) **Camas** en el edificio y cantidad. De una calchón De palos con calchón De palos sin calchón Hamacas	___	9) ¿Todos lugares donde **se bañan**. Qué familia y cuántas personas de la familia. Dentro de un baño u otro edificio En un pared de privacidad Afuera nada más	___	15) **Focos** de luz	___
				16) **Conexiones** de **luz**	___
				17) **Televisiones** que funcionen	___
6) **Estufa** en el edificio o a fuera. Klekwil (piedras con leña)	___	10) ¿Dónde **lavan la ropa**? ¿Cuáles familias ocupan el lavadero o la piedra? Y ¿A dónde va el desagua?	___	18) **Radios** que funcionen	___
Una estufa con leña al dentro Con gas				19) **Refrigerios** que funcionen	___

Fecha_____ Hora empezada_____ Nombre completo de(l) (la) entrevistado/a_____

Mapa del lote

Notas:

Mapa del lote

Notas:

Fecha________________ Hora empezada_________________ Nombre completo de(l) (la) entrevistado/a_________________

Descripción de las casas del lote de la entrevistada (del entrevistado). Sola cuenta como casa, el edificio donde duermen la gente.

	8. Casa 1 (de la entrevistada)		9. Casa 2		10. Casa 3		11. Casa 4		12. Casa 5		13. Casa 6	
a. Número de niños (0-5 años)	H	M	H	M	H	M	H	M	H	M	H	M
b. Número de niños (6-10 años)	H	M	H	M	H	M	H	M	H	M	H	M
c. Número de niños (11-17 años)	H	M	H	M	H	M	H	M	H	M	H	M
d. Número de adultos (18-49 años)	H	M	H	M	H	M	H	M	H	M	H	M
e. Número de adultos (50-64 años)	H	M	H	M	H	M	H	M	H	M	H	M
f. Números de adultos con 65 años o más	H	M	H	M	H	M	H	M	H	M	H	M
¿Cuántos animales? g. puercos / marranos												
h. burros												
i. caballos												
j. pollos												
k. guajolote / pipile												
l. gatos												
m. perros												
n. vacas												
o. chivos												
p. Otros animales____												
q. ¿Ocupan ollas de barro o las ocuparon antes?	i. Si ii. No iii. Ya no, antes si iv. Otro___________		i. Si ii. No iii. Ya no, antes si iv. Otro___________		i. Si ii. No iii. Ya no, antes si iv. Otro___________		i. Si ii. No iii. Ya no, antes si iv. Otro___________		i. Si ii. No iii. Ya no, antes si iv. Otro___________		i. Si ii. No iii. Ya no, antes si iv. Otro___________	
r. ¿Si contestan "ya no, antes si", cuándo dejaron de ocuparlas?	i. No sabe ii. Este año iii. 2007 iv. 2006 v. 2005 vi. 2004 vii. 2003 viii. 2002 ix. 2001 o antes		i. Este año ii. 2007 iii. 2006 iv. 2005 v. 2004 vi. 2003 vii. 2002 vii. 2001 o antes		i. Este año ii. 2007 iii. 2006 iv. 2005 v. 2004 vi. 2003 vii. 2002 vii. 2001 o antes		i. Este año ii. 2007 iii. 2006 iv. 2005 v. 2004 vi. 2003 vii. 2002 vii. 2001 o antes		i. Este año ii. 2007 iii. 2006 iv. 2005 v. 2004 vi. 2003 vii. 2002 vii. 2001 o antes		i. Este año ii. 2007 iii. 2006 iv. 2005 v. 2004 vi. 2003 vii. 2002 vii. 2001 o antes	
s. ¿Si contestan si, cuántas veces la usan por semana, por lo normal?	1 2 3 4 5 6(casi diario) 7 (diario) No sabe		1 2 3 4 5 6(casi diario) 7 (diario) No sabe		1 2 3 4 5 6(casi diario) 7 (diario) No sabe		1 2 3 4 5 6(casi diario) 7 (diario) No sabe		1 2 3 4 5 6(casi diario) 7 (diario) No sabe		1 2 3 4 5 6(casi diario) 7 (diario) No sabe	

14. ¿Compran agua de garrafón? a. si b. No

15. Si compran agua de garrafón, ¿Con cuáles familias (casas) en tu lote comparten el agua de garrafón regularmente? (Ocupe el código de casa ocupado en la mapa y preguntas “9” a “14.” Puede marcar más de una respuesta.

a. ninguna otra casa (solo casa 1) b. Casa 2 c. Casa 3 d. Casa 4 e. Casa 5 f. Casa 6 g. Otro_____

16. ¿Con cuántas personas, aparte de las que viven en tu casa, comparten el agua que está en los tambos / tanques / cubetas de tu casa?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33+_____

17. ¿Con cuántas personas, aparte de las que viven en tu casa, comparten el agua de garrafón regularmente?

0 1 2 3 4 5 6 7 8 9 10 11+_____

18. ¿Con cuáles familias (casas) en el lote comparten el agua guardada en cubetas, tambos o tanques regularmente? (Ocupe el código de casa ocupado en la mapa y preguntas “8” a “13.” Puede marcar más de una respuesta.

a. ninguna otra casa (solo casa 1) b. Casa 2 c. Casa 3 d. Casa 4 e. Casa 5 f. Casa 6 g. Otro_____

En la próxima sección sobre los individuos de la casa, incluye todos los individuos de todas las casa con quién la entrevistada comparte su agua, sea de garrafón o la guardada en cubetas, tambos o tanques.

Fecha_____ Hora empezada_____ Nombre completo de(l) (la) entrevistado/a_____

Sección 2: Datos de base de la casa - Información sobre cada persona en la familia dónde vive la entrevistada o el entrevistado. Incluye todos que comparten el agua, sea agua de garrafón o agua en cubetas, tambos o tanques. Puede ser que este incluye dos o más familias.
SOLAMENTE incluye personas que están VIVAS. En columna "20," marca "esta a fuera" para cualquier persona que está a fuera del pueblo siete (7) meses o más por año. Marca "vive en Tlama" las personas que están en el pueblo un total de seis meses o más en un año.

1. Nombre complete	2. Edad (Años)	3. Sexo (H o M)	4. Vive en Tlama o fuera	5. Tiene acta de nacimiento	6. Tiene credencial elector	7. Puede leer	8. Puede escribir	9. ¿Escuela terminada? (K, P1,P2, P3, P4, P5, P6. S1, S2, S3, Prep1, Prep2, Prep3	
a.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
b.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
c.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
d.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
e.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
f.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____

1. Nombre completo	2.	3. Sexo (H or M)	4. Vive en Tlama o fuera	5. Tiene acta de nacimiento	6. Tiene credencia elector	7. Puede leer	8. Puede escribir	9. ¿Escuela terminada? (K, P1,P2, P3, P4, P5, P6. S1, S2, S3, Prep1, Prep2, Prep3	
g.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
h.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
i.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
j.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
k.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
l.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____
m.			i. Vive en Tlama ii. Está a fuera (7+)	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No	i. No sabe ii. Sí iii. No iv. Un poco	i. No sabe ii. Sí iii. No iv. Un poco	i. Si Terminó____ ii. Está en_____ iii. Va con CJ	iv. No Nunca fue v. No va vi. Otro____

Nombre completo	10. ¿Dónde duerme?	11. ¿Pinta palma?	12. ¿Qué tipo de agua toma? Puede marcar más de una.	13. Si toma agua de garrafón ¿con qué frecuencia?	14.Oportunidades?	15.Pensión?	16. PRO Campo?
a.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
b.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
c.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
d.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
e.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
f.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año

Nombre completo	10. ¿Dónde duerme?	11. ¿Pinta palma?	12. ¿Qué tipo de agua toma? Puede marcar más de una.	13. Si toma agua de garrafón ¿con qué frecuencia?	14.Oportunidades?	15.Pensión?	16. PRO Campo?
g.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
h.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada(con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
i.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
j.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
k.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
l.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año
m.	i. En el piso ii. En una hamaca iii. En otate sin calchón (cama de palos, madera) iv. En otate con calchón v. En una cama comprada (con calchón) vi. Otro_____	i. no, nunca ii, muy a veces iii. si, regularmente (1 vez al mes o más) iv. Otro_____	i. Agua de garrafón ii. Agua de los pozos/ presas iii. Agua de la llave iv. Agua de la lluvia v. Otro_____	i. Solo a veces ii. Como la mitad del tiempo iii. Casi siempre iv. Siempre (sin excepción) v. Otro_____	i. No ii. Si _____ pesos cada dos meses	i. No ii. Si _____ pesos cada mes	i. No ii. Si _____ pesos cada año

Sección 3. Fuentes de agua **¿Qué agua ocupan o ocuparon para:**

	a. Meses de lluvia – este año (2008)	**b. Meses de sequía – este año (2008)**	**a. Meses de lluvia – el año pasado (2007)**	**b. Meses de sequía – el año pasado (2007)**
1. Para cocinar, agua de:	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________
2. Para bañarse agua de:	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________
3. Para lavar, agua de:	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________
4. Para el jardín, agua de:	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________
5. Para los animales agua de:	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________	i. los pozos / presas/ laguna ii. la llave / Los Sabinos iii. el garrafón iv. la pipa (camión) v. la lluvia vi. Otro___________________

Sección 4. Consiguiendo agua – fuentes
Solo si han ido a los pozos durante los últimos dos anos. Si no han ido a los pozos, brinque a sección 5.

1. ¿Quién(es) normalmente hace(n) los viajes para traer el agua a su casa?

a. la entrevistada b. su esposo c. su hija(s) d. su hijo(s) e. otra persona

Marca un "X" en la fila de la fuente que ocupan y en la columna del tiempo que lo ocupan. Pregúntales qué pozos ocupan ahora, cuáles ocuparon en los meses de secas y luego, cuáles ocuparon el año pasado, llenando la tabla con sus repuestas. Luego, asegura que es correcto que nunca ocuparon los otros.

	a. Este año (20o8) meses de lluvia (junio-nov)	b. Este año (2008) meses de sequía (dic-mayo)	c. Año pasado (2007) meses de lluvia (junio – nov)	d. Año pasado, meses de sequía (dic – mayo)	e. Nunca lo ocupan
2. Tlamapa (pozo #1)					
3. Coixcapan (pozo #2)					
4. Tlajilapa (pozo #3)					
5. Aztocapa (pozo #4)					
6. Tlashilmolco (pozo #5)					
7, Michacapa (presa en San Juan)					
8. La Pila (presa abajo de Tlashimolco)					
9. Xochitltielpa (carretera a BVC)					
10. La laguna grande					
11. Colotzintla (presa en Santiago)					
12. Otro_____					

	a. Este año, meses de lluvia	b. Este año, meses de secas	c. Año pasado, meses de lluvia	d. Año pasado, meses de secas
13. ¿Llevan / llevaron la ropa a un pozo o laguna para lavar (en vez de hacerlo en su casa)?	i. Si ii. No	i. Si ii. No	i. Si ii. No	i. Si ii. No

Solo pregunte "14" si contestaron "Si" a una de las preguntas "13" "a", "b" o "c".
14. ¿Cuándo llevan su ropa para lavar a fuera de la casa, a dónde la llevan? Puede marcar más de una repuesta.

a. Tlamapa (pozo #1) b. Coixcapan (pozo #2)
c. Aztocapa (pozo #4) d. Tlashimolco (pozo #5)
e. Michacapa (presa en San Juan) f. La Pila (presa debajo de Tlashimolco))
g. Xochitltielpa (carretera a BVC) h. Colotzintla (presa en Santiago)
i. La laguna grande j. Otro_____

15. ¿En los últimos dos años, alguien en la familia se baña a los pozos o a las lagunas? a. Si b. No, nadie

Pregunte "16"y "17" solo si contestan "si" a "15".
16. ¿Si contestan si, cuántos lo hacen? 1 2 3 4 5 6 7+

17. ¿Quién lo hace? Puede marcar más de una repuesta.

a. Mujeres (18 años +) b. Hombres (18 años +) c. Niñas (menor de 18 años) d. Niños (menor de 18 años)

Sección 5: Garrafones compradas. ***Solo pregunte esta sección si toman agua de garrafón.***

1. ¿Qué tipo de agua normalmente compran y que precio tiene ahora? Puede marcar más de una repuesta.

a. Agua Electrapura $_____ b. Agua de Los Ángeles $_____

c. Agua "de Taxco" $_____ d. No sabe el nombre $_____

e. Otro_____ $ _____

2. ¿Cuándo empezaron de comprar garrafones de agua?

a. Este año (2008)	b. 2007	c. 2006	d. 2005	e. 2004
f. 2003	g. 2002	h. 2001 o antes	i. No sabe / no recuerda	

3. ¿Por qué compran / toman el agua de garrafón?

a. es agua limpia
b. tiene buen sabor
c. es agua claro
d. para tener / mantener un buen salud
e. es agua saludable
f. me dijeron que lo debo tomar
g. dicen que el agua de los pozos y de la llave no sirve
h. agua de pozo está sucia
i. agua de pozo está contaminada
j. agua de Los Sabinos / de la llave está sucia
k. agua de Los Sabinos está contaminada
l. Me lo recomendó Caminamos Juntos / el centro de salud / el prieto
m. Otro_____

Sección 6. Llaves y medidores de agua

1. ¿Su familia tiene una toma de la llave?

a. Si b. Si, pero no sirve c. No

2. ¿Tienen acceso a una llave?
   a. No y nunca ocupamos agua de la llave
   b.Ocupamos agua de la llave pública
   c. Si, una llave al mismo lote
   d. Si, siempre podemos comprar de un vecino con llave
   e. Si, a veces podemos comprar de un vecino con llave
   f. Otro_____

3. ¿Qué pasó que ustedes no tienen una llave?
   a. Por el costo
   b. Por que no llegan los tubos aquí
   c. Porque los dueños del agua / los del comité no nos quieren dar
   d. Por que la bomba no funcione para bombear el agua aquí
   e. Por que no la queremos / no vemos la necesidad
   f. No sabe
   g. Otro_____

4. Si compran de una llave pública o de un vecino ¿Cuánto pagan?
   a. _____ pesos por lata
   b. _____ pesos por cubeta
   c. _____ pesos por tambo
   d. Otro_____

Brinque a la próxima sección

5. ¿Desde cuándo está rota?

   a. menos de un mes
   b. entre 1 mes y 6 meses (menos de 7 meses)
   c. entre 7 meses y 11 meses (menos de 12 meses)
   d. entre 1 año y 2 años (menos de 2 años)
   e. 2 años o más

6. ¿Qué pasó a la llave descompuesta?

   a. Se rompió por camiones
   b. Se rompió por alguien
   c. Lo desconectaron por arreglar la calle
   d. No sirve el depósito o la bomba y no ocupan estos tubos
   e. No sabe
   f. Otro_____

7. ¿Quién tiene la responsabilidad para arreglarla?

   a. Nosotros de la familia
   b. La comité de agua / los encargados / los dueños del agua
   c. Los de Taxco / encargados de Taxco / comité de Taxco
   d. Un nombre _____
   e. No sabe
   f. Otro_____

Sigue con "8"

8. ¿Cuándo fue instalada tu llave?

   a. Este año (2008) b. 2007 (el año pasado) c. 2006
   d. 2005 e. 2004 f. 2003
   g. 2002 h. Antes de 2002 i. No sabe

9. ¿Cuánto pagó por la conexión de la llave?

a. pesos_____
b. trabajo (días) _____
c. material (lista de materiales)_____Valor (pesos) _____
d. Otro_____
e. No sabe / No recuerda

10. ¿Cómo es calculado el costo de su agua? Si varia, marca todos que aplican.

a. mensual a $_____ b. Por tambo a $_____

c. por lo que dice el medidor d. otro_____

11 ¿Quién viene para cobrar?

a. Alguien de la comité / de los encargados / de los dueños del agua (nombre)_____
b. Alguien de la comité / de los encargados / de los dueños del agua pero no sabe su nombre
c. Vamos a la comisaría a pagar cuando nos llaman por sonido
d. No sabe quién
e. Otro_____

12. ¿Qué pasa si usted no paga?

a. Cortan la conexión
b. Ya no se la dan
c. No sabe
d. Otro_____

13. ¿Quiénes son en el comité de agua ahora? (Marca todos que contestan)

a. Juan Salazar
b. Otro nombre_____
c. Otro nombre_____
d. Otro nombre_____
e. Juan Salazar y otros pero no conoce sus nombres
f. No sabe
g. Otro_____

14. ¿Tiene usted un medidor de agua ahora?

a. Si b. Si, pero está descompuesta c. No

15. ¿Qué pasó con el medidor? ***Brinque a la próxima sección***

a. Se rompió por alguien
b. Se tapó y lo desconectamos
c. No sabe
d. Otro_____

16. ¿Quién tiene la responsabilidad para arreglarla?

a. Nosotros de la familia c. Un nombre _____
b. La comité / encargados / dueños del agua d. No sabe
e. Los de Taxco / de la comité o encargados de Taxco f. Otro_____

17. ¿Fue instalado el medidor al mismo tiempo de su llave? a. Si b. No, fue instalado en _____

18. ¿Cobraron el medidor a parte? a. Si b. No

19. ¿Cuánto más pagó por el medidor? $_____

20. ¿Para que sirven los medidores de agua?

a. para medir la cantidad de agua que estamos agarrando
b. para saber cuánto hay que pagar
b. para que no podemos robar el agua
c. no sabe
d. Otro_____

Si contestan "a", "b" o "c".

21. ¿Cómo está calculado el costo de lo que dice el medidor?

a. Muestra el agua en metros y hay 5 tambos en un metro.
b. Muestra el agua en metros y hay 1000 litros en un metro.
c. No sabe
d. Otro_____

22. ¿Usted sabe leer el medidor?

a. Si b. No c. Un poco d. No sabe

Pídele intentar leerlo si dijo "si" o "un poco" o "no sabe"

23. ¿Pudo leerlo correctamente? a. Si b. No
c. Lo que él o ella dijo que dice el medidor_____
d. Lo que dice en verdad el medidor_____

24. ¿Alguien (más) en la casa sabe leer el medidor? a. Si b. No

25. Si, nombran a alguien que está en la casa, pídelo(s) leerlo y escribe si puede leerlo correctamente o no.

a. _____ i. No está para probarlo ii. Si, puede iii. No puede

iv. Lo que él o ella dijo que dice el medidor_____ v. Lo que dice en verdad el medidor_____

b. _____ i. No está para probarlo ii. Si, puede iii. No puede

iv. Lo que él o ella dijo que dice el medidor_____ v. Lo que dice en verdad el medidor_____

c. _____ i. No está para probarlo ii. Si, puede iii. No puede

iv. Lo que él o ella dijo que dice el medidor_____ v. Lo que dice en verdad el medidor_____

d. _____ i. No está para probarlo ii. Si, puede iii. No puede

iv. Lo que él o ella dijo que dice el medidor_____ v. Lo que dice en verdad el medidor_____

Contesta "26" y "27" solo si lo leyeron correctamente

26. Los que lo leyeron correctamente ¿cuándo aprendieron a leerlo?

a. Primera persona_____

i. Este año (2008)	ii. 2007 (el año pasado)	iii. 2006
iv. 2005	v. 2004	vi. 2003
vii. 2002	viii. Antes de 2002	ix. No sabe

b. Secunda persona_____

i. Este año (2008)	ii. 2007 (el año pasado)	iii. 2006
iv. 2005	v. 2004	vi. 2003
vii. 2002	viii. Antes de 2002	ix. No sabe

c. Tercera persona_____

i. Este año (2008)	ii. 2007 (el año pasado)	iii. 2006
iv. 2005	v. 2004	vi. 2003
vii. 2002	viii. Antes de 2002	ix. No sabe

27. ¿Cómo aprendió a leerlo?

a. Primera persona_____

i. Enseño a su mismo/misma
ii. Un amigo le enseño
iii. Alguien del comité de agua le enseño
iv. Alguien de Caminamos Juntos le enseño
v. Otro_____

b. Secunda persona_____

i. Enseño a su mismo/misma
ii. Un amigo le enseño
iii. Alguien del comité de agua le enseño
iv. Alguien de Caminamos Juntos le enseño
v. Otro_____

c. Tercera persona_____

i. Enseño a su mismo/misma
ii. Un amigo le enseño
iii. Alguien del comité de agua le enseño
iv. Alguien de Caminamos Juntos le enseño
v. Otro_____

28. ¿Quién viene para leer tu medidor? (¿Quién vino antes, si está descompuesta)

a. Alguien de la comité / de los encargados / de los dueños del agua (nombre)_____
b. Alguien de la comité / de los encargados / de los dueños del agua pero no sabe su nombre
c. Nadie
d. No sabe quién

Sección 7: Uso de agua por la familia (general, época de lluvia y época de sequia)

¿Limpian la casa con agua? Por cada opción abajo, ¿cada cuántos días lo hacen en los meses de lluvia? ¿En los meses de sequía?

	a. Meses de lluvia - frecuencia	b. Meses de lluvia - cantidad	c. Meses de sequía-frecuencia	d. Meses de sequía - cantidad
1. No, nunca limpian con agua	X	X	X	X
2. Si, se riegan el suelo antes de barrerlo para evitar el polvo	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____
3. Si, tropean	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____
4. Si, lavan superficies con un trapo y agua	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____
5. Otro	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. cada dos semanas vi. una vez en el mes vii. Otro_____	i. Volumen del contenedor_____ ii. Cuántos contenedores_____

Otros usos de agua – Cuáles de estos usos de agua ocupan ustedes, con qué cantidad de agua y cada cuántos días.

	a. Meses de lluvia – frecuencia (aproximadamente)	**b. Meses de lluvia - cantidad**	**c. Meses de sequía – frecuencia (aproximadamente)**	**d. Meses de sequía - cantidad**
6. Lavando la ropa	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. Cada dos semanas vi. otro_____	i. Volumen del contenedor _____ ii. Cuántos contenedores _____	i. diario ii. cada tercer día iii. dos veces en la semana iv. cada ocho días v. Cada dos semanas vi. otro_____	i. Volumen del contenedor _____ ii. Cuántos contenedores _____
7. Echando agua en una tasa del baño	i.Nunca / no tenemos un baño de agua ii. Si, cada vez que ocupamos la taza iii. Si, cada vez que hay excremento pero no cuando orinamos iv. Si, como dos veces al día v. Si, como una vez al día vi. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____	i.Nunca / no tenemos un baño de agua ii. Si, cada vez que ocupamos la taza iii. Si, cada vez que hay excremento pero no cuando orinamos iv. Si, como dos veces al día v. Si, como una vez al día vi. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____
8. Ocupando agua para regar un jardín	i. Nunca ii. diario iii. cada tercer día iv. dos veces en la semana v. cada ocho días vi. cada dos semanas vii. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____	i. Nunca ii. diario iii. cada tercer día iv. dos veces en la semana v. cada ocho días vi. cada dos semanas vii. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____
9. Ocupando agua para pintar la palma	i. Nunca ii. dos veces en la semana iii. una vez en la semana iv. cada dos semanas v. cada tres semanas vi. una vez al mes vii. menos de una vez al mes viii. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____ iii. ¿Cuántos manojos? _____	i. Nunca ii. dos veces en la semana iii. una vez en la semana iv. cada dos semanas v. cada tres semanas vi. una vez al mes vii. menos de una vez al mes viii. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____ iii. ¿Cuántos manojos? _____
10. ¿Ocupan agua para hervir la palma?	i. Nunca ii. dos veces en la semana iii. una vez en la semana iv. cada dos semanas v. cada tres semanas vi. una vez al mes vii. menos de una vez al mes viii. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____ iii. ¿Cuántos manojos? _____	i. Nunca ii. dos veces en la semana iii. una vez en la semana iv. cada dos semanas v. cada tres semanas vi. una vez al mes vii. menos de una vez al mes viii. Otro_____	i. Volumen del contenedor _____ ii. ¿Cuántos contenedores? _____ iii. ¿Cuántos manojos? _____

11. En la época de lluvia, normalmente,

Escribe los nombres en el mismo orden en que fueron escrito en sección 1.2	1a. Miembro 1 de la casa – meses **de lluvia** _____	1b. Miembro 1 de la casa – meses **de sequía** _____	2a. Miembro 2 de la casa - meses **de lluvia** _____	2b. Miembro 2 de la casa - meses **de sequía** _____	3a. Miembro 3 de la casa – meses **de lluvia** _____	3b. Miembro 3 de la casa – meses **de sequía** _____
i.. ¿Cuántas veces en una semana se baña esta persona?	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____
¿Cada vez que esta persona se baña, que tipo de cubeta ocupa y cuántas o que fracción? (Pídelos mostrártelas)	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____

Escribe los nombres en el mismo orden en que fueron escrito en sección 1.2	4a. Miembro 4 de la casa – meses **de lluvia** _____	4b. Miembro 4 de la casa – meses **de sequía** _____	5a. Miembro 5 de la casa - meses **de lluvia** _____	5b. Miembro 5 de la casa - meses **de sequía** _____	6a. Miembro 6 de la casa – meses **de lluvia** _____	6b. Miembro 6 de la casa – meses **de sequía** _____
i. ¿Cuántas veces en una semana se baña esta persona?	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____
¿Cada vez que esta persona se baña, que tipo de cubeta ocupa y cuántas o que fracción? (Pídelos mostrártelas)	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____

Escribe los nombres en el mismo orden en que fueron escrito en sección 1.2	7a. Miembro 7 de la casa – meses **de lluvia** _____	7b. Miembro 7 de la casa – meses **de sequía** _____	8a. Miembro 8 de la casa - meses **de lluvia** _____	8b. Miembro 8 de la casa - meses **de sequía** _____	9a. Miembro 9 de la casa – meses **de lluvia** _____	9b. Miembro 9 de la casa – meses **de sequía** _____
i. ¿Cuántas veces en una semana se baña esta persona?	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____
¿Cada vez que esta persona se baña, que tipo de cubeta ocupa y cuántas o que fracción? (Pídelos mostrártelas)	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____

Escribe los nombres en el mismo orden en que fueron escrito en sección 1.2	10a. Miembro 10 de la casa – meses **de lluvia** _____	10b. Miembro 10 de la casa – meses **de sequía** _____	11a. Miembro 11 de la casa - meses **de lluvia** _____	11b. Miembro 11 de la casa - meses **de sequía** _____	12a. Miembro 12 de la casa – meses **de lluvia** _____	12b. Miembro 12 de la casa – meses **de sequía** _____
i. ¿Cuántas veces en una semana se baña esta persona?	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____
¿Cada vez que esta persona se baña, que tipo de cubeta ocupa y cuántas o que fracción? (Pídelos mostrártelas)	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____

Escribe los nombres en el mismo orden en que fueron escrito en sección 1.2	13a. Miembro 13 de la casa – meses **de lluvia** _____	13b. Miembro 13 de la casa – meses **de sequía** _____	14a. Miembro 14 de la casa - meses **de lluvia** _____	14b. Miembro 14 de la casa - meses **de sequía** _____	15a. Miembro 15 de la casa – meses **de lluvia** _____	15b. Miembro 15 de la casa – meses **de sequía** _____
a. ¿Cuántas veces en una semana se baña esta persona?	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____	1 2 3 4 5 6 7 Otro_____
b. ¿Cada vez que esta persona se baña, que tipo de cubeta ocupa y cuántas o que fracción? (Pídelos mostrártelas)	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____	ii. Volumen del contenedor_____ iii. Cuántos contenedores_____

12 a. ¿Cuantos arboles de fruta tiene en su jardín? 0 1 2 3 4 5 6 7 8 9 10 11+

b. ¿A cuántos de estos echan agua? 0 1 2 3 4 5 6 7 8 9 10 11+

c. ¿Cuántos de estos dan fruta? 0 1 2 3 4 5 6 7 8 9 10 11+

13. ¿Cuántas plantas comestibles, no incluyendo los arboles, tiene en su jardín en los meses de sequía (la cuaresma)?

0 1 2 3 4 5 6 7 8 9 10 11+

14. ¿Cuántas plantas que tiene otro uso (para lavar, curar etcétera) tiene en su jardín en los meses de sequía (la cuaresma)?

0 1 2 3 4 5 6 7 8 9 10 11+

15. ¿Cuántas plantas con flores (no comestibles) tiene en su jardín en los meses de sequía (la cuaresma)?

a. 0 b. 1-5 c. 6-10 d. 11-20 e. 21-30 f. 31+

Sección 8 : Ingresos

Nombre completo (cada persona)	1. Ingreso principal (durante los últimos dos años) Solo trabajo de que reciben dinero. Sola marque una.	2. Detalles del trabajo	3. ¿Cuánto gana por semana por este trabajo, por lo normal?	4. Otras fuentes de ingreso (puede marcar más de una repuesta	5. Detalles	6. ¿Cuánto gana en una semana?	7. ¿Por cuánto tiempo al ano esta afuera de Tlama para trabajar?
a.	i. No tiene trabajo pagado / ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más
b.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más

Sección 8 : Ingresos

Nombre completo (cada persona)	1. Ingreso principal (durante los últimos dos años) Solo trabajo de que reciben dinero. Sola marque una.	2. Detalles del trabajo	3. ¿Cuánto gana por semana por este trabajo, por lo normal?	4. Otras fuentes de ingreso (puede marcar más de una repuesta	5. Detalles	6. ¿Cuánto gana en una semana?	7. ¿Por cuánto tiempo al ano esta afuera de Tlama para trabajar?
c.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más
d.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más

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Nombre completo (cada persona)	1. Ingreso principal (durante los últimos dos años) Solo trabajo de que reciben dinero. Sola marque una.	2. Detalles del trabajo	3. ¿Cuánto gana por semana por este trabajo, por lo normal?	4. Otras fuentes de ingreso (puede marcar más de una repuesta	5. Detalles	6. ¿Cuánto gana en una semana?	7. ¿Por cuánto tiempo al ano esta afuera de Tlama para trabajar?
e.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más
f.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más

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g.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más
h.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más

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i.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más
j.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más

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k.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más
l.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. 7 meses o más

Nombre del entrevistado o de la entrevistada_____

Sección 8 : Ingresos

Nombre completo (cada persona)	1. Ingreso principal (durante los últimos dos años) Solo trabajo de que reciben dinero. Sola marque una.	2. Detalles del trabajo	3. ¿Cuánto gana por semana por este trabajo, por lo normal?	4. Otras fuentes de ingreso (puede marcar más de una repuesta	5. Detalles	6. ¿Cuánto gana en una semana?	7. ¿Por cuánto tiempo al ano esta afuera de Tlama para trabajar?
m.	i. No tiene trabajo pagado / Ningún ingreso ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. No hay otras fuentes ii. Teje palma iii. Hace pulseras y las vende a fuera iv. Hace bolsas metálicas v. Comerciante (¿que vende?) _____ vi. Albañil vii. Peón (ayudante de un albañil) viii. Herrero ix. Chalan (calle / construcción) x. Carpintero xi. Carnicero xii. Trabaja en el campo xiii. Trabaja en una mina xiv. Trabaja en su propia tienda /puesto xv. Va a leñar y la vende xvi. Recoge palma y la vende xvii. Partera xviii. Costura ixx. Educadora xx. Otro_____			i. Nunca sale ii. menos de un mes iii. 1-2 meses (menos de tres) iv. 3-4 meses (menos de cinco) v. 5-6 meses (menos de siete) vi. más de 7 meses

8. ¿Reciben dinero en la casa de un(os) familiar(es) que vive(n) afuera? a. si b. No

9. Si contestan si, ¿de cuántas personas reciben dinero de afuera? 1 2 3 4 5 6+

10. ¿Cuánto reciben a la semana o al mes o al año normalmente? _____ pesos cada _____

Ocupando las repuestas a la sección de ingresos, llena el calendario del mes de agosto con la familia, preguntando sobre todos las fuentes de ingresos y cuánto dinero ganaron en el mes

****** Nombres y relación de todos que eran presentes durante la entrevista a parte de la entrevistada.**

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

AGOSTO 2008 Ingresos						
Lunes	*Martes*	*Miércoles*	*Jueves*	*Viernes*	*Sábado*	*Domingo*
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Sección 9: Guardando agua

CASA 1 (Casa de la entrevistada o del entrevistado). Tome fotos de cada contenedor en el orden de lo cual están escritos aquí.

# Fotos	Volumen	Descripción del contenedor

1. Volumen total en casa 1 _____

2. Número de contenedores de agua total en casa 1 _____

Sección 10: Historia de fotos. Tome fotos también de las casas, los tanques de agua, los baños, todos los lugares de donde captan agua de la lluvia y todos los jardines.

# Fotos	Descripción de los fotos

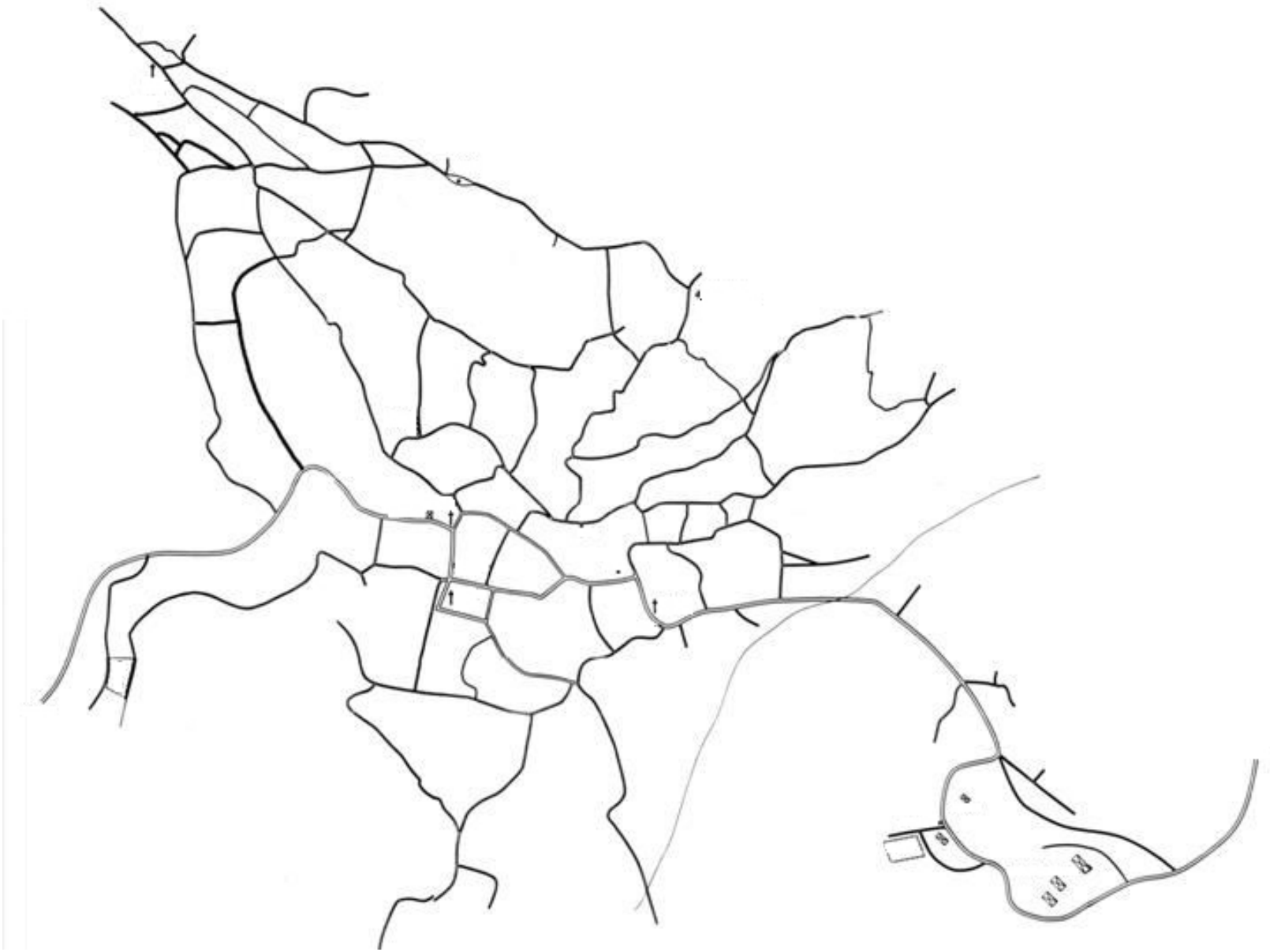
# Fotos	Descripción de los fotos

Sección 11. Tiempo y distancia

Acompáñelos a cada pozo o laguna de que ocupan el agua, pidiéndolos ir a su ritmo normal mientras tomas cuenta del tiempo preciso que tarda (con un reloj). Intente acompañarlos a la hora en que normalmente van. Marque los pozos en el mapa adjunta con las letras "a", "b", "c" etc.

1. Nombre del pozo o de la laguna (escribe los nombres dados en "1".	2. ¿Cuánto tiempo tardó para llegar de su casa? (min:sec)	3. ¿Fue un viaje directo o se pararon para descansar o para platicar?	4. Distancia al pozo (ocupe el cable) (metros con dos decimales)	5. ¿Fue una esperanza por agua al pozo? Si, sí, escribe el tiempo. (min:sec)	6. ¿Este viaje fue típico en términos del tiempo del viaje? (por esta época de lluvia)	7. ¿Este viaje fue típico en términos del tiempo de la espera? (por esta época de lluvia)
a.		Directo Se paró para descansar Se paró para platicar Otro		No Sí _____	Si, fue típico No fue más corto No fue más largo	Si, fue típico No fue más corto No fue más largo
b.		Directo Se paró para descansar Se paró para platicar Otro		No Sí _____	Si, fue típico No fue más corto No fue más largo	Si, fue típico No fue más corto No fue más largo
c.		Directo Se paró para descansar Se paró para platicar Otro		No Sí _____	Si, fue típico No fue más corto No fue más largo	Si, fue típico No fue más corto No fue más largo
d.		Directo Se paró para descansar Se paró para platicar Otro		No Sí_____	Si, fue típico No fue más corto No fue más largo	Si, fue típico No fue más corto No fue más largo
e.		Directo Se paró para descansar Se paró para platicar Otro		No Sí _____	Si, fue típico No fue más corto No fue más largo	Si, fue típico No fue más corto No fue más largo

En esta carta, marquen la ruta que toman para llegar de la casa al pozo o a la presa o a la laguna. Marque el pozo con la letra "a", "b", "c", "d", "e" según la lista en la página "25".



Notas

Para ayudar a la gente recordarse de los años, puede preguntarle según los eventos que pasaron en los años siguientes.

Año	Comisario que entró en este año	Otros eventos y sus fechas
2008	Saturnino Moreno	
2007	Saturnino Moreno	Abril 2007, se fue el Padre
2006	Saturnino Moreno (julio 2006 - --)	
2005	Bernardo María (julio 2005 – julio 2006)	Octubre, 2005 Salió PRI y entró PAN en Taxco
2004	José Margarito (julio 2004 – julio 2005)	
2003	Abram Fermín (julio 2003 – julio 2004)	
2002	José Mantilla (julio 2002 – julio 2003)	