THE EFFECTS OF URBAN WATER SCARCITY ON SOCIABILTY AND RECIPROCITY IN COCHABAMBA, BOLIVIA

By

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For Annette and Ashley

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Global trends like desertification, urban growth, and economic restructuring are making water increasingly scarce—and water access increasingly inequitable—in cities around the world. While much is being done to extend water provision systems to the urban poor, the roots of urban water scarcity are complex and difficult to resolve. Today, as urban water scarcity worsens, research is needed to help mitigate its impact on the environment and human welfare.

This study is designed to engage with interdisciplinary scholarship on two practical problems in urban water scarcity: (1) small-scale human-environment interactions and (2) changing survival strategies among the urban poor. The study is also designed to answer one unexamined question in anthropological theory: what are the effects of urban water scarcity on social interactions and economic exchanges? To do so, I employ the Laughlin-Brady model of human adaptation to resource scarcity.

Over 18 months, I performed participant-observation, direct observations, and survey interviews in an impoverished, water-scarce neighborhood in Cochabamba, Bolivia. The dissertation examines the political ecology of urban water scarcity in Cochabamba, and shows how hydrological, infrastructural, and social trends combine to create conditions of severe water scarcity for residents of the city's poorest residents. The study contains a thorough discussion of the definition and operationalization of the "urban water scarcity" concept, including water provision, water security, and the culture-bound experience of water scarcity.

The data indicate that water scarcity does affect sociability during the dry season, as predicted by the Laughlin-Brady model. When people are first hit by severe water scarcity, they become more sociable. As scarcity worsens, however, sociability decreases. The data also show that water security and provision are positively correlated with sociability during the dry season, but that the relationship disappears during the wet season. There were no significant changes in reciprocity. The findings indicate that social responses to water scarcity mimic responses to other resource scarcities (like famine), and point to future directions for research on and prevention of severe urban water scarcity.

CHAPTER 1
INTRODUCTION

Global trends like desertification, urban growth, and economic restructuring are making water increasingly scarce—and water access increasingly inequitable—in cities around the world. At least 157 million urbanites have no access to an improved water source, and hundreds of millions more lack adequate access to safe water. The vast majority of people without safe water are concentrated in developing cities in Latin America (15 percent), Africa (25 percent), and Asia (57 percent) (UN-Habitat 2003). While much is being done to extend water provision systems to the urban poor, the roots of urban water scarcity are complex and difficult to resolve. Today, as urban water scarcity worsens, research is needed to help mitigate its impact on the environment and human welfare.

Anthropological theories of resource scarcity have much to contribute to interdisciplinary research on urban water scarcity. In this study, I examine the effects of urban water scarcity on sociability and reciprocity—and show how the findings relate to ongoing interdisciplinary research. The study is based on 18 months of field research conducted in an impoverished, water-scarce neighborhood called Villa Israel located on the outskirts of Cochabamba, Bolivia. There, my research team and I performed participant-observations, direct observations, and survey interviews. I will dedicate later chapters to discussing water scarcity, sociability, and reciprocity in Villa Israel. Here, I wish to focus first on the broad practical and theoretical issues with which this study engages.

The study's theoretical contribution is to advance anthropological theory in ways that contribute to (1) interdisciplinary theories of urban water scarcity and (2) anthropological knowledge of human belief and behavior. This chapter, then, is divided into two main sections. In the first section, I examine real-world problems that motivate social, biological, and physical scientists to study water-scarce urban environments. In the second section, I show that urban water scarcity is a topic that bridges theoretical issues in urban, economic, and ecological anthropology. To understand its causes and hypothesize its effects, I examine anthropological research on the urban poor in Latin America, the structure of urban services in Latin American cities, and human adaptations to environmental scarcity across cultures.

Two Practical Problems: Environmental Sustainability and Human Well-being

Studies of urban water scarcity are needed for compelling environmental and social reasons. Below I briefly examine two key problems that this study engages: (1) integrated human-environment interactions and (2) the survival and well-being of the urban poor. For each, I briefly discuss the relevant academic research in the problem area, and situate this study within it.

Problem One: Studying Human-Environment Interactions

In this section, I discuss the environmental aspects of water scarcity. First, I examine how human-environmental interactions shape urban water scarcity. Next, I discuss how interdisciplinary collaborations have developed to examine this issue. Finally, I explain how this study contributes to new research in human-environment interactions.

Despite extensive efforts to improve water delivery and quality over the last two decades, 1.1 billion people still lack adequate access to water resources around the world

(Gleick 2004). Although resolving water problems is a major international policy priority, it will be difficult to sustainably manage water resources until we understand the complex human-environment interactions that produce local scarcities. Ecosystems shape the physical availability of water resources for human use around the world (Gleick, Singh, and Shi 2001). However, human social systems overlay these natural systems, and shape peoples' ability to access water resources. From these complex ecological and social systems emerge human patterns of environmental exploitation. Human patterns of environmental exploitation, in turn, have enormous impacts on ecosystems, which ultimately affects the quality and distribution of global water resources (Daily 1997). Put simply, cyclical interactions between the natural ecosystems and human systems are complex, ever-changing, and the key to creating systems of sustainable water management.

Over the last decade, many scholars in the natural sciences have become interested in collaborating with social scientists to understand social-ecological systems and human-environment interactions (cf. Gunderson and Holling 2002). Recently, successful interdisciplinary research teams have been built around the study of urban ecosystems, a new area of research that has the potential to yield generalizable theories and better management practices for urban social-ecological systems (Collins et al 2000, Grimm et al 2000, Pickett et al 2001, Redman, Grove, and Kuby 2004). The urban ecosystems approach has much to contribute to the study of urban water scarcity, in which scholars often treat the city and its water systems as analytically isolated from basin-wide hydrological and ecological issues (Falkenmark and Lundqvist 1995).

While this study is predominately anthropological in its use of theory and methods, it is designed to engage with outside disciplines. Without a serious discussion of Villa Israel's wider social and ecological environment—and particularly the hydrology of the Cochabamba valley—it would be impossible to understand urban water scarcity and its profound effects on daily life there. This study, then, represents a modest contribution to cross-disciplinary efforts to integrate the social and ecological sciences in the study of urban ecosystems, especially with regard to the relationship between desertification, urbanization, and the sustainability of human systems of water distribution and use.

Problem Two: Survival and Well-being of the Urban Poor

In this section, I discuss the effects of water scarcity on the survival and well-being of the urban poor. A number of studies have established that water scarcity and water degradation have serious effects on household economies and personal health. Beyond this, however, few have examined the effects of water scarcity on families, communities, and cultural institutions. After briefly reviewing the economic and health impacts of water scarcity, I argue that more should be done to understand how urban water scarcity affects social, economic, and cultural institutions among the urban poor.

In developing cities, urban water distribution generally takes a center/periphery form, in which well-provisioned downtowns give way to outskirts with progressively fewer municipal services (Gilbert 1998). Without adequate infrastructure, the urban poor suffer from severe water scarcity even in cities that have enough water to meet their residents' needs. As over-abstraction (or the excessive removal) of groundwater and desertification diminish available water resources, even independent community wells are running dry. When people lack municipal and community water sources, they usually rely on private water vendors that charge 4 to 100 times the price of municipal water

(Elhance 1999). The relatively high cost of water burdens the over-strapped budgets of the urban poor. Many household heads must make decisions about whether scarce cash will be spent on food or water, and whether precious time will be spent earning income or trying to track down a water vendor.

While the economics of urban water distribution undermine the livelihoods of the urban poor, water scarcity and degradation pose a direct threat to their survival. The effects of unsafe water on health are staggering: 80 percent of illnesses and 30 percent of deaths in developing countries are caused by the consumption of contaminated water (Elhance 1999) through a variety of diseases such as cholera, typhoid, and dysentery. For those who survive, water related illnesses can push at-risk families into a downward spiral of health care costs and lost of work opportunities (Gleick 2004). In recognition of these problems, the United Nations Millennium Development Goals aim to halve the number of people without access to safe water and to significantly improve the lives of 100 million slum dwellers by 2015 (United Nations undated). Even if the goals are met—which seems unlikely given the inadequacy of resources and funding currently dedicated to the problem—between 34 and 76 million people will die of preventable water-related illnesses by 2020 (Gleick 2004).

Water scarcity clearly does major damage to the health and economic well-being of the world's urban poor. Beyond this, however, the effects of urban water scarcity on families, communities, and cultural institutions have not been studied extensively. In rural communities struck by drought and famine, an enormous amount of research shows that families break down, communities disperse, and long-standing cultural institutions are destroyed as people pursue survival at all costs (e.g., in studies of rural African

communities Turnbull 1972, Laughlin 1974, Cashdan 1985, Colson 1979 and reviews of famine literature Dirks 1980, Corbett 1988, Walker 1989). Whether these findings can be generalized to urban populations in today's political and economic conditions remains an empirical question (cf. Ember and Ember 1992, Booth 1984)—one that is tested in this research.

New Directions in Interdisciplinary Research on Urban Water Scarcity

In this section, I showed that urban water scarcity is a problem that bridges two interdisciplinary research areas. New research on the political ecology of urban water scarcity, and its effects on human social and economic interactions, would inform theory in both problem areas. First, understanding how human systems of water distribution and consumption work will help explain larger cycles of environmental degradation. Second, understanding the effects of urban water scarcity on social and economic relations would help us find the links between the direct effects of urban water scarcity (on health and well-being) and possible secondary effects (on families, communities, and cultural institutions). In the next section, I explain how I used anthropological research on urban poverty, resource distribution, and resource scarcity to create new hypotheses regarding the effects of urban water scarcity on sociability and reciprocity.

Toward a Cultural Anthropology of Urban Water Scarcity in Latin America

In the second half of this chapter, I begin to develop a research approach that tests cross-cultural hypotheses of urban water scarcity, while situating them in their ethnographic context. In the first section, I review changes in Latin American politics, economy and the lives of the urban poor over the last thirty years. Recent Latin American history helps explain how urban water scarcity emerged—and why it appears to be worsening today. In the second section, I discuss the structure of water distribution and

scarcity in Latin American cities. In the third section, I examine anthropological research on resource scarcity, asking how three phases of research in ecological anthropology—classic findings, political ecology, and new ecology—can be integrated to theorize the social effects of urban water scarcity. Finally, I pose four hypotheses regarding the effects of water scarcity on sociability and reciprocity.

Politics, Economics, and the Urban Poor in Latin America: 1960-2005

Starting in the early 1960s, increased rural-urban migration and the buildup of huge squatter settlements in Latin America sparked fears that the urban poor would organize around a radical political agenda capable of toppling existing power structures. In response to these fears, anthropologists and other social scientists extensively documented the cooperative economic and conservative political strategies that people used to combat scarcity. Scholars showed that the urban poor relied primarily on strong familial relationships and reciprocal help networks to insure themselves against unemployment, low wages, and a lack of water, electricity, and other urban services (Stack 1974, Leeds 1971, Safa 1974, Lobo 1982, Lomnitz 1977, Isbell 1978, Halebsky 1995). Further, they found that impoverished migrants were not marginal or isolated, but were bound up in patronage relationships with political elites (Eames and Goode 1973, Dietz and Moore 1979, Perlman 1976, Portes and Walton 1976, Cornelius 1975, Lloyd 1979, Castells 1983, Mangin 1967) and rural communities (Isbell 1978, Buechler and Buechler 1971, Lobo 1982, Graves 1974).

During the 1970s, the dynamics of urban land invasion and political patronage became established, and more squatters came to the city expecting to acquire improved basic services through clientalistic relations with the state. The more city outskirts and the demands of their residents grew, the less capable the state became of supporting new

squatters (Castells 1983). When economic growth slowed across the region, Latin American elites shifted to loan dependence to support social programs (like the extension of basic services). By the early 1980s, most Latin American nations lacked the foreign exchange to make loan payments and faced default (Weeks 1995). International financiers arranged emergency aid packages that required compliance with neoliberal economic reform programs. These structural adjustment programs called for the privatization of state industries and free trade reforms including the acceptance of expanded foreign investment, an end to subsidies, and a reduction in tariffs. The collapse of national economies and the policies designed to correct it resulted in decreased wages, unemployment, and cuts in state services and subsidies for Latin America's poorest people (Safa 2004).

After the crisis of the 1980s, research began to indicate that cooperative economic strategies that once protected livelihoods in shantytowns and squatter settlements were in decline (Eckstein 1990). González de la Rocha and her collaborators developed the "poverty of resources" approach to explain changes in survival strategies among the urban poor in Mexico. They argued that survival-oriented exchange networks only function when people have enough goods, income, and labor available to invest in reciprocal relationships. The restructuring of the economy and deterioration of labor markets have profoundly eroded poor households' asset bases, undermining their ability to sustain cooperative help networks (González de la Rocha and Gantt 1995, González de la Rocha 2001, 2004). Moser also explained that global trends in infrastructural decline, job loss, and economic crisis caused a shift from reciprocal community-level survival strategies to preservationist household-level survival strategies among the urban poor in

Ecuador, Hungary, the Philippines, and Zambia. In a recent symposium on 30 years of scholarship on Latin America's urban poor, leading scholars agreed that survival strategies had been seriously undermined by recent economic trends (Safa 2004, González de la Rocha 2004, Ward 2004).

Latin America's cities share a history of rural migration, shantytown formation, political patronage, economic crisis, and changing survival strategies among the urban poor. These trends all contributed to the emergence of urban water scarcity—and help explain why it seems to be worsening. In the following section, I explain in greater detail how urban water distribution systems (and exclusion from them) are structured in Latin American cities today.

Urban Water Distribution in Latin America

From a theoretical perspective, resource scarcity is commonly viewed as having its origins in a shortage of supply, an excess of demand, elite resource capture, and ecological marginalization (Homer-Dixon 1999). In semi-arid Latin American cities, all four of these factors play an important role in creating municipal water distribution systems that exclude the poor. However, many municipalities suffer neither from a shortage of supply nor an excess of demand—they lack the political will or funding to extend municipal systems to far-flung settlements where the urban poor are concentrated. In that case, the inequitable distribution of entitlements, that is, the ability to access resources (Sen 1999) probably best explains why some people have access to adequate water resources in cities and others do not.

Power relationships in the city determine the extent of municipal water services, rationing requirements, and the quality of water distributed to various neighborhoods (Swyngedouw 2004). In most city centers in the developing world, for instance, water is

delivered through municipal systems directly into households. On urban peripheries, however, entire neighborhoods often lack access to municipal water distribution systems. In Latin America alone, 24 million people are estimated to have no urban water service whatsoever, and many more have inadequate or unsafe service (UN-Habitat 2003). In cities, the opportunity to collect drinkable surface water is severely restricted by water pollution and public ordinance. Households usually buy low-quality water from a cistern truck, which is operated by a private vendor. Private vendors typically charge 10 to 20 times the fee charged by public utilities, and people living in marginal urban areas pay between 10 and 40 percent of their incomes to acquire water in this way (Marvin and Laurie 1999, Swyngedouw 1997). As a result, the geographic marginalization of people on the urban periphery deepens their economic marginalization (Satterthwaite 1998).

When rural migrants first began to move en masse to Latin American cities, they too lacked municipal water services. After a period without services, living conditions normally catalyzed groups of squatters to negotiate for community water sources—whether through municipal connections or local wells. While the urban poor have always been pushed to the worst available land, there had been more surface water available and higher water tables also facilitated groundwater abstraction. After the collapse of state patronage systems and funding for basic services, squatters' ability to tap state sources for infrastructural improvements was severely limited. While non-governmental organizations (NGOs) have filled in the funding gap to some extent, population growth, over-abstraction, and climate change make it increasingly difficult to find water sources in the areas where squatter settlements are located. Additionally, as the urban poor withdraw from cooperative community networks, it becomes more difficult for them to

exert political pressure, self-organize to provide services, and maintain existing community infrastructure.

While water scarcity can hit anywhere, it currently tends to be concentrated among the urban poor, and especially among the impoverished residents of shantytowns and squatter settlements. In Latin America, environmental, political, economic, and social trends determine how water scarcity is distributed across urban populations.

Understanding Human Responses to Urban Water Scarcity

While this project is rooted deeply in urban and economic anthropology, it draws primarily on ecological anthropology to find testable theories of human response to urban water scarcity. In the first section below, I briefly review how ecological anthropologists from three stages of research have all contributed to our understanding of resource scarcity, and to some extent of urban water scarcity. In the second section, I argue that a long-neglected theory of human response to resource scarcity—when updated with new theoretical perspectives—proves an excellent framework for testing the effects of urban water scarcity on human reciprocity and sociability.

Ecological Anthropology: Classic Contributions and New Directions

Fifty years of research in ecological anthropology has taught us a great deal about how humans respond to changing ecological conditions and resource availability. Cultural materialists and neo-functionalists demonstrated how competition for scarce resources shaped the presence, function, and evolution of cultural traits (cf. Vayda 1969, Rappaport 1974, Harris 1979). Ecological anthropologists also explored how humans respond to environmental stress through studies of demography, adaptive strategies, and coping mechanisms (cf. Vayda and McCay 1975, Laughlin and Brady 1978). While these scholars made enormous contributions to our understanding of human-environment

interactions, they later came under attack in cultural anthropology for misunderstanding basic biological principles, blinding themselves to the ways in which systems of political and economic domination create non-functional adaptations, and making overly-simplistic ecological determinist explanations of complex phenomena (Hallpike 1973, Friedman 1974, Diener et al. 1980). In the 1980s, political ecologists began to examine how ecological, economic, and social systems shape human-environment interactions (cf. Durham 1979, Schmink 1982, Stonich 1989, 1993). The shift toward political ecology was widely regarded as a move away from active borrowing of ecological terms and concepts that characterized earlier research in ecological anthropology (Orlove 1980, Little 1999). Over the last 20 years, political ecologists have developed new models for how anthropologists can produce rigorous ethnographic work that examines the complex interrelationships between ecological, economic, and social systems.

Negotiating the difficult theoretical terrain between anthropology and ecology appears to have been a fruitful exercise for ecological anthropologists, as some are now emerging as leaders in new interdisciplinary collaborations on social-ecological systems (Redman 1999, Pavao-Zuckerman 2000, Abel and Stepp 2003, Stepp et al 2003). Cultural anthropologists and archaeologists have been welcomed in interdisciplinary collaborations on the study of urban ecosystems, where they lend expertise on social, economic, and political issues (Wali et al 2003, van der Leeuw and Redman 2002). To date, anthropologists' work on urban ecosystems combines political ecologists' concern with class, gender, ethnicity, and power (cf. Durham 1995) with the ecologists' need to understand how human history, values, and desires figure into ecological outcomes. Early results from two major urban ecology projects in which anthropologists participate (the

NSF Central Arizona Phoenix Long Term Ecological Research program and the Field Museum's Chicago project) indicate that these collaborations, while difficult, are yielding more complete understandings of urban human-environment interactions and management needs.

While cultural anthropologists have yet to publish on water issues in urban ecosystems, they are developing innovative approaches to the study of urban water scarcity. For instance, authors in an edited text on Water, Culture, and Power: Local Struggles in a Global Context use political ecological approaches to examine how ecological and social factors combine to create local conflicts and water scarcity (Johnston and Donahue 1998). In his study of "suffering from water" in a Mexican town, Ennis-McMillan explained how people experienced bodily distress over the unjust allocation of scarce water in a community where local hydrology, overpopulation, poverty, managerial and technical negligence, and price gouging combined to create water scarcity (2001, 2006). These studies demonstrate how anthropologists' analyses of culture, politics, economy, and power relationships can contribute to scholars' overall understanding of urban water issues. However, as Durham explained, future anthropological research should go further—by explicating the causal links between social processes, forming hypotheses, and testing the hypotheses with statistical analysis (Durham 1995). Using reproducible scientific methods facilitates collaborations across disciplines, as well as the accumulation of cross-cultural knowledge within anthropology. When participant-observation is paired with scientific methods, research findings can be particularly compelling.

Building a Theory to Test Human Responses to Urban Water Scarcity

I propose using one long-neglected anthropological theory—Laughlin and Brady's 1978 model of human adaptation to resource scarcity—to test the socio-economic effects of water scarcity. Laughlin and Brady hypothesized that sociability and reciprocity underwent a series of predictable changes during cycles of resource scarcity (like seasonal scarcity or drought cycles). When people experience initial periods of scarcity, they tend to unify to find cooperative solutions to the problem. People tend to increase resource sharing and enlarge cooperative groups to include socially distant groups. As scarcity worsens, however, people lack the resources and energy to sustain this kind of enhanced sharing and cooperation. Instead, they withdraw from the enlarged sharing network, narrowing their group participation and limiting reciprocal sharing to people with whom they have stronger, more trusting, and more durable social ties.

As people withdraw from cooperative relationships, Laughlin showed, they often switch from exchanges based on positive to generalized reciprocity or from generalized to negative reciprocity (1974). With people increasingly looking for benefits for themselves or their narrowed cooperative groups, competition increases and cleavages form between groups. Cooperative goal-making drops off, and the likelihood that the community will adopt cooperative economic or political tactics to deal with scarcity decreases. Laughlin and Brady suggested that each society, then, has a structure that governs the making and maintenance of solidarities, and that withdrawal of social relationships is ordered by that structure in scarce times, as is the re-establishment of those ties when times of plenty return.

The model was tested by respected anthropologists at the time it was proposed (cf. Dirks 1978 with West Indian slave societies, Lomnitz 1978 in a Mexican shantytown,

and Turnbull 1978 among the Ik of Uganda). Today, it still provides a valuable framework for understanding human adaptive cycles. While the Laughlin and Brady volume may include out-of-date references to ecological theory, ecologists have been able to build new theories out of the old ones, and anthropologists should do the same. Political ecological approaches can be used to explain how, where, and when urban water scarcity emerges in complex societies. Additionally, anthropological research that draws on "new ecology" can help clarify how concepts like nested hierarchies, nonlinearity, surprise, and transformation can be integrated into Laughlin and Brady's work (Abel and Stepp 2003, Scoones 1999, Redman 2005). These concepts can help us explain when and why social systems do not follow predicted patterns. Together, the Laughlin and Brady model, political ecology, and ecological anthropology provide a framework for understanding how urban water scarcity is created by human societies, and how it affects social relationships within affected groups.

To test the relationship between urban water scarcity, sociability, and reciprocity, I developed four hypotheses using information I received from three development agencies working in Villa Israel in 2002. I was told that water scarcity was present in Villa Israel throughout the year, and became so severe during the dry season that fourteen children under the age of one died from water-related illnesses between April and July of 2002 (Trujillo 2002). Based on this information, I concluded that people probably experienced moderate water scarcity during the wet season, and suffered from severe water scarcity during the dry season months of May, June, July, and August. For this study, then, I tested the following four hypotheses:

Hypothesis 1: Household heads participate in more social interactions during the wet season than during the dry season.

Hypothesis 2: Household heads participate in more reciprocal economic exchanges during the wet season than during the dry season.

Hypothesis 3: Household heads with more water participate in more social interactions than those with less water.

Hypothesis 4: Household heads with more water participate in more reciprocal economic exchanges than those with less water.

Chapter Conclusion

This study is designed to engage with interdisciplinary scholarship on two practical problems in urban water scarcity: (1) small-scale human-environment interactions and (2) changing survival strategies that affect the resilience of households, communities, and cultural institutions. The study is also designed to answer one unexamined question in anthropological theory: what are the effects of urban water scarcity on social interactions and economic exchanges? To do so, I employ the Laughlin-Brady model of human adaptation to resource scarcity—as updated by recent anthropological work in political ecology and new ecology.

The study provides a test of the relationship between urban water scarcity, sociability, and reciprocity in Villa Israel. It also contributes one data point to any future cross-cultural study of the Laughlin-Brady model in water-scarce urban communities. It uses ethnographic and reproducible scientific methods to test four hypotheses over 18 months of field research in Villa Israel. It also situates the findings in the wider environmental, cultural, political, and economic realities of Bolivia, Latin America, and the world.

Having examined the global trends that shape studies of urban water scarcity in this chapter, I will now situate the study in social and environmental realities of Bolivia (chapter 2) and Villa Israel (chapter 3). Then, in chapter 4, I discuss the study itself, and the field methods that I used over 18 months in Villa Israel. In chapter 5, I examine the political ecology of urban water scarcity in Villa Israel using data from the field research. In chapter 6, I describe the social interactions and economic exchanges that took place in Villa Israel using data from the field research. In chapter 7, I test the relationship between urban water scarcity, social interactions, and economic exchanges in Villa Israel. Finally, in chapter 8, I discuss how the findings relate to interdisciplinary theories of urban water scarcity and anthropological theories of human belief and behavior.

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CHAPTER 2
BOLIVIA: A CONCISE HISTORY

Introduction

When Laughlin and Brady predicted that responses to resource scarcity would be similar across cultures, they cautioned that the shape those responses take could be distinct in each ethnographic context (1978). In this study, I show how Laughlin and Brady's theory can be applied to a water-scarce shantytown—an ethnographic context I chose because people's circumstances there are similar to those found in squatter settlements and shantytowns across cultures. While I believe Laughlin and Brady's theories are generalizable, I recognize that historical events play an important role in shaping culture, belief, and action. As a result, this chapter is designed to convey a concise history of the relevant geographic, environmental, demographic, cultural, economic, and political trends that shape life in Bolivian squatter settlements today.

I begin with a discussion of Bolivia's physical environment. This section provides an orientation to the country's complex geography and ecology. Next, I discuss elements of Bolivian history that still influence the country today—in particular, pre-Columbian forms of social organization, Spanish and criollo dominance, the exploitation of natural resources, and the rise of powerful workers' unions. Then, I examine the distribution of culture, religion, and demography, with an eye to explaining how the country has been transformed by modern historical events. After that, I discuss major changes in economics and politics since the 1980s, examining the new climate of neo-liberalism, indigenous activism, and political controversy in Bolivia. The unrest that began with

Cochabamba's 2000 Water War is now unfolding in a spectacular series of political developments that may affect the entire region. Finally, I examine how the urban poor are affected by the new neoliberal economy. This last section will lead directly into a discussion of life among the urban poor in one of Cochabamba's most impoverished squatter settlements, Villa Israel.

Geography, Environment, and Natural Resources

Located in the center of South America, Bolivia has been landlocked since it lost access to the Pacific Ocean to Chile in 1884 (Kluck 1989). On the eastern edge of its Amazonian region, Bolivia shares a long border with Brazil. To the southeast, the arid Chaco scrublands straddle Bolivia and Paraguay. To the direct south, Bolivia borders Argentina. To the southwest, Chile borders Bolivia along the Cordillera Occidental of the Andes. To the northwest, Bolivia shares Lake Titicaca and its surroundings with Peru.

Running roughly from west to east, Bolivia has four major geographic regions: the Altiplano, highland valleys, Amazon, and Chaco. The Altiplano region is a high Andean plateau that runs along the western edge of the country. Plain-level altitudes range from 4,200 to 4,400 meters (Kluck 1989). Located in the Cerrada river basin, the Altiplano receives between 100 and 500 mm of annual rainfall (Van Damme 2002, Mattos and Crespo 2000, FAO 2005). While known for its inhospitable climate, the Altiplano has always been Bolivia's most populous region, and is currently the home of 41 percent of the population (Library of Congress 2005).

To the east of the Altiplano, the central highland valleys have a temperate semi-tropical climate, moderate elevation, and fertile soil. They contain major cities such as Cochabamba, Sucre, and Tarija, and 29 percent of the Bolivian population (Library of Congress 2005). To the north and east of the highland valleys, Amazonian rainforests are

situated in the tropical lowlands. This area encompasses one of the world's most biodiverse regions and 60 percent of Bolivia's landmass (Swaney 2001). Together, the highland valleys and Amazonian rainforests are located in the Amazonas river basin, which receives between 300 and 500 mm annual rainfall in the valleys and between 1700 and 2200 mm of rainfall annually in the Amazon.

In the far southeastern lowlands, the Chaco is an arid, sparsely-populated scrubland. The Chaco (along with the southern tip of the highland valley region) is located in the La Plata basin, and receives less than 100 mm of annual rainfall (Van Damme 2002, Mattos and Crespo 2000, FAO 2005). Bolivia's combined lowland regions—the Amazon and Chaco—contain 30 percent of the population, which is growing rapidly due to rapid economic development in Santa Cruz (Library of Congress 2005).

Within Bolivia's four climactic regions, there are 16 large eco-regions and 198 ecosystems. At least 22,000 superior plant species and 2,342 vertebrate species have been discovered in Bolivia, and new research constantly identifies more species (UNDP 2002, Bojanic 2001). In addition to its biological wealth, the country has great mineral wealth. Bolivia contains significant deposits of tin, gold, and zinc, as well as South America's second-largest natural gas reserve and fifth-largest oil reserve (Library of Congress 2005, EIA 2005). Because population and consumption have historically been low in Bolivia, human impacts on natural resources have been relatively limited (Ibisch 1998). Even so, recent large-scale land conversions have caused vegetation loss, erosion, and soil salinization. As a result, desertification has developed in arid areas, as has flooding in

tropical areas (Van Damme 2002, Bojanic 2001, UNDP 2002, Paredes and Aguirre 2000).

Politically, Bolivia is divided into nine departments. The La Paz department includes the capital city of La Paz, Lake Titicaca, the headwaters of the Río Beni, the north Altiplano, and the Amazonian highlands. To the south, Oruro is a small department containing the famous San Jose mine and Lakes Poopó and Uru Uru. Bolivia's southeastern department is Potosí, which contains the salt flat Salar de Uyuni and the once silver-rich mountain of Cerro Rico. The highland valley departments are Cochabamba, Chuquisaca, and Tarija. The northernmost of the Amazonian lowland departments is the Pando, which contains the Río Beni. To its south is the Beni department, which contains the Ríos Mamoré and Guaporé. Finally, Santa Cruz is an enormous department in the southeast corner of Bolivia that encompasses both rainforest and scrubland, the Río Paraguá, and Laguna Concepción (Kluck 1989).

A Brief History of Bolivia's Social, Political, and Economic Organization

At one time, population in the area now known as Bolivia was clustered primarily on the fertile edges of Lake Titicaca, in the western slopes of the Andes. Pre-Columbian communities were structured around kinship-based groups called ayllus (Wagner 1989). The ayllu was the unit through which natural resources, productive activities, and social obligations were organized. The entire system, while not egalitarian, was based on reciprocal exchanges called ayni and labor rotations called mit'a (Moseley 1992).

The first major regional civilization, the Tiwanaku, dominated the area from about 600 to 1200 AD. After a long period of regional power struggle and Aymara dominance, the Quechua-controlled Inca empire gained control of highland Bolivia in 1450 (Library of Congress 2005). Building on the basic Andean socio-political unit, the ayllu, the Incas

instituted successful development programs in agriculture, mining, and lowland colonization (Moseley 1992). The colonization program prompted a major change in Bolivia's population distribution, as large numbers of Quechua immigrants were sent to the highland valleys to establish settlements loyal to the empire (Wagner 1989).

In the 1530s, Spanish conquistador Francisco Pizarro and his troops conquered and dissolved the Incan territory. In 1544, a large vein of silver was discovered in Potosí, and Bolivia became a major source of income for the Spanish Crown. Appropriating the mit'a concept, Spanish colonizers required that indigenous highland men spend every sixth year working in the mines. The Spanish also created the encomienda, a peonage-based agricultural system in which the Crown gave colonists control over indigenous land and laborers (Wagner 1989). Over the next century, millions of native people were conscripted into mining and agricultural work, especially in Potosí and Oruro, creating major cities and population growth in those areas.

In the 1700s, Spanish dominance went into decline as the easy-to-mine mineral veins were tapped and organized indigenous resistance grew. A series of indigenous and criollo revolts ensued from 1780 until independence was won in 1825 (Wagner 1989). After independence, wealthy criollo landowners continued to control Bolivia's economic assets, and peasants continued to labor in the peonage system. The next century of Bolivian national politics was marred by inept leadership, corruption, failed wars, territory losses, and economic mismanagement.

In 1952, mine workers led a revolt, the April Revolution, to reclaim control of the government. The Nationalist Revolutionary Movement (MNR) enacted sweeping reforms including the nationalization of mines, land redistribution, universal suffrage, and

expansion of education. The MNR also institutionalized miners' and peasants' unions, which participated in decisions about natural resource distribution and use. This was the first step taken in 400 years toward ceding control of Bolivia's natural resources to indigenous groups. The miners and peasant unions established the organizational groundwork for popular protest coalitions that remain powerful in Bolivia today.

The MNR controlled Bolivia until 1964, when a democratically-elected president was overthrown in a military coup. Eighteen years of political instability followed, in which the MNR and military coup leaders struggled for control of the country. Since democratic elections were reinstituted in 1982, there have been no coups in Bolivia despite serious internal economic and political instability.

Culture and Religion

Despite a relatively small population of about 9.0 million people (World Bank 2005), Bolivia has a very diverse cultural life. About 62 percent of Bolivia's population is of native descent. Of these, 31 percent say they are Quechua and 25 percent say they are Aymara (INE 2004). People of Quechua and Aymara origin traditionally occupied the highlands, although a half-century of economic crises, political turmoil, and migration has blurred such ethnic boundaries. Another 35 percent of the population is mestizo. After that, much of the remaining population is of Chiquitano, Guaraní, Mojeño, and European descent, while 1 percent, living mainly in the La Paz department, is of African descent.

The national religion of Bolivia is Roman Catholicism. Many sources claim that Bolivia's Catholic population is very high—95 percent (cf. Library of Congress 2005, CIA 2005). According to the 2001 national census, however, 78 percent of the Bolivian population is Catholic, and 20 percent report being Protestant, evangelical, or belonging

to some other Christian sect (INE 2003a). Others estimate that only between 60 and 70 percent of Bolivia's population is Catholic (cf. Bureau of Inter-American Affairs 1998), and by all accounts Protestantism is on the rise, as it is throughout Latin America, especially in countries with large indigenous populations (Dow, in press). Whatever the statistics, the Catholic Church still dominates much of the cultural life of Bolivians, through numerous fiestas for saints or virgins, charity work in local communities, and its role in weddings, baptisms, and funerals. Despite the dominance of the Catholic Church, Bolivian Catholic beliefs, rituals, and symbolism are interwoven with Quechua and Aymara ones. The most salient example of this is the fusion of the Virgin Mary and Pachamama, the earth mother, in Bolivian Catholicism. Throughout Bolivia, people practice Catholicism and indigenous religions concurrently, consulting both priests and yatiri (curers) for help with different ailments.

Since the 1980s, Protestant missionary groups have become increasingly common in Bolivia. In 1999, religious groups totaled 400, most of which were Protestant missionary groups including Baptists, Pentecostals, Mennonites, Seventh-Day Adventists, and various evangelical groups (Bureau for Democracy, Human Rights, and Labor 1999). In general, all religions are tolerated, although discrimination against religious minorities, particularly Protestants, persists. For instance, Bolivian Protestants tend to be excluded from participation in community events and governance, often because they refuse to participate in important social activities such as drinking alcohol, dancing, and fiestas celebrating Catholic saints (cf. Buechler and Buechler 1971, Goldstein 2003).

Recent Demography: Migration, Identity, and Urbanization

Since the agrarian reforms of the 1950s, temporary and permanent migrations have become an increasingly common part of Bolivian lifestyles. Prior to the 1950s, many peasants were tied to the land through the hacienda system of labor obligations to landowners. After the hacienda system was abolished in 1953, families began to send young men and women to labor seasonally in the lowlands, to mine in the highlands, and to market year-round in city centers like Cochabamba (Kluck 1989). In the 1980s, economic crises caused an enormous migration of highlanders to urban squatter settlements and lowland colonization areas (McFarren 1992). After highlanders flooded to the cities in the 1980s, urban settlement became dominated by rural-urban migrants in the 1990s.

Over the last fifty years, highland migrants to the valleys and lowlands have maintained close contact with the relatives they left behind in the Altiplano. Peasant families establish exchange ties through migrating members with urban vendors and producers of non-local goods all across Bolivia. Migrants, in turn, usually continue to contribute to their home communities by dancing in homage to a virgin, hosting migrants, and employing urban networks or Spanish skills to solve community legal or political problems (cf. Buechler and Buechler 1971). In this way, multilevel ties between urban and rural communities have been maintained, and can be used to sustain impoverished urban and rural populations with infusions of goods, labor, and food during crises.

While highlanders often maintain relationships in their home communities, they occupy an uncertain role in Bolivian society. As a group, they have come to be known as cholos—a class of people who represented the integration of indigenous ancestry and culture with European culture (Weismantel 2001). Cholos normally speak accented

Spanish and adopt some mestizo cultural practices, while maintaining other indigenous beliefs and practices (such as language use, dress, food preparation, and the use of indigenous medicine). Cholos often are often socially isolated; in towns they continue to be disparaged as peasants, while in their villages, they are considered to be urbanites. In the new context of citizenship movements emerging in Bolivia after 2000, cholos are left exposed on the national political scene, lacking the claims to rights and resources associated with both conventional urban power structures and new indigenous rights groups (Jackson and Warren 2005).

Today, 62 percent of the Bolivian population is urban, and urbanization continues to rise at a rate of 3.6 percent per year (Library of Congress 2005). Bolivia's population is becoming increasingly concentrated in four cities: La Paz, El Alto, Santa Cruz, and Cochabamba. In the 2001 census, 77 of Bolivia's urban population resided in these four areas (INE 2002). As I explain in the next section, profound changes in Bolivia's political economy during the 1980s and 1990s led large numbers of people to leave their homes in the Altiplano to seek new lives in the country's four major urban areas (Mattos and Crespo 2000).

Recent Economic History

In 1984, a devastating cycle of debt, trade deficits, and hyperinflation that crippled Bolivia's banks and markets led the government to enact a sweeping IMF-sponsored structural adjustment program (Nash 1992). Despite extensive grassroots opposition, outsiders considered the plan to be an astounding success when the Bolivian economy began to function again nearly immediately after its enactment (McFarren 1992). Then, in 1994, a new reform called "capitalization" privatized 50 percent of Bolivia's saleable national industries—oil and gas (YPFB), electricity (ELFEC), telecommunications

(ENTEL), airlines (LAB), and trains (ENFE) (Kohl 2003). Many Bolivians believed, based on the Bolivian government's claims at the time, that the capitalization program would cause foreign companies to bring enormous infusions of capital to create jobs, increase economic growth, and help struggling Bolivian industries compete internationally (Kohl 2002).

While privatization and capitalization did improve the performance of Bolivia's economy and national industries, it was a bitter disappointment for many Bolivians—particularly in highland mining communities. The privatization and closure of national mines in 1986 disassembled the country's core industry, dispersing 27,000 ex-miners mainly into urban squatter settlements and the lowland coca-growing regions (McFarren 1992, Nash 1992), while capitalization did not create new jobs for displaced workers. In fact, many key industries suffered a net loss in jobs after capitalization, as companies imported materials and even workers rather than developing Bolivians' capacity to provide the necessary materials domestically (Kohl 2002). In addition, the Bolivian government lost hundreds of millions of dollars in revenues after the privatization of the YPFB (Kohl 2002), which led to cut-backs in jobs and social programs through the country. As a result, many Bolivians lost a substantial portion of their social safety net in the 1980s and 1990s, including public services, income security, and market regulation of prices for essentials.

The economic and social disruptions of the 1980s undermined grassroots activism in Bolivia (Whitehead 2001). The 1985 privatization and closure of national mines, in particular, disassembled Bolivia's core activist networks, dispersing ex-miners into new regions and professions. The dispersal of miners' unions was widely considered a major

step backward in indigenous people's fight to regain control of Bolivia's natural resources. A political reform enacted alongside the Capitalization Law, however, revived the old activist networks, and enabled grassroots groups to reinvent themselves as new social movements.

Recent Political History

In 1994, the Popular Participation Law (LPP) was passed. The LPP was designed to make Bolivian democracy more representative and redistribute national funds and responsibilities at the local level. As part of the reorganization of local-level Bolivian politics, the LPP created Grassroots Territorial Organizations (GTOs) based on recognized civil society organizations such as pre-colonial indigenous groups (like ayllus), urban neighborhood councils, and rural campesino unions (Kohl 2003). The decentralization and indigenous rights reforms passed in 1994 gave new political resources, access, and legitimacy to territorial grassroots organizations (Kohl 2003, Van Cott 2000, Whitehead 2001). The compulsory development of GTOs unified people on the local level, educated them in political procedures, and linked them to sponsoring political parties (cf. Medeiros 1990), and helped them gain democratic representation in the national parliament for the first time (Van Cott 2000). The LPP, then, created a political opportunity for disenfranchised groups, like indigenous, urban poor, and campesino groups, to seize control of tiny pieces of municipal budgets—and to work toward larger goals.

Now, after the austerity, capitalization, and decentralization reforms, five major regional political interests can be identified in Bolivia. First, in La Paz, the Aymara heartland, Aymara separatists agitate for territorial sovereignty. A second regional interest encompasses all of the western highlands (La Paz, Oruro, Potosí, and

Cochabamba departments). There, politically active urban poor, campesinos, and indigenous peoples demand various economic and political reforms, and exert influence through highly visible protest tactics like regional blockades. Third, in the Yungas and Chapare, coca growers constantly find new ways to circumvent U.S.-backed coca eradication programs. Chapare is now the stronghold of the Movement Toward Socialism (MAS) party. With the support of coca growers and other disenfranchised political interests, MAS leader Evo Morales has risen to remarkable fame and influence in Bolivia and abroad—and was elected Bolivia's first indigenous president in December 2005. Fourth, in the Amazon, eastern indigenous groups spearheaded the March for Life and the drive for expanded indigenous rights in the 1990s. Fifth, lowlanders based mainly in Santa Cruz and known as Cambas (as opposed to highlanders, or Kollas) are Bolivia's final major interest group. Camba-dominated Santa Cruz area has its own culture, in which residents are generally mestizo, speak a distinct Spanish dialect, and reject highland values and beliefs. It also has political and economic interests and goals quite distinct from those of highland and indigenous activists.

Bolivian Economy and Politics After 2000

The rivalry between Cambas and Kollas is arguably the most important political division in Bolivia today. After the privatization of the national mines in the 1980s, many highlanders settled in eastern lowland colonies (Kluck 1989). Since then, major natural gas discoveries and Bolivia's fastest economic growth have been located squarely in Camba territory. While Santa Cruz prospers, the highlands have become increasingly impoverished and politically unstable. In the 2001 census, Santa Cruz was the only department in all of Bolivia in which less than half of its residents (38 percent) were impoverished. Potosí, once the heart of the Spain's colonial mining empire, had become

Bolivia's poorest department, with 80 percent of its residents living in poverty (INE 2003b).

Many Cambas have come to see the Kolla regions as an economic, political, and cultural drag on their success, and have initiated a growing movement for regional autonomy. Kollas, outraged by the racist undertones in Camba political rhetoric, retort that Santa Cruz's success has been built on Kolla labor and are fighting to nationalize lowland gas reserves. At the core of the dispute are two distinct visions of Bolivia's past and future. Cambas, encouraged by financial successes in the coca and natural gas sectors, argue that Bolivia's future is in neoliberal economic reform and participation in the globalized economy. Kollas, drawing on the historical memory of centuries of mining booms and market collapses, argue that only a welfare state can protect its citizens from the risks of having a national economy based on the export of raw materials and cash crops.

In the late 1990s, public opinion began to turn against capitalization and other neoliberal reforms (Kohl 2002)—particularly among highlanders who had suffered the worst of mining reforms in the 1980s. After the famous Cochabamba Water War in 2000, a series of increasingly violent protests broke out across the country, mainly over the privatization of water and gas resources (Schultz 2005). The protests have been massive and draw from nearly all sectors and interests in highland society. To date, the protesters have succeeded in nullifying Bolivia's business deals with foreign investors, forcing the resignation of two presidents, and calling for a new constituent assembly to rewrite Bolivia's constitution. After Evo Morales' accession to the Presidency in January 2006, he appointed a government cabinet drawn from the leaders of Bolivia's major social

movement. The new government will surely work to secure re-nationalization of natural resources, the reinstitution of a welfare state, and more formal political power for indigenous people. Even so, powerful interests are still at work to preserve neoliberal reforms and growth-oriented policies. In the fight to define Bolivia's political and economic future, there is no clear winner—yet.

Poverty, Well-being, and Livelihoods in Contemporary Bolivia

While the Bolivian protests are exciting to watch and theorize about, the grinding misery of everyday poverty affects far more people—and is the topic of this study. The great outcry over economic reforms in Bolivia today might seem to imply that standards of living are have fallen sharply in the country over the last decade. Indeed, many scholars have shown that—across Latin America—austerity packages, structural adjustment, and neoliberal reforms were followed by the absolute breakdown of livelihoods and cooperative survival strategies among the urban poor (cf. Safa 2004, Moser 1996, Gonzalez de la Rocha 1995). By some measures, however, quite the opposite appears to be true, at least for Bolivia.

In Bolivia's 1976 census, 86 percent of the Bolivian population was considered to be impoverished—that is, they had one or more of five basic needs unsatisfied (housing materials, housing space, water and sanitation, health, or education). By 1992, the number of impoverished Bolivians had dropped to 71 percent. In the most recent national census, in 2001, 59 percent of Bolivians, or 4.7 million people, were classified as impoverished using the same measure (INE 2003b). Looking at Bolivia's impoverished people in four ranked groups, the two poorest groups shrank between 1992 and 2001, while the two moderately poor groups grew in size (INE 2003b). Non-governmental organizations and development groups are clearly making progress toward meeting the

infrastructural, health, and educational needs of Bolivia's poorest citizens (cf. World Bank 2005).

There is, then an apparent paradox between successes in measures of development and Bolivians' growing intolerance for the direction of the economic reforms. The paradox is easily reconciled, however: at the same time that material conditions are improving, livelihoods are dwindling. As of 2003, the fraction of jobs in industry (29.1 percent) and agriculture (14.4 percent) was shrinking. The only sector of the Bolivian economy that was growing was services, at 56.5 percent of the GDP (World Bank 2005). Thus, the result of economic downturns and neoliberal restructuring is job growth in the mostly-informal service sector, where benefits are few, underemployment is common, and many are self-employed (Library of Congress 2005). Unemployment was estimated at 8 to 10 percent of the Bolivian workforce in 2002, and self-employment at 65 percent (Library of Congress 2005). Infrastructure, education, and health care are basic necessities and are improving in Bolivia, but these advances do not stop the everyday need to buy food, water, and other essential market goods.

With an economy that is increasingly market-based and deregulated, people's survival is tied to their ability to raise cash income. In urban areas, where people have little access to subsistence goods to offset poverty, 39 percent of the population is impoverished (INE 2004). People living in Bolivia's squatter settlements tend to make a living providing services in the informal market, as vendors, maids, day laborers, and taxi drivers. With less disposable income circulating in the Bolivian economy, the middle classes have cut back their spending on the non-essential goods and services that many of the poorest urbanites provide (Gill 1994). In addition to the ways that their jobs are

affected, squatters are more vulnerable than are other impoverished urbanites to changes in resource distribution and infrastructural development (Eckstein 1990). For instance, squatters live far from the city centers, and rely on long-distance transport to get to work. Sharp rises in gas and transportation costs can make it difficult or impossible for them to get to work, school, or wholesale markets in the city center.

In the next chapter, I discuss how people in Villa Israel have come to live and survive in one Cochabamba shantytown.

CHAPTER 3
SETTING

Finding the Field Site

In the summer of 2002, I made an exploratory trip to Bolivia to talk to development specialists and hydrological engineers about the possibility of conducting water scarcity research there. Two hydrologic engineers from a water-delivery NGO called Water for People, Susana Southerwood and Abraham Aruquipa, expressed a strong interest in the research project I proposed to them. Susana suggested that I consider working in a 20-year old Cochabamban squatter settlement called Villa Israel. She explained that, although Water for People had been involved with Villa Israel for almost ten years, the community's complex social composition and tendency toward conflict had made it difficult to get things done. Susana said that she would be interested in any insight I could add into what was happening, socially, politically, and economically in the community.

I was intrigued by Susana's description of the community, and decided to go see it for myself. I was staying in a hotel in downtown Cochabamba, and had no idea where Villa Israel was or how one could get there. The community did not appear on any official map of Cochabamba. Not knowing what else to do, I found a taxi driver who had heard of the place and asked him to take me out there. I was nervous about what I would find—especially after hearing Susana's description of the conflictive community. All of the ethnographies I had read about Andean communities rejecting and even attacking foreign researchers flashed through my mind during the long taxi ride into and beyond the impoverished south side of the city.

Finally, the taxi driver pulled off the highway, careened into and back over the top of a ditch, and announced that we had arrived. As we clattered into the community, I looked out over a vast dry expanse of land cluttered with dusty houses. There were no trees, no plants, and no water in sight. There was only a handful of people mulling about—mostly highland indigenous women known as *cholitas*, dressed in petticoats and full knee-length skirts called *polleras*, lacy white tops, and long braided black hair. There was no possible pretext for me to be there—no businesses, restaurants, no foreigners of any sort whatsoever. I asked the taxi driver if there was any bus or taxi line that serviced the community. He said that there was a bus that came around every once in a while, but there was not one vehicle in sight. Realizing that to present myself to the community as a clueless intruder looking for a way out was probably not the most auspicious entrée into a field site, I told the *taxista* that I would pay double—an exorbitant amount of money—for him to take me back to the city.

That summer, I took refuge in the safe havens of government offices and NGO headquarters, learning all I could about Cochabamba's water problems and what was being done to solve them. After meeting with about ten different development organizations, I felt confident that I had found the right city for my research. I knew, however, that the success of the project rode not on institutional support, but on the acceptance and collaboration of the community members themselves.

Gaining Entry

On my second trip to Bolivia, in the summer of 2003, I knew I needed a plan to get started in the community. Once again, Susana proposed a solution. She was supervising work on Villa Israel's water system, and invited me to go along with her and a friend while they checked on the workers' progress. While we were there, she introduced me to

several well-known men in the community. As we walked around, we ran into a large group of women who were building a cement-floored sports court. The women asked us to help them by paying for 20 bags of cement, and Susana coordinated the emptying of our pockets. She then elbowed me along with the women, saying—this is your chance, now go with them and get to work.

I went with two of the women to buy the cement, and they asked me to stay for lunch. After Susana and her friend had left, I was invited to a feast of steak, salad, potatoes, and Coca-cola. Eating alone, I was embarrassed to be treated to such a delicious meal while 35 women stood around watching me. I ate slowly and talked endlessly, answering every question I could draw out of the shy women about myself, my family, my hometown—anything to keep them smiling. When the meal finally ended, I asked the women if I could come back the next day and help them with their work, since I had some free time and was there to learn more about their lives.

The women tried to discourage me, saying that I could just sit in the shade of the courtyard's single tree if I wanted to see what they were doing. They confided that their work consisted of mining large boulders from an area that also served as an informal latrine. A few women argued that the work was far too nasty to do voluntarily. Of course, any qualms I felt about working in an open sewer were nothing compared to the prospect of trying to start participant-observation elsewhere in the seemingly-deserted community. I felt very fortunate indeed to be welcomed so easily into Villa Israel.

The work was brutal, as we spent weeks in pairs, lugging boulders, and mixing, shoveling, and spreading cement. A tenuous camaraderie developed during breaks in which the women complained, told jokes, or sang with me. I slowly realized that there

were two subgroups among the women, and people were watching closely to see which one I favored. If I carried rocks or shared lunch with one group too many times in a row, I could be sure that the others would snub me. At the time, I did not realize how rare it was to see Villa Israel residents' joys and hostilities out in the open.

After a few months of participant-observation, I found my footing in Villa Israel. I used my role as informal mascot of the women's work group to gain wider acceptance in the community. I slowly advanced my research program, moving from participant-observation to surveys to direct observation, and I learned to accept that Villa Israel residents' regard for me would always tilt between affection and resentment. As I became a confident ethnographer, I learned how to explain to curious new visitors what to expect on their first trip out.

Landscape

A trip to Villa Israel normally starts in the city of Cochabamba. There are only two transport lines that serve the community, the number 35 bus line and the 101 *taxi-trufi* line. The number 35 bus line is a large line that runs the north-south length of Cochabamba, from high in the foothills of Tunari Park, snaking through downtown and the city's enormous marketplace, and ending at the outside edge of Villa Israel. The bus is slow to load and progress, comes about every 20 to 30 minutes, and runs only from about 6:00 am to 10:30 pm. The 101 *taxi-trufi* line also originates in Villa Israel, following the 35 route until it hits the Prado (main street) uptown, and then turns left to end in a western barrio called Villa Mexico. It features a set of speedy taxis designed to hold five people, but can pack in up to twelve people when some are shoved into the hatchback. The 101 line runs at 5 to 15 minute intervals nearly 24 hours—although few drivers want to head out of the relative safety of the downtown area between 9 pm and 5

am. Although it is slow and uncomfortable, the 35 bus is the choice of most Villa Israel residents because (at the time of research) it costs 1 boliviano ($ 0.12), while the taxi-trufi costs 1.50 bolivianos ($ 0.19).

On their way to Villa Israel, the 35 and 101 reach the southern edge of the market and turn onto the Pan-American Highway. From this jumping-point at the edge of the city proper, the ride takes about 20 minutes in *taxi-trufi* and 45 minutes in bus. During the drive south, highly-populated barrios with internet cafes and restaurants gradually give way to patches of unused land, rustic corn-beer bars known as *chicherías,* and adobe housing. About halfway through the ride, one must pass a large slaughterhouse, and a putrid stench hangs over the area and wafts into the passing vehicles. Finally, just as the settlements appear to end completely, the bus passes a spiffy brick health center and one last Catholic church. With a sharp turn right, the bus heads though a field and lurches down into a usually-dry riverbed (the one I thought was an inconveniently-placed ditch). Pulling up out of the riverbed, a Villa Israel sign appears over the road's entrance to the community. Finally, the bus makes a wide left, and heads up Villa Israel's main thoroughfare.

The view of the community that the bus affords is unspectacular. Looking out over the landscape, a new visitor immediately takes in the overwhelming grayness of the terrain. A few squat hills, dotted with scrubby trees, climb up behind the community. Dust and litter blow along the curbs. The dry riverbed is dotted with feces, and clouds of filthy sand occasionally gust over the bank's edges, engulfing passersby. Skinny dogs dominate the streets, running in packs whose complex social organization appears to rival that of the community itself. Most houses are walled in, and every street-side is lined

with an uneven barricade of thorns, chicken wire, adobe, concrete topped with glass shards, metal fencing, and brick.

Later, one learns to pick out the community's landmarks in the dull and unwelcoming landscape. At the head of the main street sit the community's two most imposing structures: the Christian Evangelical Union (UCE) church and the community land prospector's three-story house. The bus stop (just behind the UCE church) and the taxi stop (at the side of the riverbed) are the hubs of Villa Israel's economy; they provide work to many men and a few intrepid women, the community's only reliable vendors of prepared food, and its lifeline to food, work, and education in the city. The open fields are actually the heart of Villa Israel's social life, and come alive on Sundays when teams—ranging from uniformed city-wide competitors to *pollera*-swinging women's teams to groups of industrious children—assemble to face off in the community's five soccer fields, basketball court, and volleyball court. In time, one might even discover that the patches of green trees tucked into the hills' crevices indicate where Villa Israel's two wells suck at tiny underground pools of water.

The Cadence of Community Life

Daily life in Villa Israel starts at about 4 am. Before dawn, wives start to cook or clean, prepare for work, and boil the morning tea. A bit later, husbands get up, and quickly eat breakfast and get ready for work before rushing off between 5 and 6:30 am. From about 4:30 am, the community water guard starts his morning rounds, methodically blowing his whistle, opening a pump, and looking on as women, strong children, and a few men fill up their families' buckets and gasoline cans with 20 to 40 liters of water. The guard continues his rounds, closing each pump and padlocking its door in turn, until 9 am. Between 7 and 8 am there is a frantic rush all around the community, as women

line up to get to the *cancha* and send their children running out of front doors to buy bread or make it to school on time.

After the frenetic early morning, life in Villa Israel drags to a slow pace by mid-morning. Those who have not left the community to work stay close to home, doing morning chores or attending their cottage industries. By 10 am, mothers or older sisters must begin a 2-hour preparation process to make a typical stew. Laboriously soaking, washing, and rinsing ingredients using just one or two buckets, some women work all morning to ready the midday meal. Few people go out, and the streets are empty and quiet.

At noon, there is a brief burst of energy when the children are released from school, and mothers or older sisters serve up lunch for the family. From 3 to 6 pm, those who can snatch a bit of precious leisure time to rest or nap. Everyone else keeps busy with errands and housework. At 6 pm, there is another rush to the corner stores, this time to buy meat or bread for the evening dinner. From 6 to 8 pm, children go out to play in the streets and soccer fields. From 8 to 9 pm, wage-earning women and men begin to return home, and dinner is served. At nighttime, from about 8 to 11 pm, families spend time together, usually gathered around an old television. By 11 pm, the community is quiet and everyone is at home and sleeping—except members of Villa Israel's two gangs, relatively tame groups of young people who wander the riverbed or hang out in the soccer fields until about 2 am.

Villa Israel's social offerings are meager during the week, as community members focus almost exclusively on families and work. A few times during the week, people gather in the evening to go to church or attend a community meeting. Only on Sundays

does the community come out from their walled-in houses to socialize. By late Sunday morning, the soccer fields, community market, churches, and food stands fill up with people enjoying their only day off from work.

Origins

To outsiders, Villa Israel leaders try to portray the community as a group of humble evangelical Christians who came to Cochabamba from the highlands in search of a better life. One visit to a meeting of the conflictive *Junta Vecina*l (Neighborhood Council) is enough for any visitor to recognize that the real story is more complicated. The community was indeed settled, nearly 20 years ago, by an evangelical Christian land prospector hailing from Huanuni, Oruro—an impoverished mining district perched high in Bolivia's Andean *altiplano*. Recruiting people to pioneer his squatter settlement in the usual way, through networks of relations and contacts, the prospector found family members, evangelicals, and Huanuni residents.

Quickly, however, word about Cochabamba's latest barrio got out, and all kinds of people came to buy, rent, and squat in the community. People arrived from Cochabamba's other barrios, the rainforests, the mines and the countryside, and as far away as Argentina. In 2000, about 1712 people were estimated to live in Villa Israel (Claure Periera & Asociados 2001). By the time that my research team and I conducted our first random survey of 101 community residents, in April 2004, Villa Israel had become a Bolivian melting pot. Today, the population has a wide range of origins, experiences, identities, and beliefs—which makes it an interesting, complex, and sometimes problematic place.

The majority of Villa Israel's adult population (92 percent) was born in the impoverished highland departments of Potosi, Oruro, and La Paz. A few were born in the

tropical coca-growing regions of Cochabamba's Chapare (1 percent) or the La Paz rainforests (2 percent). Another 3 percent of adult residents came from Santa Cruz, the lowland region whose residents are despised by highland Bolivians. About 75 percent of adult residents were born in the countryside, in the departments of Potosi (26 percent), Cochabamba (20 percent), Oruro (18 percent), and La Paz (10 percent). The rest were born in highland mining communities (13 percent) or in the cities (10 percent).

Community Development

While many Villa Israel residents were born in farms or small pueblos in the *altiplano* countryside, not all come directly from their hometowns to Villa Israel. Those who did tend to see their move as evidence of upward mobility. Some told us that, living in Villa Israel, they acquired steady cash incomes, proximity to schools and health care, and access to cosmopolitan diversions for the first time. Although they recognize the challenges of life in Cochabamba's far-flung shantytowns, 49 percent of those polled said life in Villa Israel compares favorably to the poverty and sadness of life in the countryside. Those who came to Villa Israel after living in an urban downtown, the cash bonanza of the coca-growing regions, or the security of the pre-1985 mining communities, tend to see life in Villa Israel as harsh, intolerable, or humiliating. Of those polled, 27 percent said that life was worse in Villa Israel than where they lived before, while another 25 percent said it was the same.

Life in Villa Israel, of course, has improved enormously since the first settlers came—when there were no transportation, communication, or social services at all. With funds from aid agencies, the government, and community members, residents built evangelical churches, an elementary school, a water distribution system, water runoff channels, a foot bridge, a rock-paved street and marketplace, street curbs, a concrete

sports court, and a health clinic (which they share with the neighboring community, Ch'aqui Mayu). The community government consists of four committees—neighborhood, market, water, and school—and is charged with maintaining old projects and initiating new ones. The community has four major social programs: Compassion (an evangelical enrichment program for pre-school and school children), PLANE (a government-funded program for women's employment and community construction), the Mother's Club (a group of mothers dedicated to learning new skills), and continuing learning classes for literacy, handicrafts, and English. The evangelical churches also have informal charities, in which they mobilize parishioners to donate, intervene in family problems, give advice, cook, and pray for church members.

Although the community has initiated an impressive array of projects over its brief history, many of them were corruption-ridden, poorly executed, or both. In one infamous incident, leaders touted a scheme to buy land in a nearby community and pump its water to Villa Israel, and then ended up "losing" community funds totaling at least $10,000. In the face of political debacles such as that one, interest in cooperative ventures has plummeted. In 2004, four of the eight community groups—the water committee, PLANE, the Mother's Club, and the continuing learning classes—were defunct. When people do get together to work on a project, it rarely goes well. For example, the street curbs and runoff channels began to crumble just months after they were built. A cycle of official corruption and popular apathy undermines volunteerism and cooperation in the community. As one woman—a savvy, long-time resident of Villa Israel—explained, "We gave our trust and money to the leaders, and we can't get them back. Now we joke that,

around here, only the fools still attend meetings and give their money to the Neighborhood Council."

In spite of the community's problems, there are those who still believe in participation and progress. Many people would like to see Villa Israel look and act more like the barrios in downtown Cochabamba. A major rift has emerged between those who want the community to invest in paved roads, urban sanitation, and water delivery infrastructure, and those who believe that people should leave the community as it is. The rift is deepened by classism, racism, and real economic differences among community members. Those who want modernization and progress bitterly blame the peasants for their lack of education and disinterest in achieving a respectable middle class lifestyle. Those who oppose community projects argue that one would have to be blind to the political and economic realities of life in Villa Israel to believe that mobility to the middle classes is still within reach.

Economic Well-being

Indeed, many of the residents of Villa Israel are in an economic situation that is obviously dire. Many housewives have to feed their families on 5 *bolivianos* ($0.62) a day. Those in the worst conditions manage to live on 2 *bolivianos* ($0.25) a day—getting by with bread, tea, and bone soup. Despite the abject poverty in which many Villa Israel families live, the community has remarkable economic diversity. Some residents own three or four lots of land, and live off the income from their stores, taxis, or rental houses. Others own tidy brick houses of two and three stories, with enormous private water tanks that insulate them from the local shortages.

One of the most important elements of economic well-being in Villa Israel is home ownership. When economic crises hit, home owners are able to take in renters or working

family members, intensify cottage industries, or leave the community temporarily to work elsewhere (Moser 1996). Renters, however, are restricted in their use of housing facilities as capital, and risk ending up dispossessed if they miss a rent payment or leave their belongings unattended. About half of Villa Israel residents own their homes (53 percent). About another third (29 percent), share, borrow, or house-sit someone else's house. After that, 18 percent rents a house or a room. Villa Israel residents, then, are split almost evenly between high and low levels of housing security.

Economic security, of course, is more complex than housing security alone. A 2001 survey of the community estimated that the average annual household income in Villa Israel was 5222 Bs, or about $652.75 per year (Claure Periera & Asociados 2001). While this figure supports what little data I have household income, it does not tell us much about the range of economic well-being Villa Israel. Since Claure et al. did not explicate the methods they used to calculate average annual income, I was unable to replicate their work. In my own study, I found that it was quite difficult to get good estimates of household income because earnings varied daily, various people contributed to the household economy, and people were very reticent about income levels.

After 14 months of research in the community, I devised a 4-point scale to assess economic well-being at the household level. I used four criteria to rank households: (1) access to food, water and medicine, (2) steadiness of work, (3) ownership of housing, and (4) access to capital such as a taxi, store, or inventory. The research team used the scale to rate 75 randomly-selected households, after conducting interviews and observation in each household over an 11-month period. We found that the distribution of wealth in Villa Israel was fairly normal. Households in the category we called "poorest"—those

that regularly lacked food, water, or crucial medicines—were 11 percent of the sample. Those households we called “low-stable”—in which at least one member had steady work, but they still struggled to maintain access to basic necessities—were 25 percent of the sample. “High-stable” households—those with steady work, secure access to basic necessities, and a house or capital—were 52 percent of the sample. The households we called “wealthiest”—those with steady income, at least one house, and capital—were 12 percent of the sample.

Economy and Education

The most common sources of income in Villa Israel are the transport lines and the Cochabamba marketplace. Poor young men are hired by taxi owners to drive in three-hour shifts on the 101 line. Middle-income men drive their own taxis, while the wealthiest families hire drivers to drive their vehicles for them. At the end points of the 101 and 35 lines, women vie to sell breakfast, brunch, lunch, and late-night snacks. A few lucky workers are employed by the lines themselves to punch timecards and control the flow of vehicles.

In Cochabamba’s downtown, the marketplace is a world apart. An enormous multi-block section of southern Cochabamba dedicated to commerce, the *cancha* (a word meaning field, now used to denote the market for Cochabamba residents) teems with thousands of precariously-rigged stalls, blanket-displays, and wandering vendors. The competition is fierce, and there are often 50 or more stalls lined up in a row offering exactly the same goods at the same prices. Villa Israel’s vendors usually participate in the lowest rung of market prestige, selling fruit or vegetables from blankets and circulating wheelbarrows, away from the rows of legally-installed stalls. Profits are minimal (between 5 and 20 *bolivianos* a day, or $0.63 to $2.50), but so is the capital required—

just enough to buy a day's worth of produce at the peasant market and the blanket or wheelbarrow to display it.

Those who do not work in transportation or the market tend to work in construction, as maids, or in household industries like leatherworking, tailoring, weaving, cooking, or raising animals. Extremely few Villa Israel residents have college educations or work in white-collar jobs. In fact, I knew of only two people with college educations, both teachers, living in Villa Israel, and both moved out before the end of the study. Despite the low level of education among Villa Israel residents, most adults value education highly—even if in practice they lack the time and resources to facilitate their children's educational success. In Bolivia's current economic climate, however, a college education does not provide much insurance against unemployment and poverty. The Cochabamba job market is increasingly flooded with underemployed young professionals. New graduates from unconnected families—those who lack relatives and godparents to facilitate their access to government and business jobs—have great difficulty navigating the job market. When Villa Israel's first generation of college students graduates, in about seven years, most will be have to contend with this disadvantage when they enter the job market.

Households and the Division of Labor

The household is the heart of resistance against poverty and privation. In poor communities, households are generally organized to maximize the ratio of production to consumption (Gonzalez de la Rocha and Gantt 1994, Gonzalez de la Rocha 1995). For this reason, household composition tends to change when times get bad. Married children join their parents in joint households with multiple adult income earners. Children are sent out to work. Some mothers remain in Villa Israel while the fathers support the family

from afar, while other mothers prefer to support their children alone without involving the father.

In Villa Israel, the majority of households (55 percent) consist of a mother, father, and underage children. A quarter (25 percent) of households is of the joint type, containing multiple adult income earners with or without children. Just over a tenth (11 percent) of the households consists of mothers raising children alone. A few more households (6 percent) consist of one or both grandparents raising grandchildren. Finally, in the original study sample, there were two households with a single adult living alone and a household of only underage children.

Nearly all adults (87 percent) work in the cash economy. Most Villa Israel fathers are rarely at home, and work full-time in the city, *cancha*, or 101 *taxi-trufi* line. All single mothers and most married ones participate in income-generating activities as well. Some work full-time, in PLANE construction projects, as maids in the city, or selling produce in the *cancha*. Others work part-time or seasonally taking in washing, cooking food, knitting, weaving, or selling produce at the market. Women stay home from one to six days a week, to concentrate on housework, cooking, and taking care of children. Men who work full-time usually have Sundays off, and are often out—playing soccer, attending meetings, or visiting—on their day off.

In households with working mothers, responsibility for housekeeping and childcare normally falls to the eldest sister, or occasionally an eldest brother. These teenagers are expected to buy food, fetch water, cook, clean, and take care of their siblings. Some also have part-time jobs, and most are enrolled in school. Many teenage household heads marry early or run away to escape the responsibilities. Those who stay at home explain

that they cannot abandon their younger brothers and sisters. Younger siblings, too, have household responsibilities; they make runs to the corner store, fetch water or hunt down the water delivery truck, and usually pitch in with some of the childcare, cooking, and cleaning. Some children also work from the age of 8, selling ice cream in the community or plastic bags in the *cancha*.

The general patterns of labor division described above hold across most Villa Israel household types, except one. In two-parent households with home industries—corner stores, leather workshops, a *chicherí*a, or a bakery—the division of labor tends to be much more flexible. Mothers and fathers rotate household responsibilities, working together in the business, housework, and childrearing. The children are normally less burdened with housework, and have more time to pursue their studies. Such couples also tend to have a rapport that is visibly better than that of other couples in the community.

Language and Gender

Like most Bolivians, nearly all Villa Israel residents are of indigenous descent, and most speak an indigenous language. In addition to Spanish, Bolivia has two major indigenous languages: Quechua and Aymara. Quechua is the more common of the two, and is spoken mainly in the departments of Potosi, Cochabamba, and parts of Oruro. Aymara is spoken mainly La Paz and parts of Oruro. Although most Villa Israel residents speak a second and even third language, 90 percent speaks Spanish proficiently. Of the 10 percent who do not speak Spanish proficiently, 9 percent speaks Quechua, and 1 percent speaks Aymara. All of the people who speak indigenous languages exclusively are women.

Villa Israel Spanish is highly accented, and employs a number of Quechua words. Language can be a real source of discrimination for Villa Israel residents outside of the community, where native Spanish speakers often look down on people who speak with indigenous accents. Most children, however, speak unaccented Spanish, as well as fluent Quechua or Aymara. Villa Israel parents place a high premium on having their children succeed economically in urban Cochabamba. As a result, many actively encourage their children to integrate in mainstream *mestizo* society, and tend to avoid inculcating them in indigenous values and practices. The most obvious example of this is that, in Villa Israel, not one daughter is being raised *de pollera* (in indigenous dress); all are *de vestido* (in Western pants and dresses).

Although language and dress can be a source of grief for Villa Israel residents outside of the community, cultural differences do not cause many problems at the community level. Villa Israel's important power players are all men who, like most Villa Israel men, speak fluent Spanish and dress in Western clothes. Community meetings are conducted bilingually in Spanish and Quechua, as there are few, if any, monolingual Aymara speakers responsible for representing their households. In community organizations, language plays little role in excluding household representatives (usually men) from participation and decision-making.

Among women, language-related transgressions can be a source of rancor. Women working in community work groups or fetching water at public water taps tend to clump together according to their native language, talking and coordinating among themselves in Aymara or Quechua. When they feel left out, Quechuas accuse Aymaras of gossiping, backstabbing, and other offenses, and vice-versa. And indeed, the language-segregated

groups do engage in such behavior. Despite the resentment that these situations create, many women adapt to the linguistic barriers, moving adeptly between Aymara and Quechua groups. For instance, one woman, who came to Villa Israel as a monolingual Spanish speaker ten years ago, told me that she quickly learned to speak Quechua and Aymara out of necessity. Linguistic and cultural differences—although not one of the central problems—add to the overall discord in the community.

Religion and Politics

After the development debate, the other major clash in Villa Israel is over religion. Relations between evangelicals and Catholics are so tense there that many people do not associate across religious lines. Because of Catholics' dominance in popular society, evangelicals blame them for a host of perceived Bolivian social problems, including laziness, corruption, alcoholism, and the disintegration of the family. Many Catholics are outraged by what they call the hypocrisy of evangelicals—some of whom engage quite visibly in corruption, drinking, and family abuse—and have grown to regard evangelicals with intense suspicion and even hatred. Evangelicals, for their part, have been warned by their pastors about the corrupting influences of Catholics, and tend to avoid all non-evangelizing contact with them.

Because of the dominance of evangelicals in community life, most residents believe that the Villa Israel contains few Catholics and non-affiliates. And although evangelicals do dominate the populace (58 percent), there is a large minority of Catholics (34 percent) and people with no reported religious affiliation (8 percent). While evangelicals have established 14 different churches in Villa Israel, Catholics split their attendance between two churches, both outside the community. Catholics, then, are rather invisible and disorganized in comparison to the evangelicals. As a result, Catholics see

themselves as a persecuted minority, prevented from participating fully in community decision-making. Evangelicals, meanwhile, are secure in their dominance of community politics, but feel threatened by the arrival of new Catholic community members and the re-conversions of evangelicals back to Catholicism.

The religious composition of Villa Israel's residents does appear to be changing. While evangelicals report living in Villa Israel, on average, 6.1 years, Catholics and non-affiliates have lived in the community just 3.4 and 3.8 years, respectively. Based on the life histories people gave us, I believe that the original settlers of Villa Israel tended to already be evangelicals or quickly converted once they moved into the community. In time, some of the converts converted back to Catholicism, and new community members have moved in. Evangelicals have tried to stem non-evangelical political participation by disenfranchising non-pioneer residents from the political process and by rejecting Catholic-funded development projects. Today, the nearly-60/40 split between evangelicals and non-evangelicals makes challenges to the traditional evangelical community power structure more viable than ever before.

CHAPTER 4
FIELD METHODS

The field research was designed to yield data on social interactions, economic exchanges, and water scarcity. The research proceeded in two general phases. During the first phase, I did participant-observation, hired and trained a research team, made a sampling frame, and developed interview and observation protocols. The first phase laid the groundwork for the second, so that I was prepared to complete the first round of interviews before rainwater reserves ran out in June. During the second phase of research, my research team and I conducted five two-month cycles of semi-structured interviews with 76 randomly-selected households. We also conducted 1,986 randomized observations of 60 public places in Villa Israel.

The research design has several strengths. First, participant-observation produced data with high internal validity about local cultural institutions and practices (Kirk and Miller 1986). Second, the household interviews allowed me to document change by collecting repeated measurements of household characteristics over time. Third, the observations produced data with high external validity about social interactions in Villa Israel. Finally, the use of three forms of data collection—participant-observation, household interviews, and direct observation—enabled me to check the results of each method against the other, facilitating identification of patterns and problems in the data.

In this chapter, I describe how I implemented each phase of the research design in the field. In doing so, I have two goals: first, to report the extent to which I followed established protocols in conducting the field research and, second, to explain how those

protocols were adapted to the ethnographic context. The organization of the chapter follows the temporal progression of the fieldwork; each section builds on the one before it and lays the groundwork for the next—just as the stages of field research did. I begin with a discussion of my re-entry into the field in January 2004.

Gaining Community Support

Before starting the field research, I wanted to get general approval for the project from the local governmental authority, the Junta Vecinal or Neighborhood Council. During my pre-dissertation research in 2003, I noticed that many community members were troubled to see a *gringa* in Villa Israel. I hoped that winning the Neighborhood Council's approval would help me overcome community members' qualms. After my return to Villa Israel in January 2004, I obtained permission to do research during a meeting of the board of the Neighborhood Council.

From my first meeting with the Neighborhood Council, it was clear that community leaders thought I would be useful to them. Within a week, I was given a seat of honor at board meetings, was asked to find funding for various community projects, and was approached by a national political party representative who wanted a foothold in Villa Israel. At Neighborhood Council meetings, my research team and I were allocated time to talk to Villa Israel's household heads. After we explained our research process (and that participating households would receive monetary compensation) in one meeting, two community leaders gave fiery speeches arguing that households should participate and donate their earnings to the Neighborhood Council. At that moment, looking around at the skeptical faces of household heads, I realized that being closely associated with the Neighborhood Council could harm the project. In the weeks that followed, people told

me stories about community leaders' self-interest, corruption, and unpopularity. I decided to put some distance between my project and the local government.

Once I realized that closeness with the Neighborhood Council might compromise my position in the community, I decided that I would have to explain the project's origins, methods, and goals to potential participants by myself, person by person. Because many community members are suspicious of Americans (I discuss this further in the last section of this chapter), it was difficult to win the community's support for the project. Using my role in the women's work group as a conversation-starter, I explained who I was and what I wanted to do in Villa Israel to everyone that would talk to me. Slowly, I built grassroots support for the research project during the participant-observation phase of the research.

Participant-Observation

In January 2004, I began living in Villa Israel and doing participant-observation. As I mentioned in the last chapter, only a handful of visible social interactions transpire in Villa Israel. Because people generally stay inside walled housing compounds, it is difficult to casually meet people. Between January and May of 2004, I developed four general strategies to build relationships in Villa Israel: spending money, helping, attending get-togethers, and visiting.

After I moved to Villa Israel, I got to know people by patronizing local businesses. In Cochabamba, however, vendors sometimes consider shopping around a serious affront (that implies the vendor overcharges or has inferior products) once a commercial relationship is established, so this tactic must be used cautiously. Carefully spreading my business around, I bought bread from one bakery in the morning and another in the evening, eggs and meat from one corner store and jam from another, peach juice from

one booth and soda from another. In this way, I got to know about twenty merchants and their families. Since businesses are important gathering-places where news is exchanged, I also learned about what was going on around Villa Israel by listening in on other customers' conversations.

The best way to get access to large groups, before anyone knew me, was by offering to help out. Workers on community projects, like water line construction, tree planting, and bridge building, were always willing to welcome another laborer into their ranks. Also, there is a large unmet need for childcare in Villa Israel. I offered to teach free English classes and played games with unsupervised children in the evening. As a result, I got to know many workers, children, and parents.

Once people knew me, the fastest way to find groups of people in Villa Israel was at Sunday meetings. Every Sunday, people converge on three major soccer fields in the community. People also assemble in Neighborhood Council meetings and in church. In each of these settings, families and friends gather in small groups to gossip, eat fried tripe or puffed rice, and reflect on the main event. While these informal social groups represent rich sources of information, they are unreceptive to intrusions from strangers. For this reason, I was generally able to collect data in Sunday meetings only from the people I already knew well.

After I had been in Villa Israel for a few months, people seemed to be more comfortable with seeing me around. A few women made friends with me and invited me into their homes to eat, or to show me some weaving they had been working on, or to ask for advice on a project. In Villa Israel's patios, kitchens, and bedrooms, I learned how women wash laundry, cook meals, divide labor within households, and interact within

families. I also learned a few precious details about Villa Israel's history, controversies, and long-standing rivalries.

Despite my successes in gaining access to many areas of life in Villa Israel, my interactions with people were generally not rich. Informal conversations were filled with empty pauses, repetition, and platitudes. When I tried to dig deeper, people often answered "*así no mas*", saying, basically, that's just how it is, and looked at me blankly if I tried to ask more questions. I found that people were quite good at evading my queries, and I wondered why getting a good informal conversation going was such a challenge. After some reflection, I concluded that I had trouble building rapport because—in addition to being a *gringa*—I was an unmarried student with no children. At 26, I had little in common with other people my age in Villa Israel. As a result, many adults were not interested in talking to me about their marriages, children, or other important topics.

Despite the challenges that participant-observation presented for me, it was a fruitful research period. I developed four successful tactics to get to know and spend time with people (spending money, helping, attending get-togethers, and visits). I took notes on social relations, economic exchanges, water acquisition and use, and other elements of daily life I observed. The participant-observation data became the foundation for all the later stages of research, and helped me adapt data collection protocols for Villa Israel.

By the end of March 2004, I reached the point of diminishing returns for participant-observation data. Although I began interviewing in April, I continued doing participant-observation when interviews and direct observations were not scheduled. By May, data entry and coding began to consume nearly all of my free time. Additionally, there was a burglary in the room I rented in Villa Israel, in which the intruder entered my

computer and deleted the project data from the hard drive. All of the data were backed up on a CD, and I was easily able to recover the deleted data from the hard drive. However, it seemed clear that the project data were neither secure nor confidential in Villa Israel. For security reasons, I moved the project computer and data to a site downtown, far from Villa Israel. Once I began to split my time between the community and the computer, the intensive participant-observation research phase ended.

The Research Team

While I was able to do much of the participant-observation work alone, I needed a well-trained research team to help me complete the rest of the planned research—sampling, interviewing, and direct observations. During the summer of 2003, I began to look for research assistants. I wanted people with an interest in the project, a solid education in research methods, and a familiarity with Cochabamba's squatter settlements. I also wanted the team to reflect the demographics of Villa Israel as much as possible, in terms of sex, religion, age, and language.

After interviewing several candidates, I decided to hire close friends and teach them to do anthropological research. My two main assistants were a married couple, Wilda and Richard. Both were college students in their mid-twenties, grew up in squatter settlements, and came from Quechua-speaking families. Wilda is a Baptist woman, and Richard is a Catholic man. Together, they only represented part of the range of demographics I needed. I hired Wilda's father, Don Willy, as a full-time Quechua translator, and her mother, Doña Dominga, as a part-time Aymara translator. These two team members were Baptist, in their fifties, had no college education, and lived in a well-known Cochabamba squatter settlement. They helped round out the age, ethnic, and socio-economic demographics the team lacked. The last team member was Magda, a

talented high school student who did less-sensitive direct observation work on a part-time basis. Madga was the only Villa Israel resident who worked on the project's data collection.

I paid each team member according to the time investment he or she made in the project. Base salaries were set at a fair market price, and were renegotiated when team members had additional health or transportation expenses. Base salaries were regularly augmented with gifts, vacations, and other bonuses. I also provided educational training, such as the opportunity to publish, do data analysis, study English, and attend conferences. When I applied for research funding, I was not aware of the local custom of paying a double salary to workers in the month of December. At the end of the study, I gave researchers the project equipment (television, computer, printer, etc.) to compensate for not offering them the expected double salary in December.

In March 2004, I began a one-month training program for the full-time assistants, Wilda, Richard, and Don Willy. Together, we planned every phase of the research, each using our expertise to improve the project design. I explained the proper way to get oral informed consent, create and translate interview protocols, and design a randomized observation schedule. The research team, in turn, taught me how to make the research more understandable and acceptable to participants in Villa Israel. For instance, the research team suggested that, instead of explaining that I was conducting a research project about the effects of water scarcity on social interactions and economic exchanges, I should say that I was "writing a book about life in the community, and especially the lack of water here". The research team also helped me use local vocabulary to translate the interview protocols, rather than the formal Spanish terms with which I was more

familiar. For instance, we decided to use the informal slang term *plata* (silver) instead of formal terms *dinero* (money), *sueldo* (wage), and *salario* (salary) in the interviews. We also used Quechua words, like *mich'a*, to replace Spanish words, like *tacaño* (cheap, miserly), that were less familiar to survey participants. While Don Willy did not need an education in research methods in his role as translator, we found it helped him explain the project to wary Quechua-speaking participants. Don Willy's ability to understand and allay potential participants' misgivings about participating in an American-led scientific research project was particularly valuable. Having a team that was trained in research methods helped me adapt the research design to local knowledge, language, and political circumstances without compromising the project's integrity.

During the month-long training period, we also developed collaborative approaches to planning, research, and teamwork that became quite important in later stages of the research. The project had a heavy workload of interviews, observations, and coding that had to be completed every two months over a ten-month period. The work was physically, mentally, and emotionally exhausting. As the dry season progressed, field conditions worsened. We got sick with fatigue, headaches, vomiting, and diarrhea. Perhaps worst of all, some community members suspected us of posing a threat to community well-being throughout our time in Villa Israel. We learned to be ready for street-side snubs, shouted accusations, dog attacks, and various other affronts when we ventured out in the community. We discovered that our best defenses were wicked senses of humor, conviction in our work, and—most of all—a very strong sense of team unity.

One of the greatest strengths of the research project was its excellent field research team. I chose people whose talents and temperaments I knew well, and trained them to do

anthropological work. The demographic composition of the research team helped them gain acceptance among the research participants. In return for their labor, I offered the team members fair compensation, educational opportunities, and the ability to contribute to the research design. Over time, we developed a collaborative work style that improved our resilience to difficult field conditions and the quality of the data we collected in Villa Israel.

The Sampling Frame

The first task we tackled during the training period was creating a sampling frame. In January 2004, I asked the Neighborhood Council for a map of the community. I was given a map of empty land plots that was used for land sales before Villa Israel was settled. While it was out-of-date and somewhat inaccurate, the land sale map did give us a good foundation from which we could build a sampling frame for Villa Israel.

First, I wanted to define the boundaries of the sampling frame—what land would be considered part of Villa Israel for this study. Using the saleable land plots as a general guide, we found unmapped streets and constructions at edges of the settlement. Officially, the Neighborhood Council does not consider these “out of bounds” constructions to be part of Villa Israel. The boundaries defined by the Neighborhood Council, however, are highly politicized and are contested by the landholders themselves. As a result, I concluded that political boundaries should only be one of several factors used to determine the boundaries of the study. I also considered the existence of physical barriers between the land and the community, the physical proximity of the land to Villa Israel’s main street, and the area’s access to Villa Israel’s economic and social landmarks.

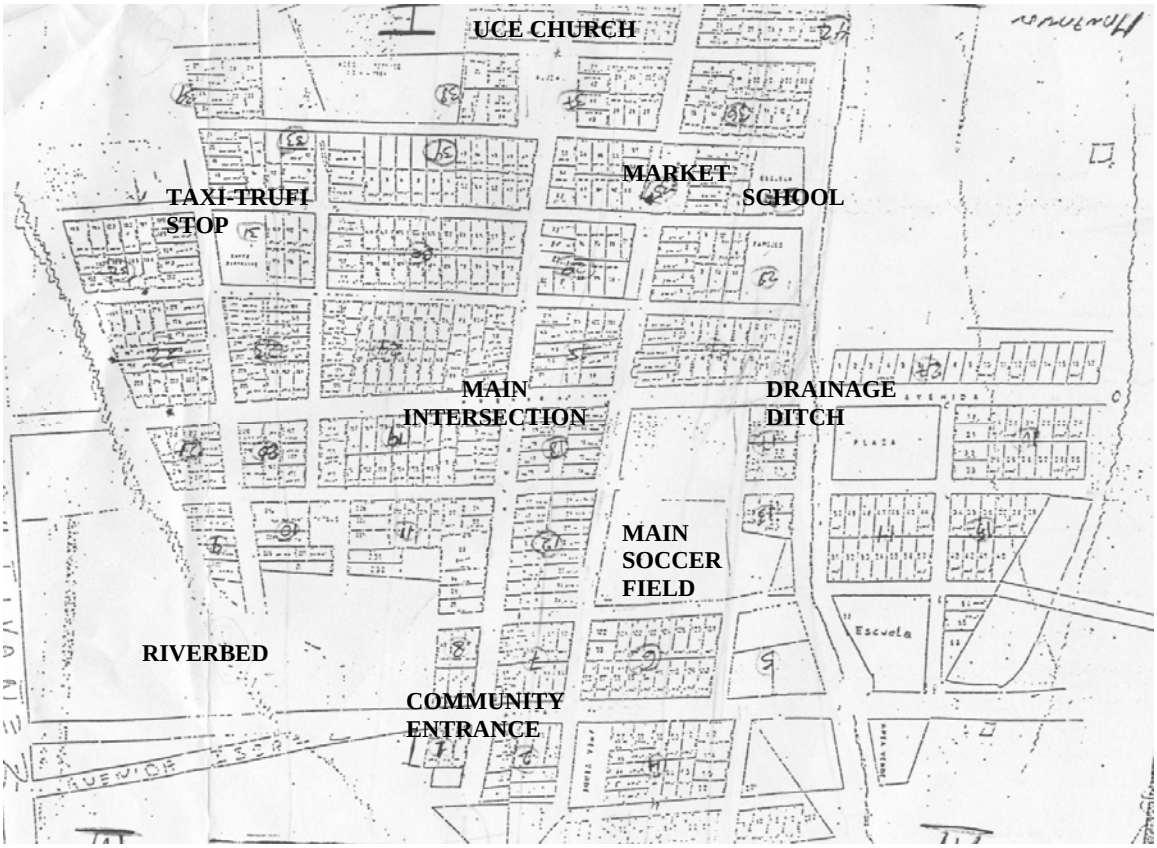

Figure 4-1. A map of Villa Israel land plots (from Claure, Periera, & Asociados 2001) similar to the one used to build a sampling frame. The actual map was a photocopy of a wall-sized map supplied by the Villa Israel Neighborhood Council.

After deciding which land would be included in the project's map of Villa Israel, I had to decide how to use the map. As I explain below, I wanted to sample households for the interviews, and to sample public places for the direct observations. The land sale map did not include housing constructions. Also, beyond a few fields labeled "green spaces", there were no public places identified on the land sale map. It was clear that the research team would have to do additional mapping before we did any sampling.

It was not difficult to create a systematic approach to mapping public places. I determined that any indoor location—a church, school, or business—was not truly public, since access would always be restricted for some people. Streets and open fields (including sports fields) could be considered public, since anyone could enter them

without restriction. After mapping the streets, I decided to number every intersection and endpoint (where a street ends) in the community. The observation sample, then, was based on a regular grid of intersections and endpoints around which Villa Israel's various public places are situated. Since sports fields always bordered streets and intersections, they were included automatically. Using the original map with extended boundaries, we determined that the community had 60 intersections and endpoints.

Drawing a sample for the interviews was much more complicated. Ideally, I would have drawn a random sample of Villa Israel's households, but could not find an appropriate sampling frame. I considered conducting a census to determine the location of households. However, since community members were still quite ambivalent about the research, any attempt to do a census would have been poorly received—and would have yielded poor-quality data. Ultimately, I decided to draw a random sample of occupied structures, since structures could be observed unobtrusively.

Starting again with land sale map, we plotted Villa Israel's constructions. I decided that, to save time, we would eliminate constructions that clearly were not occupied from the interviewing sampling frame. However, housing constructions in various stages of completion—without doors, windows, complete roofs, or electricity—could be occupied, or not. Wilda and Richard suggested we use the following criteria to code a construction as occupied: the construction has a roof and at least 3 walls (does not need windows) AND (1) has an electrical hook-up or electrical wire run from another residence, OR (2) has a visible water storage area, OR (3) has curtains, toys, or other visible items that indicate inhabitation. If we were unable to determine the above, we tried to find a neighbor to consult. If, using this rubric, we were unable to determine if a construction

was occupied, we conservatively coded it as such and included it in the random sample. Based on these coding rules, we estimated that there were about 415 occupied constructions in Villa Israel.

By mid-March, the research team had created its own map of Villa Israel. Starting with an out-of-date map depicting saleable land plots, we redefined community borders, identified 60 public places, and located 415 occupied constructions in Villa Israel. The modified map of public places and occupied constructions served as the master frame for the random samples we drew during the research. Although new constructions were built and old ones abandoned during the time we worked in the community, our random samples represent the community as it was in March 2004.

Interview Sampling, Informed Consent, and Compensation

For the household interviews, we drew a random sample of 110 of Villa Israel's 415 occupied constructions using a table of random numbers (from Bernard 2002). Once we identified a randomly-sampled occupied construction, we made an appointment to speak with the household members. We defined a "household" as a group of people who shared living quarters, expenses, and a cooking pot. We discovered that, occasionally, more than one household occupied a construction that we had selected in the random sample. If one of the occupants was the owner, we selected his or her household for the study. If not, we asked the occupants to decide among themselves who should participate. Although I would have preferred to randomly sample the households within the construction to determine a participating household, intra-household sampling was not something that community members were willing to participate in during the early stages of the research.

On our first round of contacts, we found that 13 of the constructions in the random sample (12 percent) were actually not inhabited. The remaining sample contained 96 eligible occupied constructions. We attempted to contact adults at each of the 96 occupied constructions up to 14 times. From the 96 occupied constructions, 73 households (76 percent) agreed to participate in the study. Another 23 households (24 percent) refused to participate or were never available to speak with us after 14 attempted contacts. Here, I do not separate out “refusals” from “never availables” because Villa Israel residents used avoidance as a way to communicate refusal to participate.

Once we had identified a household that was interested in participating, we sought informed consent. In most cases, we attempted to get informed consent from all adult household members, since data would be collected on everyone in the household. We told people that I was from the University of Florida, and received academic grants to work in Villa Israel. We explained that I was writing a book about people’s daily lives, and especially about how people were affected by water scarcity. We told them that we would compensate them for the time they spent talking to us, since we knew they might have to miss work. We also told them that they had the right to refuse to answer questions or withdraw from the study at any time, but that we would like to interview them five times over the course of a year.

The compensation we offered was important to participants. We gave each household 20 Bolivianos (or $2.50 USD at 2005 exchange rates) for each round of data collection in which they participated. This sum represents average compensation for a day’s work among Villa Israel residents. To be interviewed, some participants had to take off a full or half day’s work. Without reimbursement for this lost income, the neediest

participants would not have been able to take part in the study. Participants also saw the offer of compensation as a sign of respect. By recognizing that participants' time and knowledge are valuable, we showed participants that we valued them. The combined effects of economic and emotional incentives explain, in part, why the quality and quantity of information we received in interviews was so much better than what I got from participant-observation.

For the interviews themselves, we spoke only with people who we defined as "household heads", that is, people responsible for the acquisition and distribution of household goods. Of the 102 people identified as household heads, 69 percent were women and 31 percent were men. Of the women, 59 percent headed households alone and 41 percent headed households with another person. Of the men, 19 percent headed households alone and 81 percent headed households with another person. It is important to note that, in several cases, joint-headed households were headed by parent-child pairs, siblings, and other non-married teams.

In March and April of 2004, the research team identified interview participants. First, we located the occupied construction that was randomly selected from the sampling frame. We approached the occupants, selected households, and explained the research process to household adults. We also offered fair compensation for household participation. The participation rate for the first interview was 76 percent of randomly sampled occupied constructions. Because we conducted interviews with people who met our definition of household head, the majority (69 percent) of people we interviewed were women.

Developing Interview Protocols

The interviews were designed to produce testable data on social interactions, economic exchanges, and water provision. The protocol had to be carefully constructed, so that it produced accurate and reliable data. I also wanted to contribute to the literature on the urban poor, and searched for a semi-structured survey protocol that could be reproduced in Villa Israel. Stack's study (1974) of survival strategies among the urban poor contains such a protocol.

The research assistants and I translated the Stack protocol directly into Spanish, and from Spanish to Quechua. We ran a series of test interviews, and determined that some of the Stack's categories and prompts did not translate well into the Andean context. Over a period of several weeks, we drafted and tested modifications to Stack's categories and prompts. Most of the changes removed references to Stack's ethnographic context (African-Americans in the 1960s) and added references to life in an Andean squatter settlement. For instance, in the set of questions about social interactions (which Stack called "Daily Life"), we added categories that probed for interactions at soccer games, community work groups, and other activities particular to life in Villa Israel. Similarly, in the set of questions about economic exchanges (which Stack called "Finances"), we added questions about marketing, water fetching, and household economic activities.

Unlike Stack, I planned to quantify and compare social interactions and economic exchanges. That made improving participants' recall crucial, as I needed them to give us reliable estimates of the number of times they engaged in certain activities over the previous week. The participants were asked to recall activities over a week-long period because test interviews showed that other standard time periods—a day or a month—produced idiosyncratic and unreliable data. We found that most people accessed their

Table 4-1. The semi-structured interview protocol, modified from Stack 1970.

Semi-structured interview protocol (Modified version of Stack 1974)

DAILY LIVES

My aim is to learn how people spend their time from the moment they wake up in the morning until they go to bed at night.

a. Describe a typical day in great detail.

(Probe repeatedly using the following categories -- learn who they visit, which relatives they see daily or weekly, what they do for each other, whether they exchange goods and services, and how these exchanges are arranged.)

Researchers—find out what identity groups Ego has in common with each person they name—religion, kin, paisano, neighbor, work, politics, etc.

b. Who do you see or visit each day, each week? Which relatives? Which neighbors? (Name relationship.)

c. With whom did you spend your day?

d. Where and with whom do you eat breakfast, lunch, dinner? (Probe.)

e. What housework do you do (shopping, scrubbing, cooking, dishes, etc.)? What other work do you do? With whom do you work?

f. With whom do you enjoy spending time each week?

g. With whom do you participate in group activities (church groups, soccer or basketball, paid work, community work projects, etc.)?

h. Who do you sit or visit with normally at neighborhood activities—soccer games, church, neighborhood committee meetings, other events?

FINANCES

Everyone has a hard time making it on the money they get and has to get some help from others. The aim is to try to figure out how people make it. This gets very complicated because some people live together, others eat together, and others share their income.

a. Who is living in this house right now? (List relationships.) Who contributes to the finances of the household? How do they contribute (rent, utilities, etc.)?

b. Who fetches the water? Who drinks or uses it? Who helps pay for it?

c. Who ate in the household in the last week? Which meals? Who paid for the food and cooked?

d. Try to learn the source of income of everyone who contributes to the household.

e. What did you do for someone else this week? Did anyone help you out? (Probe for people outside the household. Get all the information you can about these people.)

f. Did you give anything (goods/services) to any of the individuals listed in e?

g. Did you receive anything (goods/services) from the individuals listed in e?

h. Did you trade food, money, child care, or anything else with anyone this week? With whom?

i. What else should we ask you about these relationships?

THE ACQUISITION OF GOODS

(Elicit the names of all the items –furniture, pictures, radios, etc.—in each room in the house that were acquired in the last week. Ask the following questions about each item.

Table 4-1. Continued.

a. Give a physical description of the item.
b. Does it belong to anyone in the house? Who?
c. Was the item in anyone else's home before? Whose?
d. Was it a gift or a loan? Who loaned or gave it to you?
e. Is it home-made? Who made it?
f. Where did it come from? Was it bought at a store? Where? Who bought it?
g. Who will it be given to or loaned to?
h. What else should we ask you about it?

CHATTING AND GOSSIPING

a. How do you keep up on what's happening with people you don't see very often (in, outside Villa)?
b. Who do you chat with?
c. How much time did you spend chatting yesterday? On most days? How much do people chat with each other, in general, in Villa Israel? (Get examples.)
d. How many people chat together at a time?
e. What do people chat about? (Get examples.)
f. How fast does information spread? If you tell a friend something, how long does it take for your (sister/cousin/other relative named earlier) to hear about it?
g. Are there people you don't like to chat with? Who—why? (Get examples.)
h. Do people gossip very much in Villa Israel?
i. How much do people believe the gossip?
j. What kind of people gossip the most in Villa Israel? What do they talk about?
k. When people gossip about each other, why do they do that?
l. Can you think of a time when gossip really changed the way people in Villa think about someone? Is there someone people tend to avoid now, because of something they heard from others? What happened?

CONFLICTS

a. Have you ever seen people in Villa Israel get into arguments with people outside their family? What happened?
b. When people have trouble with people outside their families, what is it usually about? What usually happens? What are the consequences? Do other people get involved? (Get examples.)
c. When people have conflicts outside the family, do other people in Villa usually find out? What do they do when they find out?
d. Have you had any trouble with anyone outside your family in the last week or so? What was it about? Did anyone else get involved? How was it resolved? (Probe as much as possible. Ask about more conflicts).
e. When people have trouble with people inside their families, what is it usually about? What usually happens? What are the consequences? Do other people get involved? (Get examples.)
f. When people have conflicts outside the family, do other people in Villa usually find out? What do they do when they find out?
g. Have you had any trouble with anyone inside your family in the last week or so? What was it about? Did anyone else get involved? How was it resolved? (Probe as much as possible. Ask about more conflicts).

memories easily when we asked about the types of interactions they had engaged in, such as visits, work, eating, casual encounters, meetings, and having fun. For people who had trouble remembering, we developed additional sets of probes based on the following native categories: relationships (family, friends, neighbors, etc.), places (home, on the street, at work, in the market, etc.), meals (breakfast, brunch, teatime, etc.), community activities (Neighborhood Council meetings, soccer games, etc.), and days of the week.

Interviews were conducted with household heads five times over a 10-month period, from April 2004 to January 2005, and took an average of 65 minutes. Like Stack, we began each interview by asking people to describe what a normal weekday was like for them. We then used this baseline understanding of the participant's lifestyle to modify the interview protocol to the participant's particular social and economic situation. Next, we asked about the participant's household economy—who was living with them, who contributed money and labor, how they divided responsibilities, where and with whom they worked. After that, we asked people about the visits they made and received, the meals they ate, and what they did with their free time in the community. Throughout, we constantly probed to determine the number of social interactions and economic exchanges in which participants had participated over the last week.

During the first round of household interviews, from April to May 2004, we interviewed 102 household heads. From June to July, we repeated the interviews with 94 household heads. In August and September, we interviewed 93 household heads for the third time. We conducted the fourth interview with 91 household heads in October and November. Finally, in December and January, we conducted the fifth and final interviews with 96 household heads. In total, we conducted 476 semi-structured interviews in Villa

Israel. Participating household heads were lost from the sample because they traveled, moved away, had an illness or disability, or later withdrew from the study.

After each interview was conducted, we recorded and coded it. Because participants were not comfortable with the use of recording devices, we took extensive notes during the interviews. We used our notes to create two-page records of the interviews after they were finished. We coded the interviews on 90 variables: 10 variables about the interview process, 10 demographic variables, 36 variables about social relations, and 34 variables about economic relations. The variables that are relevant to the theoretical question under study here will be analyzed in the chapter on social interactions and economic relations.

Measuring Water Provision and Scarcity

Ideally, any study of water scarcity could begin with a simple measure of how much water people have coming into their homes. However, when water distribution systems are highly complex, as in Villa Israel, it can be difficult or impossible to track how much water people acquire. In such cases, innovative, locally-appropriate approaches to estimating water provision must be developed.

To begin, I did extensive participant-observation and ethnography to understand how households obtain and use water. People in Villa Israel acquire water from five sources: freelance water trucks, the community tap-stand system, rainwater, the river, and other community members. They store water in three kinds of containers: underground water tanks, metal 200-liter drums, and 20-liter buckets. People use water in thirteen ways: (1) face washing, (2) hair washing, (3) tooth brushing, (4) bathing, (5) making breakfast, (6) making lunch, (7) making dinner, (8) making beverages, (9) dishwashing, (10) toilet flushing, (11) bathroom cleaning, (12) washing laundry, and (13) mopping.

I designed a data collection tool to determine the degree to which each household used these water sources, water storage containers, and water resources. Because the tool would be used by researchers and participants, many of whom cannot read, it had to be illustrated. I brought an artist to Villa Israel, and asked her to observe how people use water there for two days. I then asked her to draw a very simple depiction of each of the water tasks, containers, and sources. The sketches were then lined up together on a piece

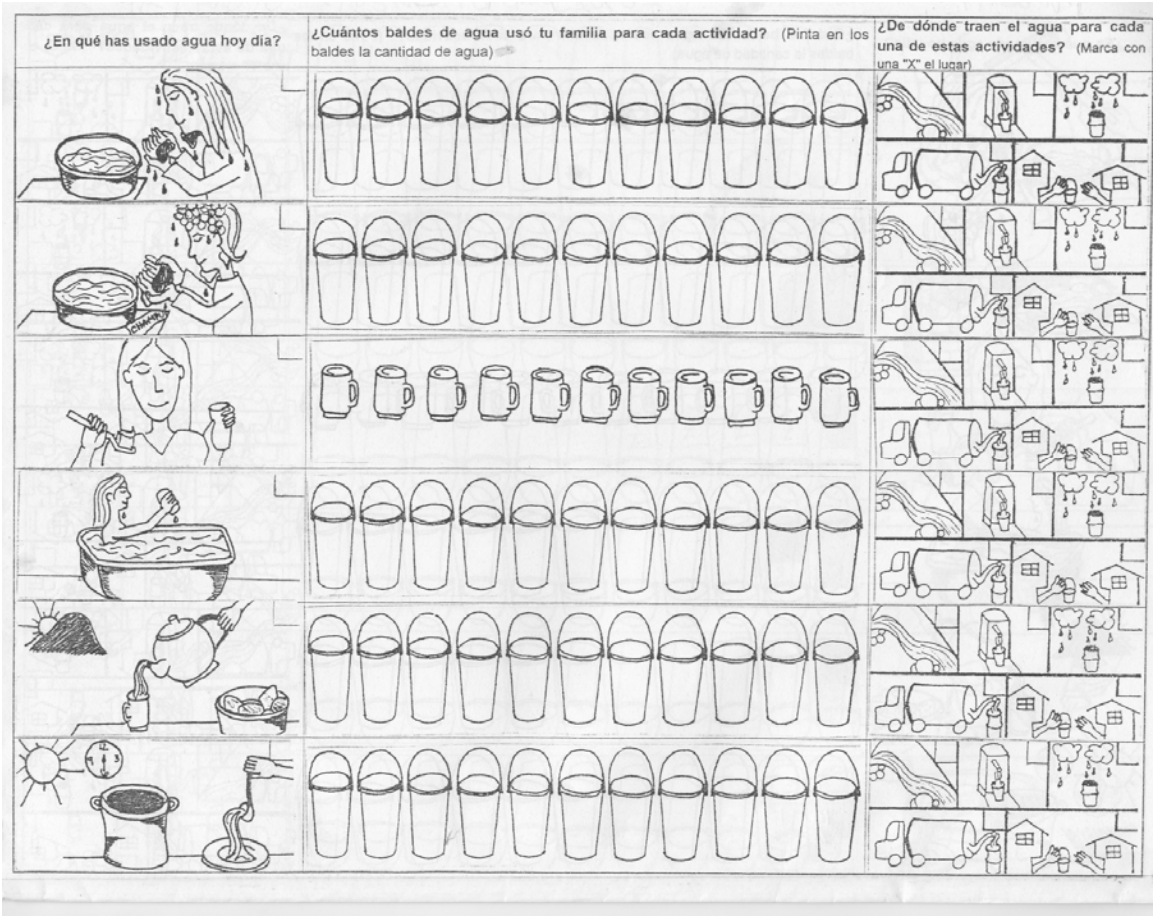

Figure 4-2. The first page of the water data collection tool. It depicts six water-use tasks (face washing, hair washing, tooth brushing, bathing, making breakfast, making lunch), two kinds of water containers (10 L buckets given to participants and cups), and five water sources (river water, tap stand, rainfall collection, *aguatero*, neighbor). Artwork by Ashley Yoder, 2004.

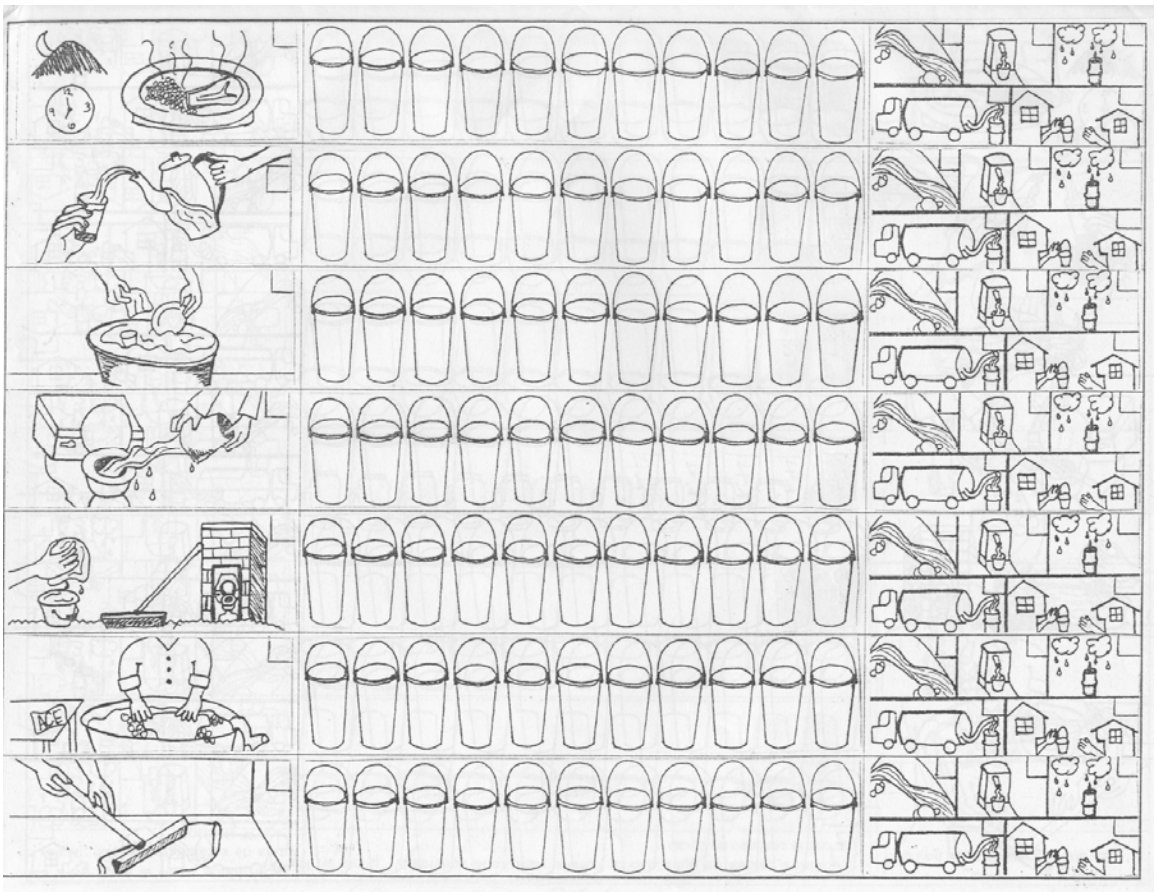

Figure 4-3. The second page of the water data collection tool. It depicts six water-use tasks (making dinner, making beverages, dishwashing, toilet flushing, bathroom cleaning, washing laundry, and mopping), water containers, and five water sources. We asked respondents to color in the correct number of buckets and draw an "X" over the correct water source. Artwork by Ashley Yoder, 2004.

of paper. This two-page chart became the basic format we used to collect the data for two water measures, a self-administered direct measure and a task-based estimate of water use.

The first measure, the self-administered direct measure of daily water use, was collected for each household on one randomly-assigned day in each of the first four interview cycles. One day before the measurement was to take place, we went to participants' houses, gave them a ten-liter bucket, and asked them to measure and record all of the water they consumed for the thirteen tasks. We showed them the chart, and

explained that they should record the amount of water their families used and where the water came from by coloring in the appropriate drawings on each of thirteen tasks. We scheduled the household's interview for the day following the water measurements. During the interview, we reviewed participants' water charts, verifying that all responses were correctly recorded.

The second measure, the task-based estimation of weekly water use, was collected directly after we verified data for the self-administered measure. Once people's memories of water use had been jogged, we asked them how often and with what quantities of water each member of their household performed each of the thirteen water tasks on the list in the last week. Household heads gave very thorough descriptions of household water use on each of the thirteen tasks. Giving a typical answer, one woman reported that, in her seven-person household, four people bathe one time a week with 10 liters of water, and three people bathe two times a week with 10 liters of water. In each interview, we probed until participants reported their household water use on each task with this level of detail.

After recording the task-based estimation, we collected data on a third measure, the overall estimate. Because most household heads consider water quite expensive and difficult to acquire, I hoped that they would be able to recall how many times they had acquired it over the last week. Also, since water containers are visible, I thought that household heads would monitor provision levels much in the same way that I watch the gauge on my truck's gas tank dropping each day. To get the overall estimate, we asked the question "how much water do you believe your household consumed in the last week?" directly, without the use of additional prompts or probes.

In addition to the water use measures, we also collected data on the experience of water scarcity. Based on data from participant-observation and interviews, I created a list of 33 questions about the experience of water scarcity. The English and Spanish versions of these questionnaires are presented in the chapter on water scarcity. For each question, we asked if the household head had the water-related experience in the last week, or not. We asked household heads the same 33 questions over four interview cycles. These data form the basis for the water experience scale, which I discuss in greater depth in the chapter on water scarcity.

Because we could not directly measure the amount of water coming into households, I devised four different measures of household water provision and scarcity (self-administered direct measure of daily water use, task-based estimate of weekly water use, overall estimate of weekly water use, and 33 questions about the experience of water scarcity). Data on water storage space and access for each household were also collected. These six measures were all created from participant-observation data, and were adapted to the specific needs and circumstances in Villa Israel. In the chapter on urban water scarcity, I will discuss each of these measures in greater detail.

Direct Observation

In my original design for this research, I argued that observation data should be collected to test the quality of recall-based interview data. For each interviewing cycle, three hours of observations were to be done in every participating household. The observations would have yielded reliable data that could be compared with recall-based interview responses about water use, social interactions, and economic exchanges. During the informed consent period, however, it became clear that most participants

would not tolerate household observations, and those who did would modify their behaviors so extensively that the data would be useless.

Instead of household observations, I decided to do direct observations of social interactions in public places. While these observations would not bear directly on the interview data, they would provide complementary information about social interactions and economic exchanges. Moreover, the observations could be conducted unobtrusively, so we could record observations with a reasonable degree of confidence in the authenticity of observed person's behavior (cf. Altman 1974, for a thorough discussion of validity and reliability in direct observation).

Observations were carried out in four 42-day cycles over 8 months. This schedule worked in tandem with the two-month interviewing cycles; for each 60 days of interviewing, we did 42 days of observations. Once we had the sampling frame of 60 public places (intersections and endpoints), we used a random number table to select 42 sets of 12 public places. For each of the four observation cycles, we repeated the same sets of 12 observations over the 42-day period.

Each of the 42 interviewing days was assigned a randomly selected time drawn from 12 daylight hours (between from 7 am and 7 pm). Observations of the 12 randomly-selected public places, then, took place during a randomly-selected hour-long block (e.g., from 7 am to 8 am). All 12 observation points had to be observed within a 60 minute time span during the assigned observation hour.

Three interviewers and the part-time observer were trained to conduct observations following a standardized method. Each observer carried a large green notebook that contained grids for entering observations, locations of intersections and endpoints, the

randomized observation schedule, and a list of 40 activity codes (drawn from participant-observations). The observer was to walk to the points he or she was assigned in a circular direction, starting from the place where my rented room was located. If the observers were questioned by a curious onlooker as to what they were doing, they were instructed to say that they were “making appointments for the interviews”—an activity that required a notebook and was often combined with observations.

When observers arrived at an observation point, they were instructed to look in all directions to a half-block distance, or to half a river-bed, or to half a field; they were not allowed to record everything that occurred within their field of vision. Because each observation point only extended halfway to the next point, no two observation points overlapped or shared the same public space. Observers proceeded to the center of an observation point, turned 360 degrees to look at everything within view, observed for up to 5 seconds, and continued walking. When there was a large crowd at an observation point, observers were allowed to sit down nearby to record, but the initial observation should only have lasted 5 seconds. The 5 second rule was instituted to make sure that observers recorded interactions and activities that occurred over a standard snapshot of time.

In spite of my efforts to make observation procedures uniform, there were some problems. It was very difficult for observers to record all the activities that went on in groups of six or more people. Additionally, there was some variation in the amount of detail that different observers recorded; some observers always recorded more activities than others. Finally, there was also some variation in our comprehension of the behaviors we observed. For instance, I was less skilled than Bolivian observers at correctly

identifying different activities. Because of this variation in activity coding, I have decided not to use the activity variable in this analysis.

Over four cycles, from June 2004 to January 2005, we conducted 1,986 observations of randomly-selected public places during randomly selected daylight hours in Villa Israel. The same observations were repeated in each cycle, and so there were 496 observations repeated four times over an eight-month time period. Data were collected on nine variables, and will be analyzed in the chapter on social interactions and economic relations.

Summary of Field Methods

The data collection for this project began in January 2004 with a five-month period of participant-observation. In March, I trained a field research team, mapped Villa Israel, and drew random samples of occupied constructions and public places. In April, the research team began conducting interviews with 102 participating household heads. The interviews produced repeated measures of social interactions, economic exchanges, and water use, and were conducted over five two-month cycles. In June, we began conducting observations of 60 public places in Villa Israel. The observations produced data about social interactions in Villa Israel, and were conducted over four 42-day cycles of randomized observations. The data were immediately coded for statistical analyses; those analyses will be presented in the three chapters that follow.

Contextualizing the Research Design: Rethinking Community and Cooperation

As I planned the research design, I put a great deal of work into creating sampling frames, interviewing protocols, observation schedules, coding schemes, and other elements needed to conduct the research in a standardized and reproducible way. Soon

after I began the research project, I realized that I had not put enough work into adapting the research design to local traditions that emphasize community and cooperation. With the help of my research team, I adopted new approaches to community relations and collaborative research that, ultimately, improved the project's data collection and quality.

The relationship between the research team and community members was quite bumpy at the beginning of the research project. While some community members did welcome us, many more were ambivalent, frightened, or hostile to the prospect of participating an American-run research project. Many Bolivians believe that American involvement in Bolivian domestic politics has been to blame for some of the most serious economic and political crises in recent Bolivian history. In recent years, Bolivians living in the Chapare-growing coca region have said that Americans in military uniforms burned their crops, homes, and possessions, leaving them destitute. Understandably, then, some feared that the fieldwork was part of an American intelligence project and would lead to some new calamity for the community.

As we discussed potential solutions to this problem, Wilda argued vigorously that we needed to do more to involve the community in the research. To start, we held a large meeting for study participants after the first round of interviews. In June, we delivered personal invitations to household heads, organized snacks and skits, and planned a raffle for those who attended. The first meeting was a huge success: the schoolroom was packed, participants were relieved to see friends and neighbors seated nearby, and people had the opportunity to ask questions about the interview process. After the first meeting, we found that participants were more open in interviews. During the course of the year,

we held more meetings for Villa Israel residents—and found community members were generally very happy to participate.

I quickly learned that inclusiveness was just as important to the research team as it was to study participants. At the team's insistence, I modified the interviewing protocol to include team-based interviewing. We implemented weekly meetings, in which we discussed problems that arose in the data collection process. We also created "coding retreats" in the seventh week of each interview cycle, in which we took a week-long break from Villa Israel to double-check our coding. The team interviewing, weekly meetings, and coding retreats all helped improve the quality of the data we collected.

As I mentioned in the section on the research team, having a well-trained and unified team proved invaluable to me during this project. Team members were dedicated to the project, and suggested important and appropriate modifications to the original research design. One of the most important sets of modifications they recommended was the inclusion of cooperative and community-oriented elements in the research. Because these elements had not been included in projects I had worked on in other ethnographic contexts, I had not anticipated the need for them in Cochabamba. In the future, I will be sure to think more carefully about local community and work traditions as I develop new research designs.

CHAPTER 5
THE POLITICAL ECOLOGY OF URBAN WATER SCARCITY

Introduction

Urban water scarcity is a rather new topic in social science research, and few, if any, published articles have attempted to define or operationalize the concept. While water scarcity has been studied extensively in rural contexts, urban water scarcity emerges out of distinct infrastructural, political, and economic systems. Theoretical frameworks, like those posited by Sen and Homer-Dixon, help us understand how complex social-ecological systems produce inequities in water distribution. However, we must go further to develop a science of urban water scarcity. In this chapter, I present an analytic framework for defining and operationalizing the urban water scarcity concept.

The chapter proceeds in three broad sections, and uses data from Cochabamba to illustrate how the analytic framework should be applied. In the first section, I analyze the political ecology of urban water scarcity in the Cochabamba Valley. Because social-ecological systems underlie all human water distribution, an analysis of urban water scarcity should begin with a thorough discussion of water resources in the region under study. Following recent case studies of urban water scarcity (Ennis-McMillan 2006, Swyngedouw 2004), I will also discuss how political and economic power shape the distribution of water in Cochabamba. In the second section, I describe water provision in Villa Israel, including the water resources, provision, and storage in the community. In the third section, I present three approaches to defining and operationalizing urban water scarcity. Using data collected in Villa Israel, I examine urban water scarcity with

measures of water provision, water security, and experience. Together, these three sections combine to create a detailed ethnographic picture of urban water scarcity in Cochabamba in general and Villa Israel in particular.

Section 1—Political Ecology of Urban Water Provision and Scarcity in Cochabamba

In this first section, I examine the political ecology of water provision and scarcity in the Cochabamba Valley. First, I discuss hydrology and water resources in the area, including groundwater resources, surface water resources, and rainfall. Next, I examine the social structures that shape water distribution, such as Cochabamba's municipal water service, urban residential segregation, and water provision systems. Although not all of the data that would ideally be used for this kind of study were available, I was able to piece together an extensive analysis of natural, economic, political, social, and cultural aspects of water provision and scarcity in Cochabamba.

Introduction to Cochabamba's Water Situation

The Valley of Cochabamba has an area of about 100 km2, and contains a number of alluvial fans, a spring zone, confined aquifers, two rivers, a lake, and a playa zone. Despite its rich water resources, industrial and domestic pollution have seriously degraded the surface water resources, and over-abstraction and pollution now threaten the aquifer system. Since local water reserves alone cannot support the valley's population, the municipality now brings in water from outside sources to support 62 percent of the city's population. However, 38 percent of the city's poorest residents are not connected to the municipal system (SEMAPA in Terhorst 2003). Unconnected residents use a combination of relatively unreliable services—such as rainwater collection, private water vendors, and community water systems—to get the water they need to survive.

Hydrology of the Cochabamba Valley

The Cochabamba Valley is located on the eastern slopes of the Andes. The valley has an average elevation of 2540 meters, and ranges from a depth of 100 meters in the northern valley to 800 meters along the northern escarpment (UN-GEOBOL in Stimson et al. 1996). The Cordillera Tunari rises to the north of the city of Cochabamba, and forested Tunari National Park slopes down the mountain side. Beyond the foot of the mountains, at the north side of the valley, wealthy Cochabamba neighborhoods, dotted with parks and swimming pools, flourish in the water-rich environment. Running through central and south Cochabamba, the valley has three major surface water bodies: the Rocha River, the Tamborada River, and the Laguna Alay. The Rocha River bisects the city of Cochabamba, which was originally settled on the Rocha's northern banks but has grown to occupy both sides equally (Ledo 2002). To the southeast of the Rocha River is Lake Alay, which is surrounded by a series of flood-prone plains. To the south of the Rocha river is the Tamborada River. Cochabamba's squatter settlements are located in the regions to the southeast of Lake Alay and to the south of the Tamborada River.

Like many semiarid intermontane basins, the Cochabamba Valley is the site of a large alluvial fan aquifer system. Such systems are formed when the gradient of a stream suddenly levels off, as at the foot of a mountain, and fluvial and debris flow sediments are deposited (National Research Council 1996). Over time, these fluvial deposits accumulate into a cone of sedimentary material, called an alluvial fan (Lutgens and Tarbuck 1998). From the top of a fan (apex) to the bottom (base), a series of streams flow away in radial or interbraided channel beds. Water runoff usually deposits the largest debris near the apex of the alluvial fan, and carries smaller sediments away toward the

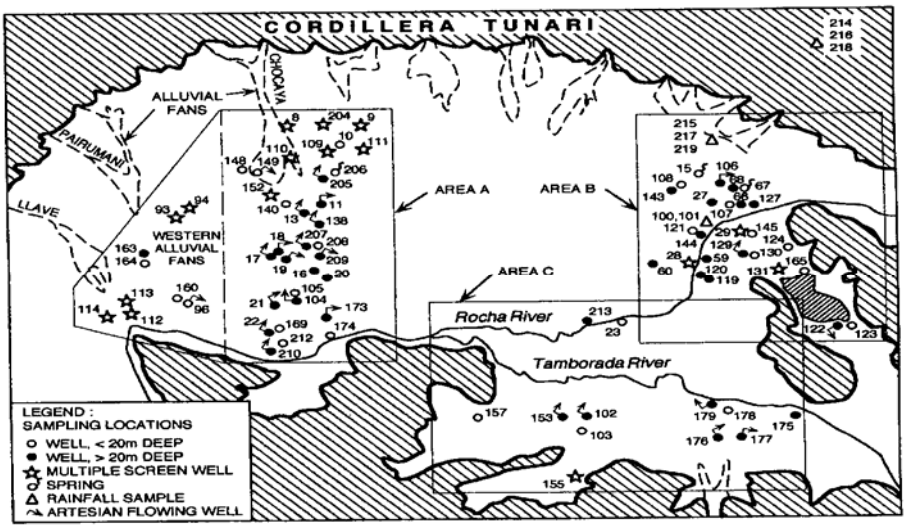

Figure 5-1. Map of the Cochabamba Valley (from Stimson et al. 2001, p. 1100). Alluvial fans and groundwater wells are concentrated in the northern edge of the Cochabamba Valley. The Rocha River bisects the city of Cochabamba. Area C delineates the southern half of the city of Cochabamba.

base. As a result, hydraulic conductivity tends to be highest at the apex of the fan and along channels where deposits are largest. Hydraulic conductivity declines toward the base of the fan, and away from entrenched channels (Stimson et al. 2001). Often, runoff drains from mountainsides in a number of streams, each forming its own alluvial fan. As the fans receive more sedimentary deposits, they grow, eventually connecting into one large system of alluvial fans that abuts the mountainside. Such a landform is called a bajada. When the streams are flooded by major downpours, excess water flows down over the bajada in sheets and collects in temporary lakes called playas.

The Cochabamba Valley was formed during the Pliocene era, and has since been covered with fluvial and alluvial deposits of detritus and lacustrine clay deposits. These deposits produced a valley floor layered with lenses of clay, silt, sand, and gravel (Stimson et al. 1996). To the northwest of the Cochabamba Valley, a large bajada is located along the edge of the Cordillera Tunari mountain range. The three major alluvial

fans found in the bajada system are the Chocaya, Llave, and Pairumani. These three alluvial fans are located on the remote northwestern side of the valley, far from urban settlements and the city itself (see alluvial fans in Figure 5-1).

The principal recharge areas of the alluvial fans are located at their apexes, in a four to five kilometer-wide area at the northwest of the valley. The most permeable portions of the bajada are located at the apex and along the main axes of the alluvial fans. At the apex and central axis of the fans, groundwater flows more quickly than in other areas of the valley. In the central axis of the Chocaya fan, for instance, groundwater velocity is estimated to be between 0.3 and 0.6 m d-1. The hydraulic conductivity of the area is believed to be between 1.0 x 10-4 and 3.0 x 10-4 m s-1 (Stimson et al. 1996).

A five to ten meter-thick clay cap extends from the base of the alluvial fans, down the valley, to the Rocha River. A one kilometer-wide spring zone is located near the base of the alluvial fans, where aquifers are semi-confined In this area, the water table is approximately two to ten meters below ground surface. In and below the spring zone is an area in which artesian wells are located (Stimson et al 1996, 2001). Artesian wells are underground water sources in which water is confined and rises to surface level without the use of pumps. The zone that contains artesian wells is closest to upper class neighborhoods, providing Cochabamba's wealthiest residents with access to the richest water resources in the valley.

The Cochabamba Valley experiences pronounced seasonal variations in precipitation. In the summer, between December and March, average monthly rainfall reaches as high as 200 mm. In the winter months, between May and September, average monthly rainfall falls below 10 mm. Some data indicates that average annual rainfall in

the Cochabamba Valley is higher (470 mm) than in the south side of the valley (400 mm) (AIG 2003, Claure Periera & Asociados 2001).

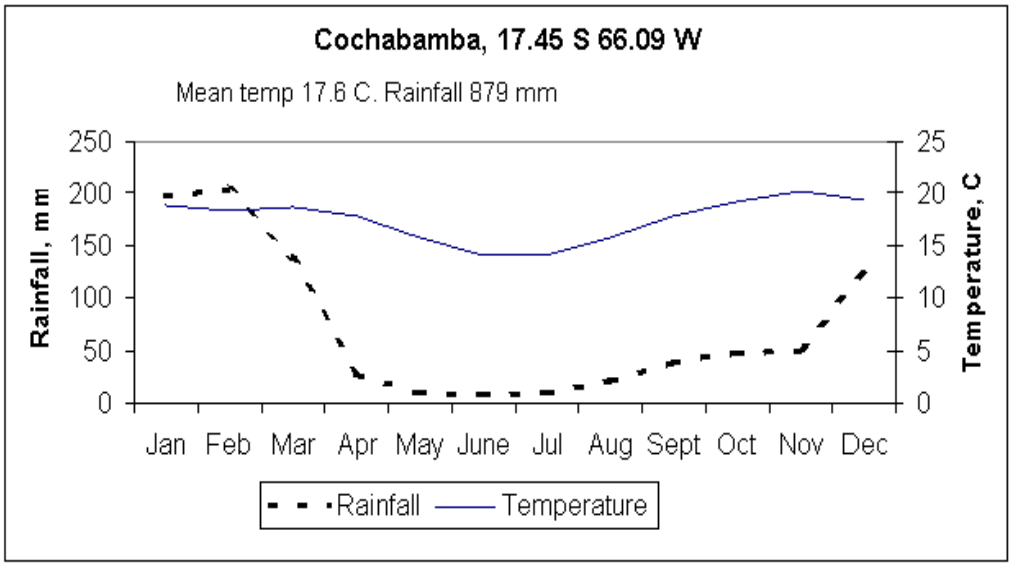

Figure 5-2. Seasonal variations in rainfall for the city of Cochabamba (from Vera undated).

There are two additional indicators of the difference in water distribution between the north side of the valley (where wealthy residents live) and south side (where poor neighborhoods and squatter settlements are located). First, the north side of the Cochabamba Valley is forested with vegetation year-round, while the south side is nearly devoid of vegetation. Second, the north side is dotted with wells, while south-side has few wells with poor output or no output. Two photos, taken just as the dry season was ending in September 2004, illustrate the stark difference between water availability in the north and south.

Since water resources in the southern zone are less studied, there is little available data on the water resources there. However, the lack of alluvial fans, wells, surface water, springs, and vegetation on the south side all indicate that it has less water (or less accessible water) than the north side of the Cochabamba Valley.

Figure 5-3. Northern Cochabamba has alluvial fans, forests, plant life, high rises, and the residences of the city's wealthiest people.

Figure 5-4. Southern Cochabamba is arid, barren, and contains the residences of the city's poorest people.

Water Resources in the Cochabamba Valley

Cochabamba's water is currently supplied by well fields located in the alluvial fan system to the northwest of the valley (see well fields in Figure 5-1, Stimson et al 2001), and by reservoirs located outside the valley. Surface water sources located outside the valley provide 40 percent of Cochabamba's water, while 30 wells provide the remaining 60 percent of the water supply (SEMAPA 2006). Well fields located in the alluvial fan system tend to be unconfined, less than thirty meters deep, and built in sand and gravel sequences. Those wells located closer to the city tend to be semi-confined, built in ground containing lacustrine clay deposits, and can be as deep as two hundred meters (Stimson et al 1996).

SEMAPA is Cochabamba's municipal water company. SEMAPA currently administers 56,148 connections to the potable water distribution system and 58,046 connections to the sewage system (SEMAPA 2006). In 2000, control briefly passed to Aguas del Tunari, a consortium led by the Bechtel Corporation. After months of protest against its sale, the water system reverted back to municipal control. Since then, SEMAPA planners have worked to improve problems in the existing water system. The SEMAPA system had three major problems in 2004: water loss, contamination, and over-abstraction.

One of the most pressing problems in the Cochabamba water distribution system is water loss; an estimated 55 percent of the volume produced is lost to leakage and theft (SEMAPA in Terhorst 2003). For instance, the total output of water produced from all sources in 1998 was 19,259,120 cubic meters (Centro de Investigación Multidisciplinario 1999). Total water loss, then, amounted to more than 10 million cubic meters in 1998 alone. Since the reversion of the Cochabamba water system to municipal control, SEMAPA has focused primarily on improving the water loss problem. One particularly successful program offered amnesty to households with illegal water connection (Terhorst 2003).

Another major problem in Cochabamba is water contamination. SEMAPA's wastewater disposal and sewage treatment services cover only 55 percent of the city's population. As a result of improper waste disposal, large septic ponds containing untreated wastewater collect in impoverished areas of the city (Ledo 2002). In addition to the sewage leaked by these ponds, septic tanks and the municipal sewage system have significant leakages. For instance, recent tests of groundwater in the southern and eastern

areas of the Cochabamba Valley show that nitrate (NO-3) concentrations have almost reached the regulatory drinking limit of 45 mg l-1 near the city (Stimson et al 2001).

Although there are clay lenses distributed throughout the floor of the Cochabamba Valley, the alluvial fan systems are not separated hydraulically from pollution sources. Because the valley aquifers are interconnected, contamination from point sources in the city threatens water quality in the entire system (Stimson et al 2001). A drought in the 1990s compounded the effects of over-abstraction, causing significant drops in the potentiometric surfaces of valley aquifers. More intensive use of groundwater resources on the Cochabamba valley floor increases the likelihood that surface contaminants will infiltrate, possibly reaching aquifers throughout the valley (Stimson et al 1996). The threat of spreading contamination adds urgency to Cochabambans' search for outside water sources.

A third problem is over-abstraction, or the unsustainable withdrawal of groundwater resources. Cochabamba's population is estimated be about one million people, and is growing quickly. Within the Cochabamba Valley, two local lakes have been drained, and groundwater levels have dropped enormously. Areas that once housed wells with a depth of only 20 meters now require wells that reach to over five times that depth (Finnegan 2002). The city's rate of growth, coupled with over-abstraction, has put enormous additional strain on a water distribution system that has never caught up to the needs of its population (Laurie and Marvin 1999).

Power, Privilege, and Water Provision in the City of Cochabamba

Beyond its hydrological and technical problems, Cochabamba's municipal water system has another serious problem—inequity. Long ago, the city of Cochabamba was located only in the central valley, while a large swath of land to the south was reserved

for agricultural development. When population was very low, people say, there was enough water in south Cochabamba to live, grow crops, and keep animals. As national economic crises pushed Bolivians into cities to find work, squatter settlements have filled in the south side of Cochabamba. Just as in squatter settlements around the world, Cochabamba land speculators buy up large pieces of land, and then divide them into low-priced residential lots (cf. Gill 2000: 55-62 for a discussion of how land speculation works in urbanizing Bolivia). Rural migrants, downwardly mobile urban families, and new residents recruited through social networks buy up the land, and then must work to legalize their claims to occupy the land.

The legalization process now takes about twenty years from settlement to authorization in Cochabamba's Districts 7, 8, 9 and 14, the southern zones where squatter settlements are located. Squatter settlements with land claims that are not yet legalized are considered "rural" by the Cochabamba Prefecture—although officials recognize that many of the communities have a high human population density, no crops, and no farm animals beyond chickens (e.g., Claure Periera & Asociados 2001). In the southern zones, even legally recognized communities and land claims, such as those in long-established communities like Villa Pagador and Valle Hermoso, do not entitle residents to all the rights of Cochabamba residency. Municipal water and sewage service, for instance, is not offered to residents of Cochabamba's south side.

SEMAPA services are currently available to 62 percent of Cochabamba's one million residents (SEMAPA in Terhorst 2003, Ledo 2002). The water system covers only the north and central parts of the city, where the wealthiest residents live. About 80 percent of Cochabamba's water supply goes to the north and central zones of the city

(Ledo in Terhorst 2003). Water provision in Cochabamba's wealthiest households runs up to 165 liters per person per day, and water costs only one percent of the household income (Ledo 2004). Water service in Cochabamba's north side typically includes multiple indoor water taps and indoor sewage. Despite the relative advantage of their water situation, residents of north and central Cochabamba are also affected by the city's water scarcity problem. Households connected to the municipal system commonly experience rationing, intermittent loss of service, and periods in which water is delivered for only a few hours a day (SEMAPA 2006). Most households cope with shortages by keeping water reserves on hand, which they replenish when the system is functioning.

Finding safe drinking water is an even greater challenge for people whose households are not connected to the municipal system. About 38 percent of residences are located in the south side of Cochabamba, where SEMAPA does not have a mandate to offer service. This area is Cochabamba's poorest—in which 93 percent of the population is considered poor by Inter-American Development Bank standards (SEMAPA in Terhorst 2003). Finding affordable water is a major burden for households on the south side. For example, Cochabamba's poorest households have as little as 20 liters per person per day, and water costs more than ten percent of the household's income (Ledo 2004). Households that lack access to the municipal water system must find alternative sources of water for daily use. These alternatives include community water systems, private water vendors, rainwater, and surface water.

Among the urban poor, community-based water systems are often considered the best alternative to municipal service. In 120 south-side neighborhoods, Water Committees are responsible for securing water access for local residents (Los Tiempos

2004). While many Water Committees have succeeded in erecting some water infrastructure, not all households can rely on water supplied by community-based systems. In my observations in south Cochabamba neighborhoods ranging from relatively new ones (like Villa Israel) to very established ones (like Valle Hermoso), I found that many local water sources provided an insufficient amount of water for daily household needs. In some systems, water sources have disappeared permanently, dry out seasonally, or lack the water needed to support growing populations. Even when community water systems have water, some household heads are unable to use them because fees are too high, they lack the political connections to gain access, or queuing up is too time-consuming. As a result, many of the poorest or most disenfranchised households have to rely on private vendors, rainwater collection, and surface water collection for water provision.

About 19 percent of Cochabamba's residents buy water from a truck operated by a private vendor (Ledo in Terhorst 2003). In 2004, private vendors charged 4 Bolivianos ($0.50 USD, 0.020 Bs/L) for one *turril*, which holds 200 liters of water. When households buy in bulk or have a long-standing relationship with a vendor, they can negotiate to buy a *turril* of water for about 3.5 Bolivianos ($0.018 Bs/L). Also, most vendors give a yapa (bonus), filling one or two additional 20 liter buckets for each *turril* purchased. Yapas can significantly drop the per-liter price of water for those who buy in bulk, to 0.015 Bolivianos per liter. Filling a 2000-liter tank of water at full price costs 40 Bolivianos, while the price is only 30 Bolivianos with a discount and yapa. Since 2000 liters normally provides about two weeks of water for a household, bulk discounts can provide a 20 Boliviano per month savings, or a 25 percent discount. It is significant that

these kinds of bulk savings are often only available to households with a large water storage capacity (2000 L tanks or larger); the poorest households pay full price to fill one or two 200-liter *turriles* at a time.

In communities where there is no municipal water service, the water vendor often provides the most convenient and reliable service. As a result, vended water is considered to be quite precious, and even a luxury for some families. Even so, people wonder and worry about the quality of water being provided to them. One rumor, which many people I spoke to believe to be true, is that water vendors fill their tanks out of the swimming pools and lakes of Cochabamba's wealthiest neighborhoods. This rumor is a powerful expression of the inequities in Cochabamba's water distribution system; many south-side residents believe that even the best water they have access to is only deemed swimming-pool quality in the north side of the city. The swimming pool rumor makes clear how deep the divide in access to wealth, economic justice, and citizenship rights is in Cochabamba.

For households that struggle to buy water from private vendors, there are alternatives. During the summer wet season, many households collect and store rainfall. However, rainwater collection requires an initial capital investment in equipment, which is prohibitively expensive for some households. For households that lack the resources to obtain water from rainwater collection, there remains only one alternative. Surface water sources, such as rivers, ponds, and canal beds can be used to collect low-quality water. People generally use this water for cleaning tasks, which offsets the cost of water provision. Minimal household water needs, when augmented with surface water, can

often be satisfied with one *turril* of vended water or rainwater a week, which is then used only for ingestion-related tasks like drinking, cooking, and dish washing.

Section 2—Water Resources, Provision, and Storage in Villa Israel

In this section, I examine the complex human-environment interactions that underlie water scarcity in Villa Israel. First, I discuss local water resources, such as groundwater and surface water. Next, I assess water provision options, including surface water collection, rainwater collection, the community water system, water delivery trucks, water loans, and water sales. Finally, I describe two types of water storage containers and purification techniques. In each subsection, I examine the natural, technological, social, political, economic, and cultural aspects of water availability in Villa Israel.

Local Water Resources

Few, if any, published studies of Villa Israel's groundwater resources have been conducted. What evidence does exist indicates that water is not plentiful. In 2001, the engineering firm Claure Periera & Asociados conducted a study of Villa Israel, and found that the community's two existing wells do not provide sufficient water to meet the needs of all residents. They also concluded that subterranean rock layers in Villa Israel could not be perforated with the drilling equipment available in Bolivia at the time. Along with basic sanitation organizations UNASBVI and PROSABAR, they recommended that Villa Israel build a distribution system to import water from a source located 3995 meters to the north of the community. In March of 1999, a well was perforated to a depth of 177 meters. The maximum daily output from the well was 5.832 liters per second. The well was intended to provide 80 liters of water per person per day to Villa Israel residents (Claure Periera & Asociados 2001). Unfortunately, before the water distribution system

was built—but after the community invested somewhere between $10,000 and $29,666 USD in the project—it was revealed that the Villa Israel Neighborhood Council had not secured the appropriate access to the underground water resources in a neighboring residential zone called Ictocta, where the well was located. To date, the community investment funds have not been recovered, and no water was ever provided to Villa Israel residents from the Ictocta well.

During the wet season, Villa Israel also has three surface water sources. First, there is a large riverbed that runs along the eastern edge of the community. Although it is generally dry for about eight months of the year, from March to November, it does provide a steady trickle of water during the wet season.

A B

Figure 5-5. Villa Israel's river A) during the rainy season, in January 2005 and B) during the dry season, in June 2004.

In Villa Israel, there are also two canal systems. Because Villa Israel and its surroundings are quite barren of vegetation, flash flooding poses a serious threat to people and land. As a result, the community has built the canals to channel floodwaters in heavy rains, minimize the risk of erosion, and enable people and vehicles to move safely through the community during the wet season. The canals, however, are only full when

the entire community is inundated with water, and thus are not very useful as a household water source.

Figure 5-6. Villa Israel's runoff canals are dry year round, except during heavy rains.

Finally, there is a surface water source high up in the hills behind Villa Israel. Study participants say that the source has water year-round. They estimate that the water is over an hour's walk away. While it is not widely used by community members, some Villa Israel residents do walk that far to find clean water for bathing and clothes washing.

Water Provision in Villa Israel

In this section, I discuss each of Villa Israel residents' water provision options in turn. Those options include surface water collection, rainwater collection, the community water system, water delivery trucks, water loans, and water sales. For each water provision option, I analyze the quantity, quality, and cost of water available, as well as the social, political, and cultural issues that affect access to water sources. The analyses are supported by data collected from participant-observation, key informants, and five cycles (10 months) of in-depth interviews with a household heads from 76 randomly-sampled residential constructions.

Surface Water Collection

The only surface water source that is widely used by Villa Israel residents is the river. As I mentioned above, the river provides only a small amount of water. During the wet season, the river's width is normally between 30.5 and 91.5 cm and its depth is between about 2.5 and 15 cm.

Figure 5-7. The Villa Israel river during the wet season.

While people in Villa Israel avoid ingesting the river water, they do rely on it for some household cleaning activities. Households located near the river collect buckets of water, and bring them home to wash floors and water plants. Some people bring bathing mats and shampoo, and bathe their entire families in the river water.

Figure 5-8. People in Villa Israel rely on river water for bathing. Note the bath liner, shampoo, and clothing.

Women also congregate in groups to chat and wash laundry when there is enough water. Even when there is no visible water, a few industrious women dig out small hollows, which fill with water and can be used for washing.

Figure 5-9. The riverbed is a center for social interactions where women wash and chat.

Villa Israel residents that grew up in the countryside see the river as a social spot, and enjoy washing and visiting there. Parents also allow their children to splash and play in the river.

Figure 5-10. Children splash and play in the river during the wet season.

People also compete for the best locations in the water-scarce river. When one family's laundry is being washed upriver, it visibly pollutes the water for those washing below. As a result, arguments sometimes break out between the washing groups that dot the river. Some women wake up early to go to the river alone and wash in the fresh morning flow, before it is contaminated by mid-morning washers.

While visible pollution causes conflicts among river-users, invisible pollution of the river is a much bigger health problem. In Villa Israel, there is no community sanitation system, nor are there minimal standards for wastewater disposal. As a result, wastewater is disposed of in the street, in septic tanks, or in unsealed dumping holes.

Figure 5-11. Wastewater is disposed of in unsealed dumping holes. Here, the hole is located inside a housing compound.

Many households lack bathrooms, and people use uninhabited areas such as fields and the bluffs above the riverbeds as makeshift toilets. Consequently, Villa Israel is filled with point contamination sites. During the wet season, rains wash away feces and other wastes directly into the riverbed.

Figure 5-12. The open area between these two bushes is used as an outdoor toilet by many Villa Israel residents. Wastes drain directly into the riverbed below.

Contaminated water then collects in river and canal beds. Although people do not use surface water for drinking or cooking, accidental ingestion almost certainly occurs as they wash and play in the river. Further, the contaminated water, when used to clean, spreads bacteria into the household via clothing, cleaning items, and direct contact. While I have no data on surface water quality, this problem likely contributed to the 24 incidents of water-related illnesses reported by the 76 Villa Israel household heads during the study period.

Rainwater Collection

In Villa Israel, households collect rainwater during the wet season with rooftop rainwater collection equipment. Such equipment consists of slanted roofs made of impermeable materials like tile, gutters affixed to the roofs, and a pipe or tube that extends from the roof gutters to a *turril* or water tank underground.

Figure 5-13. Rooftop rainwater collection equipment includes a drain from roof gutters, a *turril*, and a pipe that extends to a water tank underground.

The quantity and quality of water collected from rooftop collection systems varies enormously, and depends on the size of the roof, the maintenance of gutters and pipes, and the cleanliness of roofs and *turriles*. When roofs are left dirty, rainwater collection

yields filthy brown water that barely serves to clean patios. When the entire system is carefully maintained, however, large amounts of high-quality water can be collected.

In a major downpour, households can easily amass 200 liters of rainwater, which lasts between one and three days for a normal family. During the wet season, arguments erupt when household members forget to maintain rainwater collection equipment, and large quantities of rainwater are lost. If a household has vigilant residents and the necessary storage capacity, it is possible to fill a 10,000 liter storage tank over the course of the wet season. One woman managed to sustain her family using the rainwater supply in her 10,000 liter tank until late August. This woman, however, was the same one who walked hours to wash her family's laundry in the year-round surface water source, and was unusually conscientious about water conservation.

Several other households were able to make their rainwater supplies last into the first months of the dry season (through mid-June) or began using rainwater just as the wet season began (in November). Households that engage in frugal rainwater use tend to be downwardly mobile. They are families that have constructed large water storage tanks, but can no longer afford to fill the tanks with commercially-purchased water. Poorer households (that have small water storage areas) and wealthier ones (that can afford to fill their tanks with commercial water) generally only collect and use rainwater in the wet season months of December, January, and February.

Community Water System: Tap Stands

Residents of Villa Israel worked hard to build a community water system that draws water from the community's two small hillside wells. The water quality is high compared to other sources in Villa Israel, although it does contain visible silt deposits. The water system currently delivers water to about ten tap stands around the community.

Tap stands are small brick columns built around a water pipe that, when unlocked, produces a thin stream of water. A tap stand normally serves ten to twenty households in an area. Each tap stand is funded and constructed by the beneficiaries themselves. Because of the cost, many community zones have not erected tap stands. Some have chosen not to do so at all, while others are still working to organize the necessary funds and labor. In 2004, one new tap stand was built, and another was under construction but remains unfinished.

Figure 5-14. Tap stands are small brick columns built around a water pipe.

Local beneficiaries are also responsible for the maintenance of the tap stands. However, community members do little to maintain water systems and taps stands once they are installed, probably because they lack expertise, time, and money. At least one tap stand has been abandoned for years, as water flow is blocked. Beneficiaries have not organized to repair it, and have no plans to do so. Even functioning tap stands have some problems. Water leakage is high, and pools of water form on the ground above the underground pipes that carry water from the wells to the tap stands. Water output is also quite low, only allowing for a 20 to 40 liter allotment per household per day.

Water is distributed once a day, between 4:30 am and 9:00 am, from Monday to Saturday. One community member, an aged man, is responsible for water distribution. He gets up at 4:00 am, and opens the main pump from the wells. Then he begins his rounds, visiting each tap stand in turn. He randomizes the sequence of his tap stand visits, so that no one has to get up early or be late for work every day. Before opening the tap stand, he blows his whistle loudly to alert the zone that the tap stand is about to be opened. As people stumble sleepily out of houses with one or two large buckets in hand, he unlocks the tap stand. People then line up, waiting up to 20 minutes for their turn. The tap stands are one place in Villa Israel where social interactions are quite rich—people argue, gossip, and help each other out regularly.

Conflicts at the tap stand usually develop around one issue—access. Because home owners build and maintain the pumps, only they are eligible to use the tap stands. Each month, home owners must pay 10 Bs (between 0.016 and 0.008 Bs per liter) to gain access to the tap stands. While everyone knows the rules, not everyone agrees with them. Some homeowners who originally helped construct their zone's tap stand no longer have the time or money to collect water each day. Even so, they feel that they have the right to water, and occasionally ask that the water distributor give them 10 or 20 liters of water to make ends meet. Other people, who have paid the monthly fees, ask to be given more than 40 liters of water. In 2004, there was one man who repeatedly snuck to his tap stand when it was not supervised, opened it, and took water. Outright water theft, however, is quite rare at the tap stands. Problems generally arise when one community member tries to convince others to bend the rules.

At each tap stand, the water distributor and local beneficiaries enforce the access rules at their own discretion. At some pumps, people do make exceptions for longtime residents and renters. For instance, several of the beneficiaries of one tap stand worship at a nearby evangelical church. One day, a fellow congregant (who happens to be a renter) asked to be granted access to the tap stand. Over the protests of non-evangelical home owners, the woman was given permanent access to the water source. This situation, however, is atypical. Only a few needy renters belong to powerful coalitions in the community. More often, the most vulnerable people in Villa Israel—renters, working single mothers, and child-headed households—lack the status, time, and money to gain access to the tap stand system.

In 2004, only 30 percent of households used the community water system even once. There are several reasons why people do not use the tap stands. First, only 53 percent of residents are homeowners, and are officially eligible to use the water system. Even so, some of these eligible homeowners do not live in zones that are served by working tap stands. Of those who do have access, many say that they do not want to get involved with the politics that play out at the water pumps. Other households do not have any members that can wait four hours each day for the water distributor to arrive, or that can carry the heavy water buckets home. A few household heads prefer not to drink "dirty water" that contains visible silt deposits. Finally, even though the tap stand is cheaper (per liter) than vended water, some households simply do not have a 10 Bs lump sum to invest in water at the start of the month.

Aguateros, or Water Delivery Trucks

Water delivery trucks, or aguateros as they are called in Cochabamba, are by far the most common source of water in Villa Israel. The trucks carry enormous cisterns behind

them and, when full, hold 10,000 liters of water. During the course of the study, 100 percent of Villa Israel households reported buying water from an aguatero. Each day, between one and four aguateros make the rounds in Villa Israel. The drivers do not follow set routes, and tend instead to circulate in Villa Israel's main streets. Each truck is operated by two men; one man drives, and the other controls a large water hose on the back of the cistern. Only one of the aguateros lives in Villa Israel; the others come from outside to sell water. Because their water source is not located in Villa Israel, all aguateros must return to the north side of Cochabamba to refill their cisterns with water.

Figure 5-15. Water delivery trucks, or *aguateros*, are the most common source of water in Villa Israel. Note the *aguatero* passing through the entrance to Villa Israel.

Aguateros are independent entrepreneurs, and work to earn a profit. As a result, they prefer clients that can buy large quantities of water in one transaction. The largest storage tanks in Villa Israel hold 10,000 liters of water, and an aguatero can sell his water out in one transaction if he lands such an account. As a result, aguateros often give out their cellular phone numbers to owners of large water tanks. One woman who had a 10,000 liter storage capacity said that she called the aguatero whenever she needed to fill up her tank, made an appointment, and was even allowed to buy on credit.

When they cannot sell all of their water in one transaction, aguateros creep down Villa Israel's main roads—the ones with the most houses and best driving conditions. By

sticking to main roads, aguateros can sell water to more houses without running the risk of damaging the truck on poorly-maintained roads with potholes, mud, and large rocks. People who live on main roads said that getting the water they need was much easier than did people who live far away. For instance, a restaurant-owner who lived directly on the main street said that she never had trouble getting water, since the aguatero passed her house every day—even though she rarely bought more than a few hundred liters of water at a time.

People with little water storage capacity (200-400 liters) and remote homes have a hard time convincing aguateros to sell them water. Since there is no scheduled route, people in need of water must wait at home until they hear the beeping horn of the aguatero in the community. Once they hear the horn, they dash out into the street looking for the water truck. It is common to see three or four people running through the community when the aguatero is out, trying to anticipate which street he will turn down and how they can find him. Over four interview cycles (from June 2005 to January 2005), 52 percent of household heads said that they had run through the streets in search of the aguatero during the last week. People can run for up to 20 minutes just to find the aguatero. Once they reach the truck, they must still convince the aguatero to come to their homes and sell them water. When people have little money to spend or little storage space to fill, the aguateros sometimes refuse outright to make the sale.

Since aguateros have no formal obligation to supply community members with water, the poor have little recourse for getting the water they need. Those who have trouble securing service from the aguatero become angry, worried, or desperate to find water. I often heard people leveling the same criticism at aguateros, “they are so *creido*”.

It is interesting that people nearly always chose the word *creido* (arrogant, self-important) to describe aguateros, rather than *egoista* (selfish, self-interested) or *flojo* (lazy). On face, it would appear that aguateros' refusal to work hard to distribute water has much more to do with self-interest or perhaps laziness than arrogance. However, from the perspective of Villa Israel's poor, the aguatero's offense is not simply the refusal of a service—it is the power dynamic created by the refusal that really angers people. Once this power dynamic is established by the aguatero's refusal to sell water, Villa Israel residents only have one option—*rogar*.

In highland Bolivia, *rogar* is an important social tactic, used to cajole, guilt, or persuade people in just about any social situation. *Rogar* literally means to beg, but is actually a begging performance, in which a person uses a whining tone, self-effacing statements, and guilt-inducing arguments to get something done. By begging, one person shows submission to another, and shows that he or she relies only on the goodwill of the other to achieve an important goal. The language used in begging establishes a clear power dynamic between two people, even if just for the moment that the favor is being requested. Villa Israel residents who cannot induce aguateros to sell water in any other way use *rogar* as a last recourse. Over four interview cycles (from June 2005 to January 2005), 47 percent of household heads said that they had to beg the aguatero to sell them water in the last week. The tactic, while quite effective, forces people to lay bare the power relationship between vendors and clients. While people understand the need for aguateros to make a profit, they resent the humiliation involved in having to beg to buy water. For this reason, many Villa Israel residents see aguateros as *creidos*, rather than people understandably motivated by value-neutral economic incentives.

Despite the annoyances, cost, and humiliation involved in buying from the aguatero, it is clearly the most common way to get water in Villa Israel. There are two main reasons why this is the case. First, more water volume is distributed in Villa Israel via aguateros than any other source. Since it is nearly impossible to acquire more than 40 liters of water from the other sources year-round, people must rely on aguateros to buy water for cooking, hygiene, and house cleaning. Second, Villa Israel residents work hard to avoid social entanglements—whether cooperative or conflictive—in the community at large. Becoming reliant on communal water sources, such as the tap stand system and surface water, obligates people to involve themselves in social interactions, cooperative exchanges, and community politics. In contrast, the aguatero provides a market transaction that is relatively removed from the politics of daily life in Villa Israel. Clients do not have to cooperate, negotiate, or interact with neighbors in any way to acquire water from the aguatero. As I explain below, the ability to get water while avoiding social obligations and interactions is an important consideration for many Villa Israel residents.

Water Loans, Gifts, and Charity

When people run out of water and money, some ask nearby family members or neighbors for help. Asking for water is delicate business, and people try to avoid doing it whenever possible. Over four interview cycles (from June 2005 to January 2005), 14 percent of respondents reported receiving water from someone else in the last week, and an average of 23 percent reported giving water to someone else in the last week. The fact that 86 percent of household heads said that they did not borrow water and 77 percent did not lend water shows just how strong the aversion to water exchanges is in Villa Israel. When asked why they did not participate in water exchanges, household heads said that they wanted to avoid conflicts, that neighbors do not return borrowed water, or that they

"just don't like lending and borrowing". Another factor may be that lenders rarely give more than 10 or 20 liters of water; water borrowing only provides a short-term solution to household water problems.

The act of giving water is generally called *prestar* (to lend or loan) in Villa Israel. When people make water loans to a neighbor, they hope that she will return the water as soon as her household supply is replenished. That the ideal water loan has a quick turnaround and would be repaid in kind demonstrates clearly that most households do not maintain reciprocal relationships with their neighbors. An ideal-type exchange occurred in November 2004 when one woman, the head of a large and economically-stable household, borrowed a bucket of water from her neighbor across the street. Later that day, the woman filled up her own tank and returned the borrowed water. Her prompt return of the water enabled her to avoid the establishment of a long-standing social obligation to the neighbor.

Some families do engage in reciprocal water exchanges without the expectation that water will be repaid immediately. For instance, two impoverished households are located at the northwestern edge of Villa Israel, far from the main street where the aguatero passes. When one of the heads of household is urgently in need of water, she always visits the other to ask for a water loan. Often, however, the other woman is in equally dire circumstances and cannot afford to help her neighbor. If she does have water to spare, she gives it. Immediate repayment is not usually an option for these women, but they are able to maintain their exchange relationship despite frequent rejections and delayed repayments. Out of necessity—not choice—these neighbors maintain a trust-based water exchange relationship.

Water exchanges can also be part of a larger generalized reciprocal exchange relationship. That is, one household may loan water to another, and later be repaid when the borrower looks after the loaner's house or children, brings them a gift of fruit, or does them some other small favor. People in long-standing exchange relationships say that they "loan" each other water; they also use the terms *regalar* (to gift) or *ayudar* (to help) to describe the exchanges. Such exchanges tend to exist between family members who live close by. For instance, one young couple lives next door to the wife's parents. The couple has a water storage capacity of only 400 liters, while the parents have a tank that holds 10,000 liters. The parents offer the couple unrestricted access to their water tank; in return, the wife helps her mother run her small restaurant.

Complex exchange relationships can also develop between Villa Israel residents who are economically entangled though employment or rental agreements. For instance, people who own home-based businesses like bakeries or leatherworking shops give their employees free access to household water resources. Employees drink, cook, and even shower in the workplace. The employees are not charged for the use of water, nor is it considered part of their income. Instead, employers consider the water to be a gift. Similarly, generalized reciprocal exchanges develop between landlords and renters in Villa Israel. Since renters tend to live within a family's housing compound, along with the landlord's family, there are many opportunities for the exchange of goods, loans, and favors. Landlords frequently offer renters some or complete access to household water resources. In return, renters keep an eye on the house and children, help out around the house, or loan food and other goods to the landlord.

Thus far, I have described water exchanges that work—between people who create relationships with clear expectations and consistent behaviors. However, when people engage in water exchanges that disappoint expectations, all kinds of tensions and conflicts can develop. Because most people will not ask for water unless they are truly desperate, there is a strong prohibition against refusing water to a neighbor. As a result, many people go to great lengths to avoid being asked for water. Some people do not talk to their neighbors at all, while others ignore the door when they hear knocking.

Those who cannot avoid their neighbors become reluctantly involved in water exchanges. One impoverished elderly woman owns a tiny corner store. Because she must attend her store, she feels forced to loan water when people come in search of a loan. Another evangelical family has become a water patron to a needy neighbor. Because their church encourages charity, the evangelicals grudgingly "loan" water to the neighbor several times a week—even though they know that such loans will never be repaid. Among family members, too, resentments can develop around water loans. One woman lives with her husband, children, and the husband's aunt. The aunt, who is supposed to maintain a separate household economy, takes water from the family's tank without asking permission or repaying the loan. As a result, a nasty three-way dispute arose between the woman, her husband, and the aunt—and remains unresolved.

If people who feel obligated to give water become resentful, those who are refused water take much greater offense. In three separate families, parents abandoned their children in Villa Israel. The eldest children, ranging in age from 16 to 11, were left to fend for their younger siblings. Desperate to make ends meet, the child household heads ran out of money and water every few weeks. Eventually, neighbors began to refuse their

requests for water loans, saying they had nothing left to give. In two of the cases, the families got into bitter arguments over the refused water loans.

No adult household head admitted to being refused a water loan. This is probably because most household heads would not ask for a water loan from a neighbor that they believe would refuse them. Several people did say they avoided asking around for water loans to prevent conflicts. Rather than ask for a water loan from someone that might refuse them, household heads said they prefer to go without water, ask for a favor from the tap stand distributor, or buy water from a business or neighbor.

Buying Water from Businesses and Neighbors

When household heads wish to avoid giving and receiving water loans, some rely on monetized water exchanges instead. Over four interview cycles (from June 2005 to January 2005), 6 percent of the 76 household heads reported that they had bought water from someone in the community in the last week. Over the same study period, 2 percent of household heads reported selling water to someone else in Villa Israel in the last week. There were probably more buyers and sellers because there are several local businesses that sell water to multiple clients.

In Villa Israel, I knew of five businesses that sold water: a public shower, three corner stores, and a restaurant. Although I saw a sign advertising the public shower, I was never able to locate it. Only one family ever said that they used Villa Israel's public shower during the entire course of the study.

More common was the purchase of water from a corner store. One popular corner store, located near the entrance of Villa Israel on the main street, sold 10 L of water for 0.50 Bs (0.050 Bs/L). While the store-bought water was much more expensive than water purchased from any other local source, people did seem to accept that this was the going

market rate. I only heard one accusation of price-gouging in Villa Israel. A woman went to her corner store to buy a bucket of water, and found the store closed. She approached the proprietress of a nearby restaurant, and asked her to sell 10 liters of water. The proprietress offered to sell the water for 1.00 Bs (0.100 Bs/L), and the woman became incensed. She could not believe that someone had the nerve to sell 10 liters of water at double the retail rate. Although she bought the water that day—her family had not bathed or eaten cooked food in 24 hours—she swore never to patronize the restaurant again.

Figure 5-16. People buy water from businesses like public baths, corner stores, and restaurants. Here, a stand sells fruit juices and perhaps water from the *turril* in the background.

People also reported buying and selling water with neighbors. There did not appear to be any one situation in which buying and selling water was appropriate. In some cases, people said they bought water because they did not know anyone with water to lend. In other cases, people offered money to neighbors who extended a “gift” of water. In both cases, it appears that household heads volunteered money to avoid conflicts (that could arise out of a neighbor’s refusal to lend water) or to avoid social obligations (that come with accepting a true gift). The child-headed households, too, had considerably more

water purchases than other households. Interestingly, no one said that they resented having to buy water from stores or neighbors—they only resented being overcharged.

Water Storage and Purification

As I showed in the section on water provision, a household's water storage capacity determines how much water a family has, how long it lasts, and on which water sources they can rely. All households have small water storage vessels: *baldes* (10 liter buckets), *tachos* (20 liter buckets), and *bañadores* (wash basins). Small water storage vessels facilitate surface water collection, use of the community water system, water loans, and water sales. However, for rainwater collection and aguateros—the two sources that provide the bulk of Villa Israel's water—large-scale water storage space is vitally important. There are only two types of large-scale water storage containers used in Villa Israel: tanks and *turriles*.

Water tanks are concrete boxes that are designed to hold large quantities of water. The tanks are built underground, and are accessed through a small, square hole with a metal lid. The access hole is installed in a house's outdoor patio, above the water tank. To access the water inside the tank, people generally lean into the access hole with a bucket, and scoop water out by hand or with a rope. Three households in the study had tanks with engine-run pumps, which supply in-house taps with running water. Water tanks in Villa Israel hold between 1800 and 10000 liters of water. In all, 37 percent of Villa Israel's households have water tanks. The average storage area in Villa Israel's water tanks is 5474 liters (SD = 3390).

While many people aspire to have the large water store areas that tanks provide, not all can afford to construct them. Such a project, of course, requires homeowners to make a large investment in their property—and in staying in the community. Building a tank

costs about $1000 USD, and takes at least two construction workers to complete. Construction quality is very important, as the tank should not have cracks, an inclined floor, or access problems. Tanks can be quite difficult to clean when they become dirty, as they must be drained and scrubbed by hand. As a result, some people allow dirt and household items (like toys and pens) to accumulate at the bottom of water tanks.

After tanks, Villa Israel residents have only one other large-scale water storage option—*turriles*. *Turriles* are cylindrical containers that hold 200 liters of water. Some households use only *turriles* to store water, while others supplement water tanks with one or two additional *turriles*. In all, 63 percent of Villa Israel households have *turriles*. Households have between 200 and 1000 liters of *turril* storage capacity—or between one and five *turriles*. For households that had at least one *turril*, the average *turril*-based storage space is 332 liters. No household in Villa Israel has less than one *turril*, or 200 liters, of water storage capacity.

Unlike water tanks, *turriles* are kept above ground level. Most *turriles* are placed near the edge of housing compounds, where the aguatero can easily reach them with his hose. In some homes, *turriles* are also kept near the house, so that rainwater collection equipment can empty into the vessel. *Turriles* are relatively easy to clean because they are not deep. However, many households do not cover the vessels, and they are left open to dust, dirt, animals, and other environmental contaminants. While *turriles* can be made of metal or plastic, most in Villa Israel are second-hand metal ones that cost about 80 Bs. Some of these *turriles* are in very bad condition—they are rusted, covered in tar, or were once used to carry flammable or poisonous materials (and still carry the warning signs).

The contamination of stored water appears to be a serious problem in Villa Israel. People normally do little more than skim off visible dust and let dirt settle to the bottom of water containers before bringing the water to the kitchen to wash dishes, clean salad ingredients, or cook. However, since Villa Israel residents do not consider plain water to be an appetizing beverage, most people drink *mate* (boiled herb tea) or *moqochinchi* (water boiled with dried peaches, sugar, and cinnamon) rather than unboiled water. As a result, most drinking water is consumed in a safe, boiled manner.

Recently, a group from the Universidad Mayor de San Simon in Cochabamba began promoting the use of an alternative water purification technique, called SODIS, in Villa Israel. Using the SODIS method, people expose a small amount of drinking water to sunlight in a clear 2-liter soda bottle for 5 to 48 hours (depending on the weather). The process uses the radiation from solar energy to inactivate microorganisms such as fecal coliforms (EAWAG and SANDEC undated). Although the SODIS technique has been promoted through the local health center, it is only used by a few households and does not seem to be catching on among Villa Israel residents.

Section 3—Defining and Operationalizing the Urban Water Scarcity Concept

In the last section, I gave many examples of the ways in which the natural, technological, and social aspects of water distribution affect people in Villa Israel. The community lacks clean and productive water sources. Access to water resources has become monetized and politicized. Household levels of water provision are mediated by factors like socio-economic status, housing location, and water storage capacity. People who do not have enough water feel stressed, get sick, and even forgo washing and cooking. All of these phenomena are aspects of one overarching problem—water scarcity.

Water scarcity is a concept that, while it may seem intuitive, is not easy to define. I argue here that water scarcity can be understood in three ways: (1) the absolute lack of water needed to stay healthy and clean, (2) the inability to secure access to a stable source of water, and (3) the experience of feeling deprived of water. The challenge that I take up here is to create a series of measures that captures all these dimensions of water scarcity.

In this section, I will explore three different approaches to studying water scarcity. The first approach simply determines how much water people have. The second approach assesses the security of people's access to water sources. The third approach examines water scarcity as an experiential phenomenon that should be studied within its specific cultural context. Each of these three approaches is incomplete without the others, and all are needed to understand urban water scarcity.

Approach One: Absolute Measures of Water Provision

Any study of water scarcity should begin with an absolute measure of water provision, such as the amount of water a community, household or person has. Absolute measures enable us to compare levels of water provision with baseline biophysical water requirements for health and hygiene. They also provide valuable data that can be used to compare levels of water provision within communities, across cultures, or across historical periods.

The minimal human water requirements for drinking and household use in low-technology situations have been established by a number of international studies. Adults need to consume, on average, 5 liters of clean water daily to survive in tropical climates and 3 liters in temperate climates. To maintain minimal health standards, humans need about another 45 liters of water a day: 20 liters for sanitation, 15 liters for bathing, and 10

liters for cooking and other household chores (Gleick 1996). In total, then, adults need about 50 liters of clean water a day to stay healthy and clean.

Collecting data on water provision can be quite difficult when water sources are distant, have different distribution mechanisms, or are used by many household members. In her work in rural Uganda, Sugita (2004: 58-60) used her knowledge of local water collection to develop a sophisticated recall-based method for measuring household water provision from local wells. In Villa Israel, however, water sources were too numerous and the recall task too complex for us to collect provision data. Instead, I chose to rely on recall-based water use measures. While such water use measures are only a proxy for water provision, they are a start. In the future, researchers should develop better recall-based measures and, ideally, observation-based measures of water provision that are appropriate for use in complex urban water distribution systems.

As I explained in the chapter on field methods, I used three different approaches to estimate how much water households in Villa Israel had: a self-administered direct measure, task-based estimate, and overall estimate. Each of the approaches was designed to measure the same concept and, if they are truly accurate, should produce the same per-person per-day estimate of water provision. Here, I describe the three approaches, and discuss the results of each one.

The self-administered direct measure

For the first measure, the self-administered direct measure, we asked participants to record all of their household's water use on an illustrated water use chart. Participants measured household water use on four randomly-selected days over an eight-month period, from April to November 2004. Once I calculated the amount of water consumed by household members in one day, I divided it by the number of people living in the

household that day. This provided a rough estimate of the amount of water allocated to each household member that day. Because daily water use is quite idiosyncratic, a measure of daily water use cannot be used to compare household provision levels. When averaged over time, however, it does yield an estimate of average water use across households in Villa Israel. For the 72 households that participated in the self-measure, the household members used an average of 44.8 liters (SD=27.3) of water per person per day over the eight-month study period. The minimum average of water that any household had over the eight-month period was 6.6 liters per person per day. The maximum amount that any household had over the eight-month period was 189.5 liters per person per day.

The task-based water use estimate

The second measure is the task-based water use estimate. After we asked household heads to verify their water use self-measures, we asked them to estimate the amount of water that each household member spent on thirteen household tasks over the course of a week. The thirteen tasks are: (1) face washing, (2) hair washing, (3) tooth brushing, (4) bathing, (5) making breakfast, (6) making lunch, (7) making dinner, (8) making beverages, (9) dishwashing, (10) toilet flushing, (11) bathroom cleaning, (12) washing laundry, and (13) mopping. For each task, we asked household heads how often each household member normally performed the task over a week-long period, and what amount of water they used. For the 74 households that participated in the task-based estimate, the household members used an average of 32.9 liters (SD=18.2) of water per person per day over the eight-month study period. The minimum average of water that any household had over the eight-month period was 10.4 liters per person per day. The maximum amount that any household used over the eight-month period was 136.5 liters per person per day. The task-based estimate, then, produced estimates of household water

provision that are 11.9 liters smaller, on average, than those produced by the self-measure.

The overall estimate of weekly water use

The third measure is the overall estimate of weekly water use. We asked household heads to estimate the overall amount of water their household consumed in the last week, one time during each of five interviews over a ten-month time period. Since the study compares households, not household heads, I averaged household heads' estimates into one household-level statistic (for households with more than one head). I then produced a per-person per-day average for each household using the five estimates. For the 76 households that participated in the task-based estimate, the household members used an average of 20.1 liters (SD=12.5) of water per person per day over the ten-month study period. The minimum average of water that any household used over the eight-month period was 4.4 liters per person per day. The maximum amount that any household used over the eight-month period was 88.1 liters per person per day.

Comparing three measures of water provision

Of the three water provision measures, the self-administered direct measure provides the most conservative assessment of water scarcity in Villa Israel. According to the data from this measure, mean water provision (44.8 liters) nearly met the minimal requirement of 50 liters per person per day, and 52 households (72 percent) did not use enough water to meet their basic needs. However, several patterns in respondents' behavior indicate that they tended to underestimate water scarcity using the self-administered measure. First, we caught several respondents hastily filling in responses just before their interview appointment, which suggests that some did not actually perform the self-administered direct measure at all. Second, when we reviewed each

household head's responses with him or her, respondents frequently said that their data were incorrect. Respondents repeatedly told us to correct the data by reducing the liters of water used on a household task. Finally, even after correcting a large number of responses, there were still respondents whose responses did not fit the data I collected during participant-observation. For instance, when I made the typical lunch of stew for four people, I always used under 15 liters of water to wash and cook ingredients. Yet some respondents reported using 20, 30, or 40 liters to prepare and cook one family-size lunch. One person even reported using 110 liters (although she later retracted)!

In contrast with the self-administered measure, the overall estimate yielded the smallest mean water provision—only 20.1 liters. According to the data from this measure, 73 households (96 percent) did not use enough water to meet their basic needs. However, based on my knowledge of the 76 households in the survey sample, I know that there were more than three households in the sample with a sufficient water supply. Why, then, did respondents under-report water provision using the overall estimate? As I explained in the field methods chapter, we did not use any additional memory prompts for the overall estimate, such as asking people to specifically remember buying water, refilling tanks and buckets, or seeing the dropping water level in tanks. Since respondents knew that the study was about water scarcity, they may have underestimated water provision as part of a deference effect, in which the respondent tells the interviewer what they believe she wants to hear (Bernard 2002: 232 -233). Although there was no way to remove people's knowledge about the goals of the study, the use of cues and prompts improve the response accuracy considerably (cf. Brewer 2002).

The most accurate of the three measures, I believe, was the task-based estimate. This seems quite unintuitive, as many researchers have documented the unreliability of recall based responses (cf. Deutscher 1973, Bernard et al. 1984, Ayjan and Isiksal 2004) However, by cueing memories, keeping the recall period short, and prompting for the activities of each household member, we helped respondents give thorough and thoughtful responses (cf. Bernard 2002: 237-239). Before doing the task-based estimate, we cued respondent's memories by reviewing their self-administered water use data with them. Then, we asked them about their water habits over the last week, a relatively brief response period. For each task, we prompted them to recall the usual behaviors of each household member. While talking to people about their water use habits, I never caught respondents giving sloppy or suspicious responses, as I did with the other two measures. While I realize that forgetfulness surely did affect the accuracy of respondents' estimates, I am convinced that respondents gave their most reliable water-use data during the task-based estimate questions. According to the data from this measure, 68 households (92 percent) did not use enough water to meet their basic needs.

Table 5-1. Descriptive statistics for three measures of water scarcity

	Self-Administered Direct Measure	Task-based Water Use Estimate	Overall Estimate	Average of Three Measures
N of cases	76	74	72	76
Minimum	4.4	10.43	6.6	11.21
Maximum	88.14	136.52	189.48	134.207
Mean	20.059	32.879	44.79	31.189
Standard Deviation	12.485	18.154	27.32	17.322

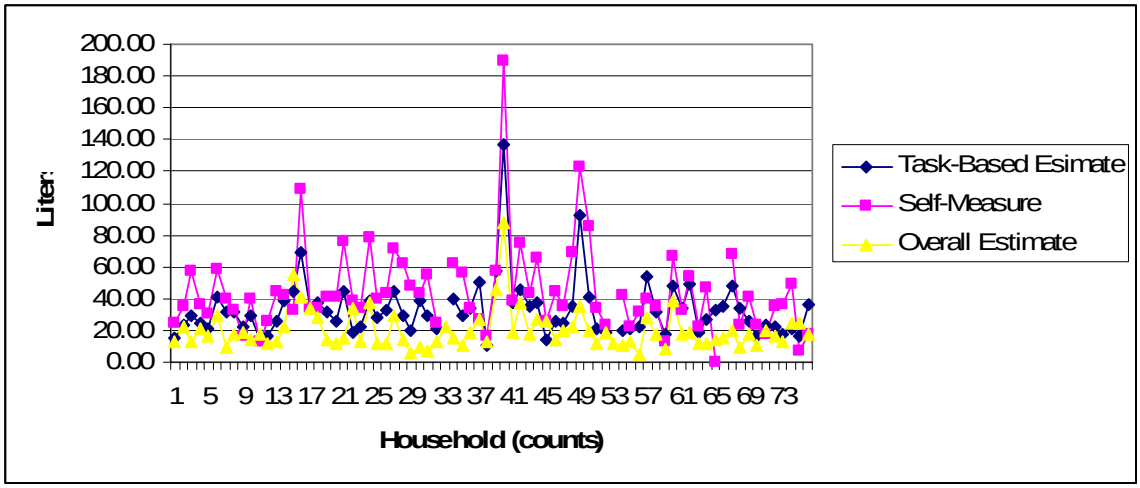

Figure 5-17. Line graph depicting average statistics for three measures of water provision, collected across five survey periods and 76 households. The self-measure yields high statistics, while the overall estimate yields low ones. The task-based estimate was selected for use in the study.

If all three methods yielded accurate measures of water provision in Villa Israel households, the three means would be the same. In reality, there is a rather large difference—ranging from 11.9 to 24.7 liters—between means for the self-administered direct measure (44.8 liters), overall estimate (20.1 liters), and task-based estimate (32.9 liters). Even if the measures are not accurate, however, they could still be reliable—meaning that they all yield a high number for households with a lot of water, and a low number for households with a little water. To test this, I correlated the three measures with each other. As it turns out, none of the measures is perfectly correlated with any other. The correlation between the task-based estimate and the self-administered direct measure is .86. The correlation between the task-based estimate and the overall estimate is .76. The correlation between the two measures I identified as less accurate—the self-administered direct measure and the overall estimate—was the lowest at .64. The low correlations indicate that at least two of the three measures are neither accurate nor reliable.

To deal with the possibility that all three measures are inaccurate, I considered averaging the three statistics to yield one overall measure of household-level water provision. Doing so creates a statistic that summarizes all three measures. The summary measure has a mean of 31.2 liters (SD = 17.3). In this case, however, I have chosen to use the task-based estimate instead of the summary measure for two reasons. First, when I tested the difference between the task-based estimate and mean of three measures, I found that they were not very different. The correlation between the two measures is also quite high (.96). Further, a t-test showed that the difference between the two means, while statistically significant, was quite small—only 1.3 liters ($p = .05$). Second, it takes an enormous amount of time and labor to collect three measures of water provision. It is unreasonable to expect that another researcher would reproduce these methods, and use the average mean in an analysis. By choosing one method and explaining why it was the best, I hope to create a model for estimating water provision that scholars can reproduce in future studies of urban water scarcity. Using the data throughout the analysis helps scholars assess the utility of the measure.

Discussion: What do the water provision data really mean?

According to international consensus, people need at least 50 liters of water a day to meet minimal human water requirements for drinking and household use in low-technology situations. If people in Villa Israel have an average of 33 liters per day, what can we conclude about water provision there? What is it like to live beneath minimal water standards? Between January 2004 and 2005, no resident of Villa Israel died of causes related to water scarcity or contaminated water. Rather than creating a dramatic death toll, the daily effects of water scarcity in Villa Israel were mundane, relentless, and immiserating. People use filthy water for house cleaning and washing. They are unable to

maintain good standards of hygiene, and suffer lice infestations and other related health problems. At times, families even lack the water needed to cook or drink.

The absolute measures of water provision provide an essential baseline measure of water scarcity in a community. However, vulnerability to water scarcity is about more than the amount of water one has at any given time. The struggle to refill tanks and the constant search for water is another important aspect of water scarcity, and is not captured very well by the absolute water measure. In the next section, I discuss water security, or what it means to have a stable and reliable water source.

Approach Two: Proxy Measures of Water Security

Water scarcity means more than just not having enough water. Another important aspect of water scarcity is water security, or a household's ability to maintain its access to water. When people have secure access to productive water sources, they can always meet minimal water needs, such as drinking, cooking, and basic hygiene. However, when households lack secure access to productive water sources, they may run out of water or be unable to replenish household water supplies at any time. When this occurs, households suffer very serious consequences—such as not drinking, cooking, or bathing.

In this section, I present four different approaches to measuring water security. Each approach provides a proxy measure, that is, it measures an indicator of water security rather than measuring water security directly. The first approach measures monthly precipitation in Cochabamba. The second approach measures the physical location of households in Villa Israel. The third approach measures involvement in Villa Israel's political and religious institutions. The fourth and final approach measures household water storage capacity. With each of these approaches, I examine the role that water security plays in determining how vulnerable people are to water scarcity.

Precipitation

The first measure of water security in Villa Israel is a measure of precipitation. As I explained in the section above, rainfall and the river are important water sources for families in Villa Israel. When it rains, many families use rainwater collection equipment to capture and store large quantities of water. They also use river water, which is generated from the runoff created by rainfall, for washing and cleaning. Rain and river water can be considered "secure" water sources because access is free and relatively unrestricted. Precipitation, then, provides a straightforward proxy measure of the water available to all Villa Israel residents.

In this study, I utilize monthly precipitation data that were collected from the Cochabamba weather station (located at 17.45 S and 66.09 W). The data were published in Official Monthly Bulletins by SENAMHI, Bolivia's National Meteorological and

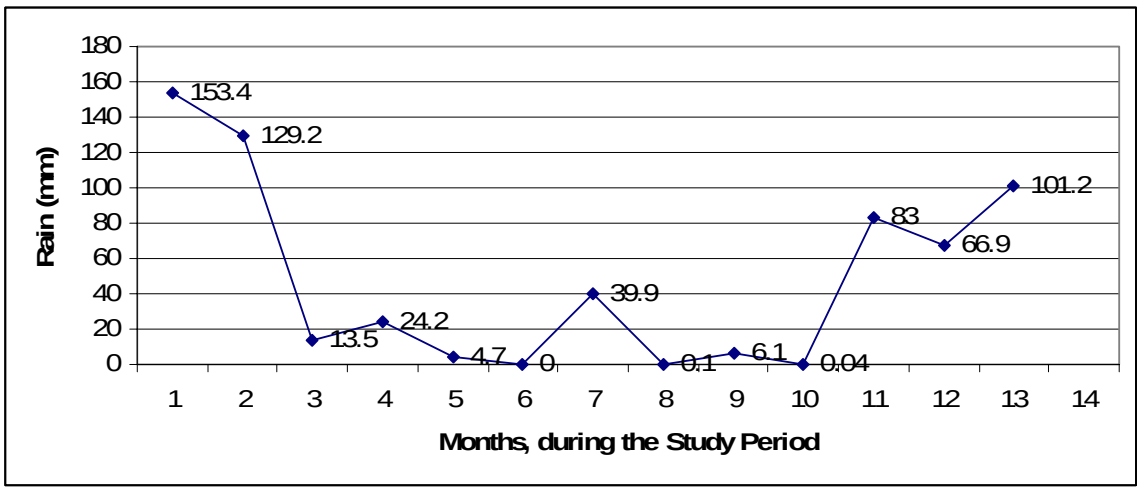

Figure 5-18. Line graph depicting monthly rainfall in the Cochabamba Valley (17.45 S and 66.09 W), from January 2004 to January 2005.

Hydrological Service. The data are collected each day from the Cochabamba station, and summed to create a monthly measure of rainfall in millimeters. The precipitation data

analyzed here were collected in Cochabamba from January 2004 to January 2005 (SENAMHI 2006).

The average monthly rainfall in Cochabamba over the 13-month study period was 47.87 mm (see appendix, Chart 5-18). The minimum monthly rainfall was 0.00 mm (recorded in June 2004), while the maximum monthly rainfall was 153.40 mm (recorded in January 2004). Rainfall only exceeded 100 mm during three months: January 2004, February 2004, and January 2005. Rainfall was less than 10 mm during five months: May 2004, June 2004, August 2004, September 2004, and October 2004. When graphed, it is clear that rainfall-based water security is highest during the wet season months (November to February) and lowest during the dry season months (March to October).

Physical location of households

The most important source of water for Villa Israel residents is the water delivery truck, or aguatero. To measure the security of households' access to the aguatero, I created a measure of the physical distance of households from the aguatero's main route. Since the entrance to Villa Israel is via the main street, aguateros must drive on that street every day. As I mentioned previously, people who live on or near the main street have little trouble finding the aguatero and convincing him to sell them water. People who live at the far edges of the community, however, have a hard time finding the aguatero, and an even more difficulty trying to convince him to drive to far-flung residences to sell water.

The physical location measure, then, is a proxy measure of the difficulty people have finding the aguatero and convincing him to sell them water. To create this measure, I divided the map of Villa Israel into four main zones. The first zone consists of households that are located within one half-block from the main street (on the east and west sides). The second zone consists of households that are located within one half-

block of the second streets from the main street (on the east and west sides). The third zone consists of households that are located within one half-block of the third streets from the main street (on the east and west sides). The fourth zone consists only of households that are located past the third street and the runoff canal on the west side of the community; the river lies directly beside the third street on the east side of the community.

People with the best access to the aguatero live in zone one, within one block of the main street. In the study sample, 22 percent of households had very secure physical access to the aguatero. People with good physical access to the aguatero live in zone two, about two blocks away from the main street. The largest percentage of households, 41 percent, is located in this zone. People with poor physical access to the aguatero live in zone three, about three blocks away from the main street. About 33 percent of households lived in this zone, and had insecure access to the aguatero. The fourth zone is quite far from the main street, and also has a major physical barrier to access, the runoff canal. Only 4 percent of households in the sample were located in this zone; their access to the aguatero was extremely insecure.

Political and religious connections

Another factor that affects a household's ability to secure access to water sources is political and religious involvement (Ennis-McMillan 2006). As I explained in the section in the community water system, people with connections—via the Neighborhood Council or a local evangelical church—have more secure access to the tap stand system than those without connections. While it does not provide enough water for exclusive long-term use, the tap stand system is an important resource for households that are experiencing a water crisis. The involvement of a household in Villa Israel's Neighborhood Council and

evangelical churches is a proxy measure for the household's politico-religious connections in the community—and their ability to get access to the tap stand system during a crisis situation.

Over 10 months, or five interview cycles, we collected data on household participation in the Neighborhood Council and local evangelical churches. In each interview, we asked household heads to tell us the number of meetings they attended in Villa Israel during the last week. The average number of meetings that household heads attended per week is a measure of how connected they are to political and religious groups in Villa Israel. People who wield more politico-religious connections, then, should have more secure access to the tap stand system than people with fewer connections.

Over the 10-month study period, the average number of politico-religious interactions that household heads had over a week-long period was 0.3 meetings (SD = 0.41). The maximum average number of meetings that any household head had over the study period was 1.5 meetings per week, and the minimum was 0.0 meetings per week. It is, perhaps, more illuminating to examine the difference between household heads that have some connections in Villa Israel and household heads that have none at all. Once the measure is dichotomized, it yields a simple variable in which household heads are assigned either a 0 (meaning that the never attended a political or religious meeting in Villa Israel) or 1 (meaning that they attended at least one political or religious meeting in Villa Israel). Over ten months, 36 percent of household heads reported that they attended no meetings at all in the community; 64 percent of household heads reported that they attended at least one political or religious meeting. Those households who had no connections at all with political and religious groups probably had more difficulty

maintaining secure, long-term access to the community tap stand system than households that had political or religious connections.

Water storage capacity

The last measure of water security is household water storage area. As I explained in the section on water provision above, each household in Villa Israel uses *turriles*, an underground water tank, or some combination of the two to store water for household use. Some households also keep 20-liter bidones or 10-liter baldes as supplemental water storage containers. Households with one *turril* of storage capacity can make 200 liters of water last up to a week, while households with a large storage tank can use water at a rate of 2500 liters per week. While there is variation in rates of consumption, households with larger water tanks generally have more secure access to water. Having a larger tank gives people more space to collect rainwater, more water to use, and more time to save and plan to refill the tank. As a result, people with water tanks have more ability to keep their tanks filled with a stable supply of water.

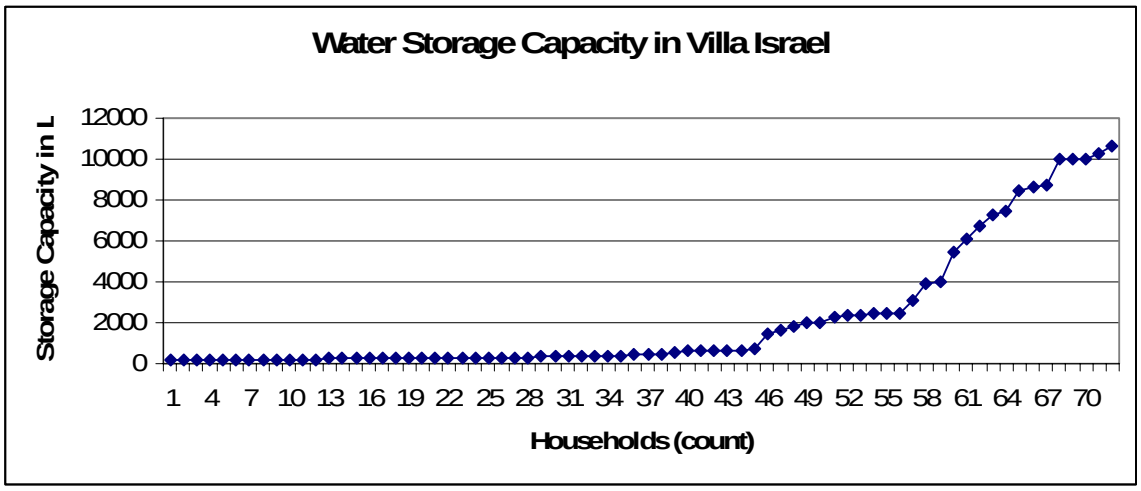

Figure 5-19. Line graph depicting water storage capacity among Villa Israel households.

Over 8 months, or four interview cycles, we asked household heads how much water storage area they had in their homes. Because people buy or sell *turriles* and build

or damage water tanks, storage capacity does vary over time. Water storage capacity ranges between 200 and 10,600 liters in Villa Israel. The average overall water storage capacity in Villa Israel households over the 8 month period was 2240 liters (SD = 3172). Eleven households (15 percent) had only one *turril* of storage space. On the other end of storage capacity, five houses (7 percent) had 10,000 liters or more of water storage area.

Summary: Proxy measures of water security

In this section, I presented four different proxy measures of water security in Villa Israel. In the first approach, I assessed the availability of precipitation, a water source that is not restricted by economic, political, or social factors. In the second approach, I examined the physical proximity of individual households to the most important water source in Villa Israel, the aguatero. In the third approach, I examined household heads' involvement with political and religious institutions that mediate access to Villa Israel's tap stand system. In the fourth and final approach, I measured households' water self-sufficiency in terms of their storage capacity.

Each of these measures captures some aspect of a household ability to secure access to water. The approach is not designed to reflect the amount of water to which a household has access. Instead, the security measures assess how likely a household is to get and maintain access to some amount of water, however small. This distinction is important because people in Villa Israel can and do survive with very small daily water allotments. It is only when they lose water access completely that people are unable to complete crucial household tasks like cooking and drinking.

Approach Three: Measures of the Experience of Urban Water Scarcity

The third and final approach that I develop here is a measure of the experience of water scarcity. Because the amount of water that people need to maintain their standard

of living varies enormously across cultures, people in different cultural contexts can experience the same water provision level as abundance or scarcity. For instance, people with less water develop cultural practices that attenuate the effects of water scarcity (cf. Vargas 2001). Conversely, people with highly water-consumptive technologies need far more than the recommended water allotment to care for themselves (cf. Gleick 1996). A measure of the experience of water scarcity indicates whether people have experienced water scarcity from the perspective of people in that culture.

From interpretation to measurement

In creating the measure of the experience water scarcity, I drew heavily from Ennis-McMillan's work on sufriendo del agua (suffering from water) in La Purificación, a water-scarce, urbanizing community in the Valley of Mexico (2001, 2006). Sufriendo del agua is the embodiment of worry over the inequitable distribution of scarce water. Ennis-McMillan explains that medical anthropologists examine bodily distress and social suffering to understand the "nexus of people's negative physical, emotional, psychological, and social experiences…to examine how people experience and articulate their bodily distress in relation to unequal social relations" (2001: 370). Ennis-McMillan showed that community residents experience bodily distress over scarce water—a variety of psychosomatic symptoms—when they see evidence of injustice in water allocation.

One of the reasons that I find the bodily distress concept so compelling is that it offers a way to understand the culturally-mediated experience of water scarcity that is both widely accepted by interpretive anthropologists and amenable to hypothesis testing. Although Ennis-McMillan describes *sufriendo del agua* as a local idiom, I thought that the embodiment of urban water scarcity might be a universal phenomenon. Ennis-McMillan included rich ethnographic descriptions of *sufriendo del agua*, and provided a

list of words that residents used to express their suffering: *frustración* (frustration), *angustia* (anguish), *molestia* (bother), *preocupación* (worry), *coraje* (anger), and of course *sufrimiento* (suffering) (2006: 117).

During the participation-observation phase of the research, I asked people about how they feel when they experience water scarcity. As it turned out, Villa Israel residents used some of the same words Ennis-McMillan recorded, *molestarse* (to get upset) and *preocuparse* (to get worried), to talk about water scarcity. Villa Israel residents also used new words that appeared to describe the embodiment of water scarcity: *renegar* (to fume) and *sentir miedo* (to feel scared). I created a questionnaire to ask about these four feelings in the Cochabamba dialect.

The culturally-constructed aspects of water scarcity, of course, are enormously complex and cannot be fully captured only by examining bodily distress. I wanted to gather data on all of the aspects of the experience of water scarcity, as I had heard Villa Israel residents talk about it. I wrote 29 additional questions, and created a questionnaire with 33 questions in all. All of the questions came from words and ideas that I learned about during participant-observation and the first round of survey research; no question came solely from categories or ideas that I brought with me to the field. This is important, because it means that the questionnaire reflects native experiences of water scarcity. It also means that replication of the questionnaire probably would not work very well for researchers in places other than south-side Cochabamba, or perhaps Bolivia. Rather, each researcher should create their own list of questions based on ethnographic research.

Data collection and analysis

Between June 2004 and January 2005, we asked household heads to respond to the 33 question four times. Each of the 33 questions asked if the household head had

experienced a water-related feeling or event during the last week. The questions required only a simple yes/no answer, and were coded using 1 (yes) and 0 (no).

I took the step of transforming rich ethnographic observations to spare yes/no questions because the data they yield enable me to create Guttman scales. A Guttman scale is a kind of composite measure made up of indicators that point to a progressive, unidimesional concept (Guttman 1950). Using Guttman scales, we can go beyond just talking about experience—we can define the steps people go through when they experience different aspects of water scarcity. We can also calculate which step each

Table 5-2. English translations of thirty-three yes/no questions about the experience of water scarcity in Villa Israel.

1.	In the last week, have you gotten angry with someone from your house over water?
2.	In the last week, have you argued with someone from your house over water?
3.	In the last week, have you gotten angry with someone from Villa Israel over water?
4.	In the last week, have you argued with someone from Villa Israel over water?
5.	Sometime in the last week, have you fumed about water scarcity?
6.	Have you worried every day over the last week about water scarcity?
7.	In the last week, have you been afraid that water would run out in your house?
8.	In the last week, have you felt annoyed about having to fetch water?
9.	In the last week, have you lacked the money you need to buy water?
10.	In the last week, did you have to run after the aguatero in the street?
11.	In the last week, have you had to beg the aguatero to come and sell you water?
12.	Have you borrowed water from anyone in Villa Israel in the last week?
13.	Have you loaned water to anyone in Villa Israel in the last week?
14.	Have you bought water from anyone in Villa Israel in the last week?
15.	Have you sold water to anyone in Villa Israel in the last week?
16.	In the last week, have you wasted time because of water scarcity?
17.	In the last week, have you wasted time because of the aguatero?
18.	In the last week, have you lost out on an opportunity to earn money because of water scarcity?
19.	In the last week, have you lost out on an opportunity to earn money because of the aguatero?
20.	In the last week, have you conserved water when bathing?
21.	In the last week, have you conserved water when cleaning the house (i.e., mopping)?
22.	In the last week, have you conserved water when washing the laundry?
23.	In the last week, have you conserved water when cooking?
24.	In the last week, has anyone gotten sick in your house because of water scarcity?
25.	In the last week, have you been unable to cook because you lacked water?
26.	In the last week, have you been unable to bathe because you lacked water?
27.	In the last week, have you been unable to clean the house because you lacked water?
28.	In the last week, have you been unable to do the dishes because you lacked water?
29.	In the last week, have you been unable to wash laundry because you lacked water?
30.	In the last week, have you thought of leaving Villa Israel because there is no water here?
31.	Have you mopped your house with clean water in the last week?
32.	Have you mopped your house with reused water in the last week?
33.	Have you used the same water more than once in the last week?

Table 5-3. Thirty-three yes/no questions about the experience of water scarcity in Villa Israel, written in the south Cochabamba Spanish dialect. The data were used to create five different Guttman scales.

1.	¿En esta última semana te has enojado con alguien de tu casa por el agua?
2.	¿En esta última semana has discutido con alguien de tu casa por el agua?
3.	¿En esta última semana te has enojado con alguien de VI por el agua?
4.	¿En esta última semana has discutido con alguien de VI por falta de agua?
5.	¿Alguna vez en esta última semana has renegado por falta de agua?
6.	¿Te has preocupado cada día en esta última semana por falta del agua?
7.	¿En esta última semana has sentido miedo porque el agua se va a acabar en tu casa?
8.	¿En esta última semana te ha molestado conseguir el agua?
9.	¿En esta última semana te ha faltado plata para comprar el agua?
10.	¿En esta última semana tenías que ir corriendo por la calle detrás del aguatero?
11.	¿En esta última semana has tenido que rogar al aguatero para que venga a venderte agua?
12.	¿En esta última semana te has prestado agua de alguien en VI?
13.	¿En esta última semana has prestado agua a alguien en VI?
14.	¿En esta última semana has comprado agua de alguien en VI?
15.	¿En esta última semana has vendido agua a alguien en VI?
16.	¿En esta última semana has perdido tiempo por falta de agua?
17.	¿En esta última semana has perdido tiempo por culpa del aguatero?
18.	¿En esta última semana has perdido la oportunidad de ganar dinero por falta de agua?
19.	¿En esta última semana has perdido la oportunidad de ganar dinero por el aguatero?
20.	¿En esta última semana has medido el agua para bañarte?
21.	¿En esta última semana has medido el agua para limpiar la casa?
22.	¿En esta última semana has medido el agua para lavar ropa?
23.	¿En esta última semana has medido el agua para cocinar?
24.	¿En esta última semana alguien se ha enfermado en tu casa por falta de agua?
25.	¿En ésta última semana no has cocinado por falta de agua?
26.	¿En ésta semana no te has bañado por falta de agua?
27.	¿En ésta semana no has limpiado la casa por falta de agua?
28.	¿En ésta semana no has lavado los platos, vasos, ollas por falta de agua?
29.	¿En ésta semana no has lavado ropa por falta de agua?
30.	¿En esta semana has pensado en irte de VI porque no hay agua?
31.	¿Has baldeado tu casa en ésta última semana con agua limpia?
32.	¿Has baldeado tu casa en ésta última semana con agua sucia?
33.	¿Has usado más de una vez la misma agua en ésta última semana?

household reached, and use the number assigned to them as ordinal data in later analyses. Using Guttman scales, then, culturally-unique experiences can be defined, measured, and ranked.

The data from 67 household heads interviewed between August and September 2004 were analyzed in Anthropac, a suite of programs that has a routine for checking the unidimensionality of a scale with the Guttman technique (Borgatti 1996). Using the program, I organized the data into columns, so that many respondents said yes to the question in the first column, fewer said yes to the second, and so on. If the variables scale

perfectly, each question is progressive, and no one answers yes to one question without also saying yes to the question that preceded it. To test how well variables scale, I calculated the coefficient of reproducibility (CR—the statistic that summarizes errors in the scale) for each scale. If the CR was greater than 0.85, I considered the questions to scale sufficiently enough to discuss further here (Bernard 2002: 302-207). I found that variables for five of the dimensions of water scarcity experience examined in this chapter—bodily distress, water-based tasks, aguatero, water exchanges, and conflicts—did scale. Below, I examine each in turn.

Bodily distress

The first concept that I tested using the Villa Israel data was Ennis-McMillan's idea of bodily distress experienced in response to water scarcity. As I explained above, there were questions on the yes/no questionnaire that dealt with four indicators of bodily distress: molestarse (to get upset), preocuparse (to get worried), renegar (to fume), and sentir miedo (to feel scared). I found that one of the indicators—to feel about water running out—does not scale very well. The other three variables do scale, with a CR of .85. The first indicator is "worrying every day about water scarcity." The second indicator is "feeling annoyed about getting water." The third indicator is "fuming about water scarcity." The series of feelings that people experience—worry, anger, fuming—represents the escalation of negative emotions about water scarcity.

People in Villa Israel do not link their suffering to wider political economic conditions in any way, as they did in Ennis-McMillan's study. When talking about water scarcity, people focus on the experience of not having water rather than the socio-economic phenomena that cause water scarcity. As a result, it is not clear that the feelings of worry, annoyance, and fuming that they express can really be considered bodily

distress. What is clear, however, is that people experience feelings about water scarcity in a measurable, predictable, and progressive way.

Water-based tasks

The second concept that I tested is a very intuitive one—water-based tasks. The idea behind this scale is that people prioritize water-use tasks when water becomes scarce. It makes sense, for instance, that people would stop watering plants before they stop drinking water. We asked people about five different household water-use tasks that they said they stopped doing when water was low—cooking, bathing, cleaning the house (mainly mopping floors), washing dishes, and doing laundry. All five task indicators do scale, with a CR of 0.88. The first task that people eliminate when water is scarce is cleaning the house. After that, they eliminate in succession: bathing, doing the laundry, cooking, and finally doing the dishes.

The rankings determined by the scale are, for the most part, unsurprising. Obviously, people would stop cleaning their homes before they stop bathing, and they would stop bathing before they stop cooking. What appears a bit strange, however, is the placement of two tasks—doing laundry and dishes—at the middle and far end of the scale. However, when one looks closely, it appears that each task is located directly after the task that logically precedes it. For instance, people stop cooking, and then stop washing dishes. Similarly, people stop bathing, and then stop washing clothes. The scale, then, seems to represent both the priority of tasks in water scarce conditions, as well as the order in which they are performed (and halted).

Buying water from the aguatero

One interesting idea I tested was that people pass through a common set of experiences when they attempt to buy water from the aguatero. I compiled a short list of

the things people said happen when they had trouble getting water from the aguatero. The list includes running out of money, chasing after the aguatero's truck, begging the aguatero to sell water, and wasting time because of the aguatero. The four indicators do scale, with a CR of .89. The first experience that most respondents had was begging the aguatero to sell water. After that, people reported running after the aguatero. Next, people said they wasted time because of the aguatero. Finally, people said that they lacked the money they needed to buy water from the aguatero.

Superficially, this scale appears to be about the experience of being unable to get water from the aguatero. However, what underlies the inability to get water from the aguatero is the amount of money that household heads have available to buy water. For instance, people who do not have a lot of money allocated to buy water have to beg the aguatero to come to their houses. The aguatero may avoid people who repeatedly buy water in small quantities, forcing them to run after the truck. People who run and beg without convincing the aguatero that it is worth selling them water have wasted their time. Finally, when people can not induce the aguatero to sell them water, it is clear that they lack the sufficient quantity of money they needed to buy water from the aguatero. In view of this interpretation, the scale seems to summarize the experience of lacking money to buy water from the aguatero.

Water exchanges

Another important water acquisition experience in Villa Israel is participating in water exchanges. As I mentioned above, there were not a large number of water exchanges reported during the interviews. As a result, I was unable to identify trends regarding how people decided to sell water, buy water, loan water, and borrow water with their neighbors. Luckily, a Guttman analysis can isolate trends that are difficult to see in

participant-observation and semi-structured interviews. The four water exchange indicators scaled very well, and had a CR of .94. The water exchange that most people engage in is loaning water to someone else in the community. After that, people borrow water from someone else. Then, people buy water from another Villa Israel resident. Finally, they sell water to another Villa Israel resident.

When I ran the Guttman procedure on these indicators, I was surprised that they do scale. I believed that people with more water would loan and sell the resource, while people with less water would borrow and buy it. In fact, the scale proves that the monetization of water exchanges is a tactic adopted only by people who also participate in water exchanges like loaning and borrowing. Buyers and sellers, then, are people who choose to monetize just a few of their water exchanges. I suggested above that people monetize water exchanges to avoid creating social obligations, and it would be very interesting to do a more comprehensive study of when and why people monetize some water exchanges and not others.

Water conflicts

The last set of indicators that I tested deals with water-related conflicts. This is a category that I was quite interested in at the onset of the study. I learned that people in Villa Israel only use two terms to describe water-related conflicts—enojarse (to get angry) and discutir (to get in an argument). Both of these terms are rather euphemistic, and actually encompass a variety of interactions. Enojarse is word that describes feeling anger, making an angry comment, making a nasty face, or storming away. When the anger is two-sided, it is said that people discutir (get in an argument). Discutir can describe anything from a disagreement to a shouting match to a minor scuffle. Once an altercation involves pushing, hitting, or punching, though, it is called pelear (to fight).

People did pelear in Villa Israel while I was there, but no one reported doing so over water.

Using only these native categories, I asked people about four kinds of conflicts—getting angry with people at home over water, getting angry with people in the community over water, getting into an argument with people at home over water, getting into an argument with people in the community over water. The water conflict indicators scaled very well, with a CR of .96. It turns out that household heads get angry with people at home over water first. After that, they get into arguments over water with people at home. Then, people get angry with community members over water. Finally, people get into water-related arguments with community members.

As I mentioned in the section on water exchanges, people in Villa Israel are very conflict-averse. It is not surprising, then, that people always get angry before they get into interpersonal conflicts, whether in the home or in the community. However, if inequity in water distribution were the main driver of water-related anger and conflict, we could expect community-level incidents to precede household-level ones. Instead, it appears that people turn their frustrations over the water situation toward community members only after water-related tensions boil over in the home.

Summary: Measures of the experience of water scarcity

In this section, I developed five Guttman scales that measure different aspects of the experience of water scarcity in Villa Israel. The five scales deal with feelings, water-based tasks, the aguatero, water exchanges, and water conflicts. These five aspects of water scarcity are not exhaustive. In fact, the experience of water scarcity is very multifaceted, and could be examined alone in a much more extensive study. In this section, I seek only to show that interpretive concepts, such as bodily suffering, can be

operationalized and measured. By doing so, we can understand the extent to which experiences associated with water scarcity are shared within and across communities. Further, using methods like Guttman scaling, we can link interpretive and scientific approaches to understanding experiences. In doing so, we promote the growth and development of a rich, diverse anthropology of urban water scarcity.

Discussion: Defining and operationalizing the urban water scarcity concept

In this chapter, I have argued that people experience water scarcity as more than just unmet biophysical needs, and the water requirement guidelines can only provide one of the tools that are needed to examine urban water scarcity. Because the amount of water needed to complete everyday household tasks varies across people and cultures, measures of experience can tell us a great deal about how and when water scarcity hits a society—regardless of the number of liters of water they have per day. In Villa Israel, many people survive with less than 10 liters of water per day. In this context, it is the complete loss of access to water sources that causes people to really experience a water crisis, in which they do not bathe, cook, or drink with water.

In this section, I developed three main approaches to measuring water scarcity. The three approaches are designed to capture different facets of the complex water scarcity phenomenon. The first approach is a measure of water provision, or the amount of water a household has per person per day. The second approach to measuring water scarcity examines water security, or the stability of a household's access to water supply sources. The third approach measures experiences of water scarcity.

Each of the approaches provides important tools for understanding water scarcity across cultures and time periods. Measures of water provision have already been reproduced successfully and used to compare levels of water scarcity in many societies.

Measures of water security and experience are bound to local systems of water distribution, and tell us about the unique ways in which water scarcity is structured and experienced across cultures. Put in anthropological terms, measures of water provision and security can tell us a great deal about the etics of urban water scarcity, while measures of water experience do a good job of telling us about the emics of urban water scarcity. Etic knowledge holds true across cultures, while emic knowledge is situated within the beliefs and language of a specific cultural context (Lett 1996, Harris 1979). It is important to study both the emics and etics of urban water scarcity to understand how the phenomenon is created and experienced across cultures.

CHAPTER 6
SOCIAL RELATIONS AND ECONOMIC EXCHANGES

In this chapter, I discuss the dependent variables that are examined in this study. In the first two sections, I briefly review anthropological studies on sociability and reciprocity. After that, I explain how the studies relate to Laughlin-Brady model and the hypotheses I tested in Villa Israel. Finally, I examine how two factors, nested cycles and cultural institutions, complicate and contribute to the analyses. I conclude that, while it is important to examine nested cycles and cultural institutions, it is also appropriate to focus on the sole theoretical question under study here—the effects of urban water scarcity on social relations and economic exchanges.

Anthropological Research on Reciprocity

The reciprocity concept is one that emerged in early anthropological inquiry, and continues to fuel anthropological theory-making today. Reciprocity has been analyzed by anthropologists from two main perspectives. The older approach views reciprocity as the phenomenon underpinning human society, based on exchanges of goods, labor, ideas, and sentiment that form the building blocks of all social systems. Another approach treats reciprocity more narrowly, as a system of economic exchange in which goods and services are given with the expectation that they will be returned later. Both of these perspectives are important, and will help explain hypothesized changes in sociability and reciprocity. In the sections that follow, I discuss the two anthropological perspectives on reciprocity, and how they relate to this study.

Reciprocity as a Social Foundation

One of the earliest anthropological works on reciprocity, Malinowski's study of the Trobriand Islanders, influenced many of the major works in economic anthropology (1922). Malinowski conceived of reciprocity as the principle that organized the entire social life of Trobriand Islanders—legal, economic, moral, social, religious, and psychological. He explained that reciprocity, or the "principle of give and take", establishes binding obligations which compel honorable citizens to accept offers and repay them so as to not be excluded from the social order.

Another influential early work drew heavily on Malinowski's analysis of reciprocity: Mauss' *The Gift* (2000). Mauss also believed that reciprocity was a system of exchange in which everything from people, to items, to labor passes "to and fro". The system, as he saw it, permeated the legal, economic, moral, religious, and aesthetic dimensions of social life. Following Durkheim (1982), he called this a *total social fact.* Homans, too, believed that exchange permeated social life, and argued that all social interactions should be analyzed as exchanges (1958). Blau, in his work on exchange and power, followed Homan's conceptualization of social exchange and expanded it, clarifying how systems of reciprocal exchange can bestow benefits, but also widen gulfs in status, power, and differences (1964).

While the reciprocity concept encompasses both social and economic exchanges, early anthropologists focused on the importance of social exchanges of ideas, power, and prestige. They showed that these reciprocal exchanges form the social foundation of all societies. Early approaches to understanding reciprocity, then, demonstrate the importance of understanding patterns of social interaction and exchange as part of reciprocity.

Reciprocity as a System of Economic Exchange

In the late 1960s, scholars began to focus more closely on explaining the economic aspects of reciprocity. Polanyi was one of the first scholars who conceptualized reciprocity as an economic system, which could be analyzed in comparison to other economic systems like redistribution and markets (1968). Following Polanyi, a number of scholars began to examine when, where, and why systems of reciprocal economic exchange are established.

Sahlins explained that reciprocal exchanges of goods and services could be less or more self-interested, depending on the social distance of the actors. He defined the most altruistic of exchanges as *generalized reciprocity*, where there is a prohibition on immediate payback. The midpoint of the continuum is *balanced reciprocity*, where goods of equal value are exchanged at the same moment or perhaps after a small delay. The far end of the continuum is *negative reciprocity*, where people attempt to get a thing for less than its value (1972). Most anthropologists, when they discuss reciprocity, refer to the kind of exchange that Sahlins called generalized reciprocity.

Later economic theorists showed that reciprocal exchange systems are intended to maximize security, and function like informal social insurance systems. In her work on the !Kung, Wiessner showed that reciprocal exchanges are a "social method of pooling risk thorough storage of social obligations" (1982: 65). When people cannot independently store the goods they need to survive, they create long-standing exchange relationships in which obligations are stored. That way, when one person needs food, water, or help, they can call in a favor (a "stored obligation") from another person.

In her work on Basarwa reciprocity, Cashdan (1985) used the economic theory of risk minimization to explain how reciprocal exchange systems work. Reciprocal systems,

like any insurance system, only work when scarcity hits individuals at different times. If everyone in the system is hit by scarcity at the same time, the system breaks down. Cashdan suggested that reciprocal insurance systems would exist in urban areas when people have independent economic fortunes, but would be truncated where urbanites' fortunes are all tied to the same risks.

Urban Reciprocity

Anthropological theories of reciprocity were created and tested in societies that were described as primitive, pre-industrial, and rural. Lomnitz was one of the first anthropologists to examine urban reciprocity as an economic system (1977). She defined reciprocity as a form of economic exchange that is social, is recurring, and maximizes security (1977: 189). Her work on reciprocity in a Mexican shantytown showed that systems of reciprocal exchange protect the urban poor against severe scarcity (1978, 1978).

Research conducted between the 1960s and 1980s documented how the urban poor used reciprocal exchanges to combat scarcity, particularly in Latin America and the Caribbean. Reciprocal exchange systems dealt with needs as diverse as job assistance, loans, goods, services, and facilities (Lomnitz 1977), childcare (Stack 1974, Safa 1974, Scheper-Hughes 1992), help during crises like accident, illness, fire (Safa 1974, Lobo 1982), moral and emotional support (Lomnitz 1977), protection against alcoholism and spousal abuse (Lomnitz 1978), and companionship (Safa 1974, Lobo 1982). Most importantly, however, reciprocal social networks were used to supplement the low incomes (Leeds 1971) and frequent joblessness (Lobo 1982, Perlman 1976) with which the urban poor had to contend.

Sociability, Reciprocity, and the Laughlin-Brady Model

From the brief survey of anthropological research that I provided above, a picture of reciprocity begins to emerge. Reciprocity describes, first, a kind of social exchange system that permeates all societies. The exchange of values, information, and social interactions provides a base on which communities and cultures are built. These reciprocal *social* interactions are a necessary but insufficient condition for the construction of reciprocal *economic* exchanges.

The emergence of reciprocal exchange systems depends on the kinds of risks and protections found in an economy. When people in a society are threatened by severe scarcity, lack sufficient material means to protect themselves against scarcity, and are not all threatened by scarcity at the same time, reciprocal exchange systems can develop. When basic necessities are abundant, can be stored, or become scarce for everyone at the same time, reciprocal exchange systems generally do not thrive. The conditions for reciprocal exchange systems, then, can develop in any economy, depending on the configuration of risks and protections found there.

The Laughlin-Brady model (1978) predicts how people will respond when the third precondition for successful a reciprocal exchange system is violated, and scarcity hits everyone in a society at the same time. Laughlin and Brady showed that, when scarcity initially hits, people invest more heavily in the reciprocal exchange system. They engage in more social interactions, participate in more reciprocal exchanges, and seek cooperative solutions. However, after this initial period of increased sociability and reciprocity, people lack the resources and energy to sustain this kind of enhanced sharing and cooperation. Instead, they begin to withdraw from social relationships, reciprocal exchanges, and cooperative solutions. As scarcity continues to worsen, people tend to

become completely isolated as they pursue individual survival. The figure below depicts the hypothesized relationship between resource scarcity, sociability, and reciprocity.

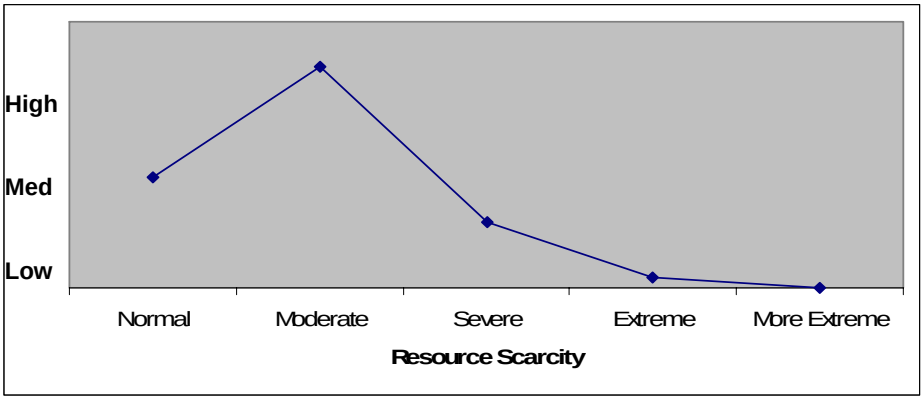

Figure 6-1. Relationships hypothesized by the Laughlin-Brady model. The X axis represents increasing resource scarcity, and the Y axis represents varying levels of reciprocity and sociability.

A test of the Laughlin-Brady model should examine changes in three dependent variables over time: sociability, reciprocity, and community participation. In this study, I used five separate measures to test changes in sociability, reciprocity, and participation in Villa Israel. By explaining exactly what kinds of exchanges I investigated, detailing the coding rules I employed, and discussing how they fit into native categories, I provide clear and reproducible measures of the three concepts under study. Before I proceed, however, I will briefly discuss how the complexity of scarcity cycles complicates our ability to understand changes in reciprocity and sociability over time.

Studying Nested Scarcity Response Cycles

The periods of privation that the Laughlin-Brady model describes can be short or long. Short-term scarcities can be caused by seasonal drought, crop failure, road blockages, or damage to urban infrastructure. Long-term scarcities can be caused by natural disasters, economic crises, or environmental degradation. A recent theory of integrated social-ecological systems explains that short-term and long-term cycles can be

nested within each other, causing responses at multiple scales (Gunderson and Holling 2002).

Like most social-ecological systems, the one under study in Villa Israel has nested scarcity response cycles. For instance, short-term seasonal changes in water provision are nested within a long-term cycle of global capitalism. While the short-term cycle—seasonal water scarcity—is the focal point of this study, it is also important to understand how that cycle it fits into larger economic trends. In the next section, I explain how a twenty-year shift toward an informal economy, punctuated by periods of severe economic crisis, appears to have undermined the urban reciprocal insurance systems among Latin America's urban poor.

As I explained in the first chapter of this study, the economic crises of the 1980s and economic restructuring of the 1990s destabilized existing economic systems in Latin America. Squatter settlements were hit harder than downtown areas because their residents lacked physical and social access to the diminishing job opportunities (Eckstein 1990). The economic crisis—and particularly the decline in the poor's opportunities to earn regular wages, intensify and diversify labor, and self-employ—disrupted their ability of invest in and redeem social obligations (González de la Rocha 1994, 2001, 2004, Moser 1996).

As a result, families intensified strategies that generate income and attempted to minimize income expenditures, consumption, and social investments (Halebsky 1995). Reciprocal relationships and participation in community organizations declined because people lacked the time and resources to invest in maintaining them (Moser 1996). Between 1980 and 1995, poor families in urban Latin America withdrew from the social,

reciprocal, and cooperative relationships that were the hallmark of shantytowns and squatter settlements between 1960 and 1980 (González de la Rocha 2001, 2004, Moser 1996).

In the section that follows, I examine data that characterize reciprocal exchange systems in Villa Israel over the 10-month survey period, from April 2004 to January 2005. Using data on average social interactions, reciprocal exchanges, and participation, I conclude that reciprocal exchange systems, while perhaps diminished, are still active in Villa Israel.

Data on Sociability, Reciprocity, and Participation in Villa Israel

In this section, I discuss the data my field team and I collected over 18 months in Villa Israel. As I explained in the chapter on field methods, data on social interactions and economic exchanges were collected using two methods: direct observations and semi-structured surveys. First, I explain how the data from each method were coded. Then, I analyze the data on reciprocity, sociability, and participation, and discuss them in view of the literature on contemporary reciprocal exchange systems in Latin America.

Public Social Interactions

Data collection and coding

Direct observations were used to collect data on public social interactions. The method yielded the only data on sociability that could not be affected by respondent accuracy problems. The direct observations were collected in four repeated 42-day cycles, and observations were made in 12 randomly-selected public places at a randomly-selected time each day. Researchers observed and coded “social interactions”. A grouping of two or more people was considered to be one social interaction. When there were multiple groupings in one public place, each grouping was considered a unique

social interaction. One social grouping was coded as distinct from another when there was physical space between the groups of people and there was no interaction observed across the groups.

The observation data represent a gross count of social interactions that occurred at a specified public place over a 5-second period of time. For instance, if a public place receives a score of 2 on “social interaction”, that means that there were two social groupings observed at the randomly-selected time. One social grouping could have had two people sitting on a stoop talking, while the other social grouping had six people playing soccer together. The two social groupings could also have any number of other configurations; what is important is that they are social and socially distinct. On the other hand, when a public place receives a score of 0, the code could represent a situation in which no people at all were present. It could also mean that there were four people there, but not one of them was interacting with any other person.

Data analysis

The mean number of public social interactions observed over 414 repeated observations of 60 public places was .82 (SD = .76). The minimum number of social interactions observed was 0 and the maximum number of social interactions was 10. Public social interaction was highest around the *taxi-trufi* stand where vendors and drivers congregate, around the Villa Israel market, and in front of the UCE church. Social interactions, then, tend to develop around economic and religious centers. Public social interaction was lowest at the edges of Villa Israel, and particularly near the river that runs along the east side of the settlement and the drainage ditches that run along the west side of the settlement. It is extremely significant that Villa Israel’s waterways are the settlement’s social “black holes”, since “watering holes” are generally known as

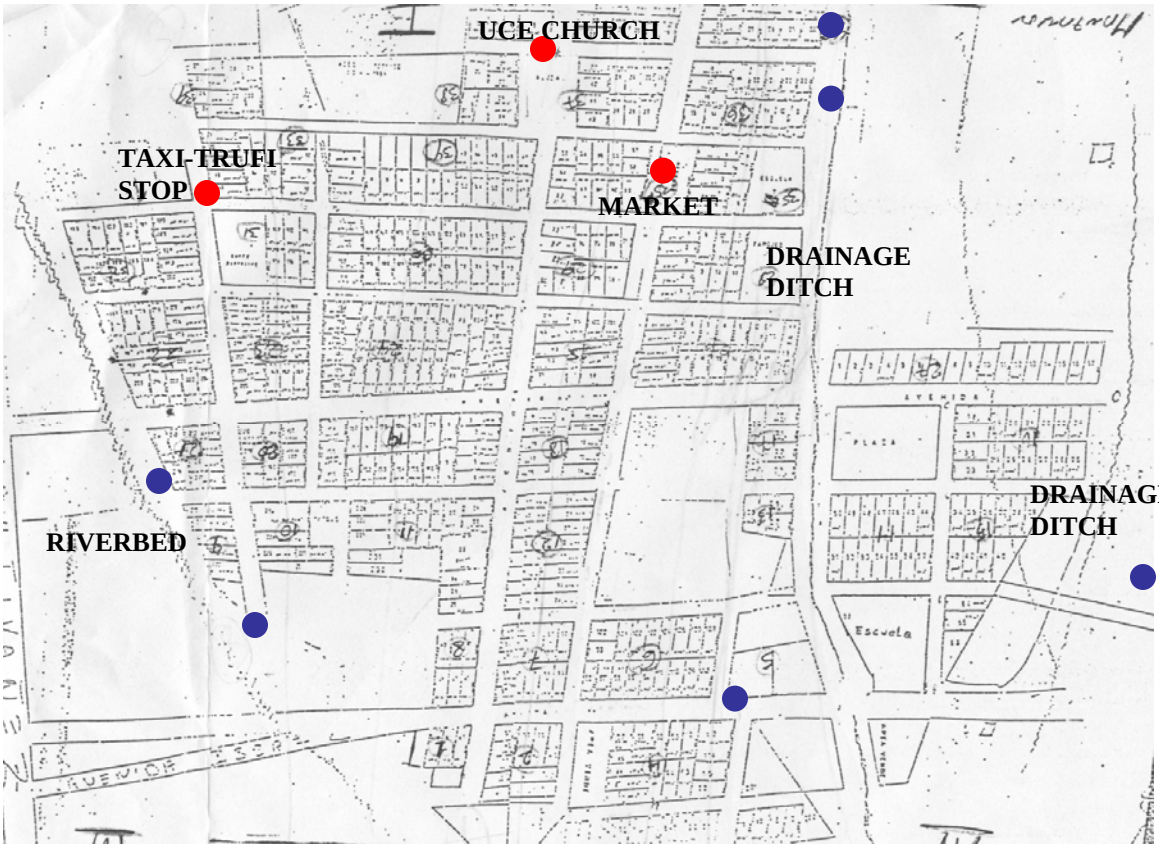

Figure 6-2. Map of Villa Israel, with dots representing 9 of 60 randomly sampled public places. Red dots represent areas with the highest number of public social interactions, and blue dots represent areas with lowest number of public social interactions.

places of high social interaction in water-scarce settlements. Of course, the Villa Israel's waterways are dry most of the year, and this explains why they do not act as social hubs.

Household-level data on Sociability, Reciprocity, and Participation

Respondent selection

Because the household is the basic unit of resource acquisition and distribution in poor urban communities (González de la Rocha 1994, González de la Rocha and Gantt 1995), I chose it as the unit of analysis for the semi-structured interviews. In the field site chapter, I described the composition of households and the division of labor within them. In the field methods chapter, I explained that we only interviewed people defined as "household heads", or those who were responsible for the acquisition and distribution of

household goods. Of the households we interviewed, 41 percent were households with more than one head. Of those, two households had three heads (a mother, father, and teenaged daughter) during the course of the study; the rest had just two household heads.

We interviewed multiple household heads because it helped us understand household decision-making, power dynamics, and division of labor. However, each household had to be represented by one head in the quantitative analyses to preserve the independence of observations and generalizability of the sample. I chose the household head that was most knowledgeable about resource acquisition and distribution to represent the household. Of the household heads chosen for quantitative analysis, 86 percent are female and 14 percent are male. Of these, three are girls under the age of 18 and one is a boy under the age of 18.

Data collected at the household level

Semi-structured interviews with household heads were used to collect recall data about the household head's social and economic activities over the last week. We used a large number of cues to prompt respondents' memories of social interactions, economic exchanges, and participation in meetings. Social interactions and economic exchanges were only counted if they took place between the respondent and a resident of *another* household located in Villa Israel. We counted the interaction and exchanges whether they occurred inside or outside Villa Israel. For instance, if two Villa Israel residents meet up in downtown Cochabamba, this counts as a social exchange. Similarly, if one Villa Israel resident feeds a neighbor's dog while the neighbor is out of town, this counts as an economic exchange. Each participant in the activity received credit for the economic exchange, whether that person was on the giving or receiving end.

The semi-structured interviews yielded data on five variables relevant to the discussion here: visiting, food sharing, loaning, helping, and community participation. First, we collected data on two measure of social interaction—visiting and food sharing. The "visit" measure counts the number of visits people made or received in the last week. According to the native construct *visitar* (to visit), a visit occurs when one person intentionally goes to another person's home to see them. If the people run into each other on the street, at the store, or at a social event, the interaction is not considered to be a visit. The "food sharing" measure counts the number times a person gave or received edible foods in the last week. *Invitar comida* (to offer food) is a very important native category in which one person gives another food for immediate consumption. Foods that are commonly offered include a banana, a few mandarin orange segments, about 10 kernels of puffed corn, a small plate of fried intestines, or a cup of soda. Food sharing is used to establish a relationship, build rapport, show friendship, or smooth over rocky relations. The food has no significant practical purpose, as the amount offered is usually less than a handful.

Next, we collected data on two measures of economic exchange—loaning and helping. The "loan" measure counts the number of times a person gave or received an item to or from someone else in the last week. According to the native construct *prestar* (to loan or borrow), a loan occurs when one person gives another any material item, like money, a bucket of water, or a hammer. Food ingredients that are not intended for immediate consumption, like onions, a bunch of bananas, or uncooked potatoes, are counted as loans, because giving them is not considered an act of *invitar comida* in Villa Israel. The "help" measure counts the number of times people gave or received help over

the last week. There is no strong native category that describes labor assistance. Instead, we asked about a number of common favors people do for each other, including keeping an eye on a neighbor's house or children, helping someone carry heavy bags to or from the bus, or helping someone wash the dishes. I classify these favors as economic exchanges because the labor has an economic value. Some of the favors were remunerated at the moment the favor was done, with cash, a meal, or a gift, and others were not. We coded them as help whether another exchange accompanied it or not.

Finally, we collected data on one measure of participation in community organizations—the number of meetings that people attended in Villa Israel over the last week. We asked people how many meetings of the Neighborhood Council or Villa Israel churches they attended in the last week. While there were also other organizations that met in Villa Israel, such as the School Council or PLANE, their meetings were periodic and would have skewed the meeting attendance data.

Data analysis

In this section, I discuss the data from five measures of sociability, reciprocity, and community meeting attendance. Data were collected over 10 months, from April 2004 to January 2005. The mean number of social interactions in which household heads reported participating was 6.72 visits and 12.34 incidents of food sharing over the week-long recall period. The mean number of economic exchanges in which household heads reported participating was 3.72 loans and 5.64 helping events over the week-long recall period. Finally, the mean number of meetings in which household heads reported participating was 0.34 for the week-long recall period.

There are some interesting differences in the reciprocal behaviors of female and male household heads. T-test analyses reveal that women engage in significantly more

food sharing (women = 13.47, men = 5.68, p = .02) and loans (women = 4.14, men = 1.24, p = .00) than men. However, there is no significant difference in female and male household heads' participation in visiting, helping, or attendance at community meetings. These data indicate that material goods like food, water, and money, tend to flow through women's networks in Villa Israel, while intangible exchanges like visiting, helping, and participation circulate equally among men and women.

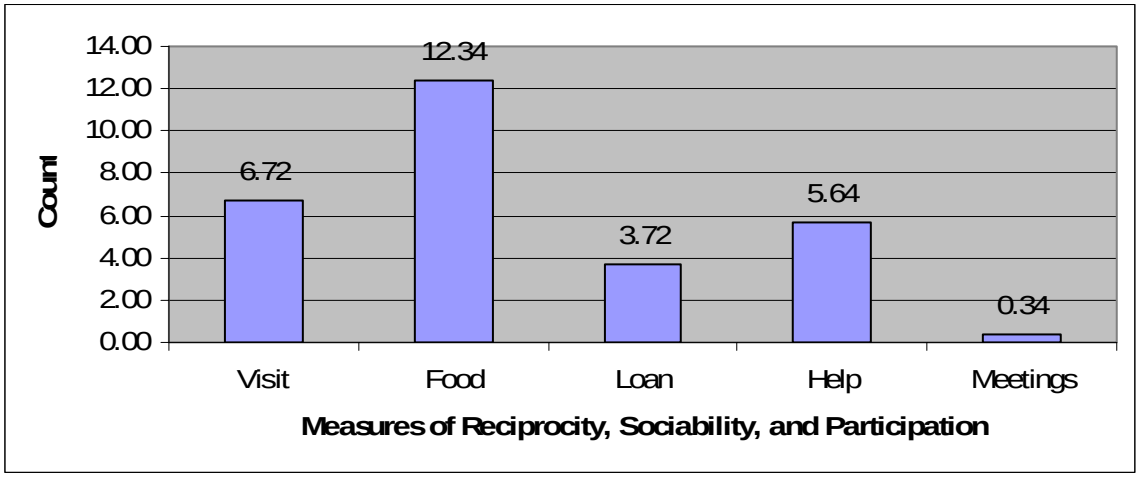

Figure 6-3. Means for five measure of reciprocity, sociability, and meeting participation.

Looking over the mean measures of reciprocity, sociability, and meeting participation, it seems clear that people engage most frequently in social interactions, less frequently in economic exchanges, and rarely in meetings. To understand why, we must consider the level of investment required for each kind of interaction, and the kind of payoff that can be expected from each one as well.

Social interactions, such as visiting or sharing food, generally require a relatively small capital investment. While the expected payoff is also quite small, social interactions provide people with a low-risk way to build social relationships and store small social obligations. In contrast, stored obligations to give a loan or help can be quite onerous. This explains why people tend to participate more actively in social exchanges than

economic ones. Community participation carries with it an even heavier burden of time, financial, and social obligation, and the investments do not necessarily result in the storage of explicit social or economic obligations. For this reason, people prefer making investments in interpersonal relationships, rather than in organizational ones.

Two excellent studies, one longitudinal (Gonzales de la Rocha 1994, 2001) and one cross-cultural (Moser 1996), indicate that urban reciprocal exchange systems are in decline. While those studies' findings cannot be generalized to Villa Israel, the authors make strong arguments that the trends they found in Mexico, Ecuador, Hungary, the Philippines, and Zambia are global. While reciprocal exchanges may have declined over the last 15 years in Villa Israel as well, the 2004-2005 data show that Villa Israel's household heads do participate actively in social and economic exchanges. They also indicate that people invest more heavily in social and intangible economic exchanges than in tangible economic ones.

Cultural Systems and Values are Unique

This study analyzes the relationship between resources and reciprocity. The theory underlying it is a materialist one; it posits that changes in the environmental base lead to changes in the way people interact with each other. As I mentioned in the theory chapter, materialist theories in ecological anthropology have historically been vulnerable to accusations that they are crass and environmentally deterministic. However, I do not believe these to be valid criticisms of this study for two reasons.

First, it is not crass to make the obvious observation that the presence or absence of some environmental resources determines how people interact. For instance, if there is water in the Villa Israel river, people meet there to wash laundry, talk to friends, and argue over who gets the best water. If there is no water in the river, no one goes there.

The observation is simple, but, as I showed in the map above, it has enormous implications for how, when, and where people interact in Villa Israel.

The second reason that the criticism is not valid is that ecological anthropologists do not contend that simply being able to predict changes in the resource base allows us to predict how, when, and where people will interact in any society. Laughlin and Brady, in their discussion of the scarcity response model, emphasized that reactions to scarcity are culturally distinct, and depend on the social and economic norms of each society. Messer, too, explained in her review of the literature on seasonal scarcity that "the environment, while it explains the periodicity and duration of social cycles, does not adequately explain the form of sociality which prevails in each phase or the institutional forms which express it" (1988: 133). These scholars underscore that while environment and economy are the most important drivers of scarcity response, they are do not act alone. Local cultures, embedded in history, place, and belief, must also be examined if we are to predict changes in social and economic interactions in specific societies.

In the section that follows, I discuss how social interactions and reciprocal exchanges are expressed through four cultural institutions in Villa Israel: family, neighborhood, religion, and business. In the literature on Latin America's urban poor, scholars have shown how each cultural institution shapes reciprocal exchanges. However, these institutions are not the same in every society, and it is important to acknowledge when and how they vary across and within cultures. During the height of the dry season, in August and September, we asked household heads to whom they go when they run out of basic necessities. Drawing on household heads' responses and data collected during

semi-structured survey interviews, I analyze how family, neighborhood, religion, and business shape survival-oriented reciprocal exchanges in Villa Israel.

Data on Exchanges within Four Cultural Institutions

Between August and September of 2004, we collected detailed data about household heads' reciprocal exchange partners over a week-long time period. The repeated measures ANOVA depicted in Figure 6-4 shows that household heads conduct significantly more exchanges within business and family relationships, and fewer exchanges with neighbors and churchgoers ($F = 5.265$, $p = .003$). People loaned and

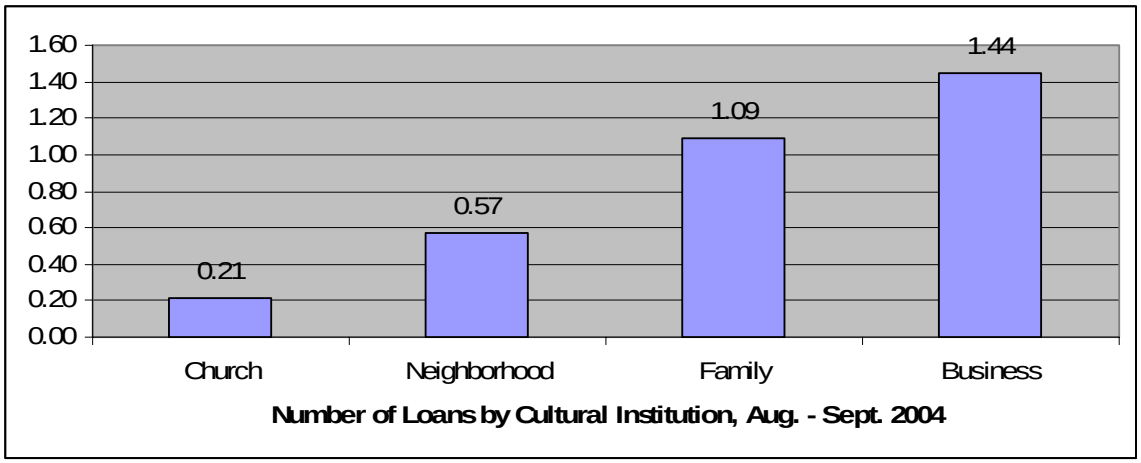

Figure 6-4. Means for loans that took place within four cultural institutions in Villa Israel (church, neighborhood, family, and business) during August and September 2004.

borrowed the least, an average of .21 items, with members of their own church. After that, they loaned and borrowed .57 items with neighbors. People loaned and borrowed more, an average of 1.09 items, with family members. People loan and borrowed the most, an average of 1.44 items, with people they knew through a business relationship, such as client-vendor, renter-landlord, or employee-employer relationships. It is important to note that only generalized reciprocal exchanges are counted; balanced reciprocal exchanges like paying rent or buying goods are not counted here.

Religion and church

In the section on the field setting, I explained that the evangelical-Catholic divide has caused major tensions among Villa Israel residents. I noted that one reason for the rivalry is a struggle for political power. In this section, I explore another major reason that tensions developed between evangelicals and Catholics—conflicts over how reciprocal exchange systems should be built and maintained.

Historically, Latin American Catholicism produced hierarchical systems of reciprocal exchanges through the rotation of *cargos*, *fiestas*, and godparenting. Cargos are ritual offices that are held on a rotating basis in Catholic communities. *Cargo* office holders redistribute their wealth in exchange for prestige and political power (Cancian 1965, Dow 1997, in press). In Bolivia, *fiestas* that play homage to local virgins are a particularly important part of local *cargo* system (Buechler and Buechler 1971, Goldstein 2003). Parents also name godparents to establish formal relationships that connect children to powerful community members. The *fiesta* and godparenting traditions ensure that reciprocal relationships link together high- and low-status families in reciprocal exchange relationships.

Over the last 20 years, a wave of evangelical conversions has swept Latin America (Stoll 1993, Cleary 1997). In her superb ethnography of Pentecostals in Bogotá, Bomann argues that the believers' relationship with the divine, quest for redemption, and spiritual passion are crucial to understanding this movement (1999). However, Bomann and other scholars agree that converts are initially attracted to the material benefits that evangelical churches offer. For instance, believers use the institutional resources and informal networks provided by evangelical churches to cope with poverty (cf. Mariz 1994). In Bolivia, the poorest shantytown dwellers are often drawn to evangelical churches because

of the material benefits and social support they provide (Gill 1990, 2000). Among evangelicals, there is a strong prohibition against drinking, dancing, music, saints, and parties. Instead of spending on celebrations, evangelicals advocate saving and reinvesting family earnings in capitalistic enterprises (Dow 1997, in press).

In Villa Israel, the prohibition and stigmatization of parties, dancing, music, and drinking has thwarted the formation of a Catholic reciprocal exchange system. Local Catholics are extremely bitter about this, and some profess a deep hatred for Villa Israel's evangelicals. One well-off Catholic retiree explained, "I like living in Villa Israel because it is tranquil, but I dislike that the majority of the people here are Protestants. Those people are shameless hypocrites." He went on to discuss the evangelicals' social shortcomings, "one Protestant here…is one of the cheapest people I have ever met in my life. Although he has quite a bit of money, he refuses to socialize with his equals… the Protestants always separate themselves in an antisocial manner whenever there is a community event" (Interview P334, 4/3/2004).

Although most evangelicals refuse to interact socially with Catholics, they do not believe that Catholics should be excluded from reciprocal exchange systems. For instance, Villa Israel's UCE Church runs an excellent daycare program, and allocates treasured spots in the program to both evangelical and Catholic children. Evangelicals universally express the idea that reciprocal exchanges should be charitable. One evangelical woman explained how she implements this ideology in her own life: "I know the people here, and I know who most needs help. Usually it is women whose husbands have left them with small children, or renters, or people who have serious marital problems. I would always choose to help the people who are most needy first" (Interview

M116, 9/6/2004). Indeed, evangelicals did participate in significantly more loans (evangelicals = 4.31, Catholics = 2.86, p = .06), helping (evangelicals = 6.79, Catholics = 3.53, p = .02), and food sharing (evangelicals = 14.51, Catholics = 8.65, p = .02) than

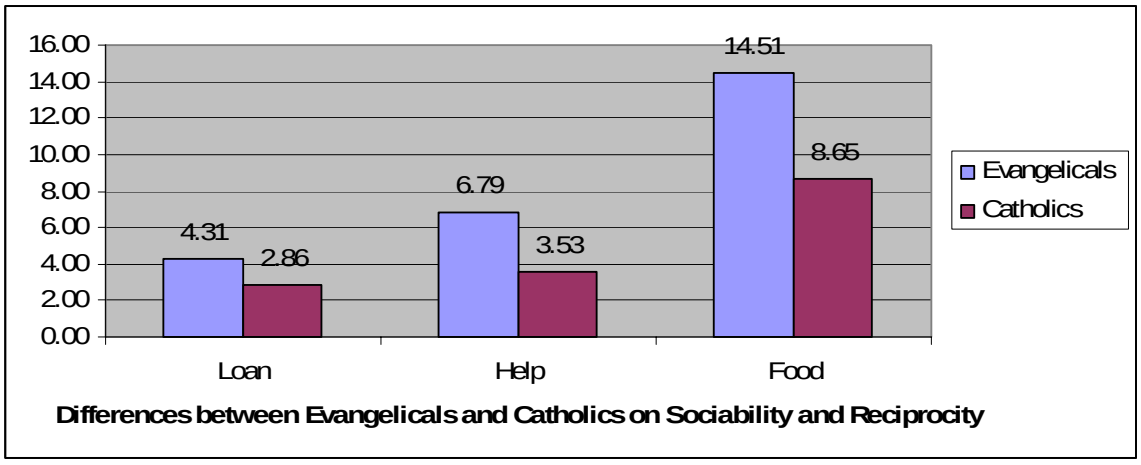

Figure 6-5. Means for the number of loans, helping, and food sharing that evangelicals and Catholics engaged in between April 2004 and January 2005.

Catholics over the 10-month study period. It is quite significant that, while evangelicals participate in more reciprocal exchanges than Catholics, there are fewer exchanges between churchgoers than any other group examined here. This indicates that evangelicals do exchange with people in the community at large, rather than just people who attend their own church.

Evangelical reciprocal values are built around bottom-up charity, while Catholic reciprocal values are built around top-down hierarchy. Catholics understand this, and feel their exclusion from access to political power, the community water system, and reciprocal exchange systems proves that evangelicals are hypocrites. It is indeed difficult to reconcile evangelical charity with the exclusion of Catholics from important community resources. Although I do not yet fully understand the dynamics at play, I believe that evangelicals' professed belief in indiscriminate charity is genuine and evidenced by their loan activity. However, I also suspect evangelical *social* exclusion of

Catholics prevents them from building trust, familiarity, and social relationships with Catholics, and precludes the establishment of meaningful reciprocal exchange relationships across religions. The evangelical prohibition on socializing with Catholics, then, effectively excludes Catholics from informal reciprocal exchange systems, even though evangelicals believe that Catholics should be beneficiaries of charity and reciprocal exchanges.

Neighborhood

In Latin America's urban migrant neighborhoods, much ethnography has documented the pivotal role that neighbors play in urban survival networks (Lomnitz 1977, Safa 1974, McFarren 1992, Halebsky 1995). In Villa Israel, only a few families maintain close reciprocal exchange relationships with neighbors. For instance, one single mother works 12 hours a day in the *cancha*, leaving her three children at home alone. She relies on her next-door neighbor to keep an eye on her children and home. When the neighbor was pregnant, the single mother provided her with a special bread, bananas, and medical advice. She also brings the woman's family meat regularly. The single mother said that, if she needed something, she would go to her neighbor before going to anyone else (Interview M8, 8/13/2004).

Most Villa Israel household heads have a much lower level of trust with neighbors. Although some occasionally watch a neighbor's house, loan a laundry brush, or give a bucket of water, many avoid getting involved in close, long-term reciprocal exchange relationships with neighbors. One woman explained why, "I would not want to ask for help from anyone. Here, people don't help you. They talk nicely to your face, and then they knife you in the back. If you ask them for help, they are just as likely to spread the news that you need help or be happy that you are in trouble. For that reason, I don't tell

anything personal to anyone and I don't trust anyone" (Interview M116, 9/6/2004). Another woman concluded, "If I am in need, I just have to endure it. Why would I go and ask for help? Everyone would just say no. They would just gossip about it. You have to keep it to yourself" (Interview M190, 9/12/2004).

Over the 18 months of field research, people constantly brought up the same themes when talking about reciprocal exchanges with neighbors: mistrust, humiliation, and gossip. In Villa Israel, people are unable to build trusting, reciprocal relationships with their neighbors because they fear that showing neediness will make them targets of gossip and humiliation. Gossiping has long been recognized as a tool that is used to suppress undesirable behaviors across cultures (cf. Stack 1974, Hill and Gurven 2004).

In Villa Israel, gossiping and humiliation suppress the appearance of neediness and participation in reciprocal exchanges. It is possible that a new value system—one that valorizes economic independence and denigrates economic interdependence—has emerged to support the widespread withdrawal from reciprocal exchange systems that was documented by González de la Rocha and Moser among the urban poor. The stigmatization of neediness, then, may be a cultural belief that develops in systems that are transitioning from a reciprocal exchange system to a non-reciprocal one. To draw definitive conclusions about this, however, data would have to be collected using natural experiments or cross-cultural research.

Envy, gossip, and their efficacy in suppressing community cooperation are common themes in anthropological studies of small-scale communities (e.g., Foster 1965). Shakow (personal communication) is currently engaged in fieldwork on envy in Choro, a rural town just outside Cochabamba, Bolivia. Shakow argues that envy, anxiety,

and community conflict are increasing in response to the economic inequities associated with neoliberal expansion (2005). Her fieldwork also indicates that Cochabambans see envy as a growing moral ill that prevents them from creating successful economic development programs.

Both Shakow and I have observed the presence of inequity, envy, gossip, and community conflict in Cochabamba. While we employ different theoretical approaches, we both believe that the trends are related to the expansion of neoliberalism and associated economic changes. An important contribution for future researchers will be to unravel the mechanisms—economic, political, and cultural—through which neoliberalism creates new configurations of cooperation and conflict. Such research will require fieldwork in a variety of contexts and explicit cross-cultural comparison.

Family

In the Andes, survival networks have been constructed around extended kin groups for centuries, if not millennia (Moseley 1992, Kluck 1989, Isbell 1978, Lobo 1982). Among urban migrants, reciprocal networks frequently draw on nuclear family, extended family, and fictive kin (Lobo 1982). In Villa Israel, too, household heads often rely on local family members for emergency loans.

Many Villa Israel household heads said that they had a high level of trust with immediate family members. One woman who lives across the street from her parents in Villa Israel explained that she “would never hesitate to borrow or take what I need from my mother, because no matter what happens, she is my mom and she has to help me” (Interview M253, 8/22/2004). Another woman with a large extended family in Villa Israel told us that if she needed help, she would go directly to her brother because “he is

the only person who would never reject me. If he couldn't help me, I would go to my other family members to ask for help" (Interview M194, 8/22/2004).

Despite the high level of trust many people develop with family members, reciprocal relationships do not flourish in all Villa Israel families. As one elderly woman said when asked what she would do if she ran out of essentials, "I couldn't ask anyone for help, not even my daughter. I would die, what else can I do?" (Interview M182, 8/20/2004). Another women explained, "I wouldn't ask anyone for help. I'm afraid to ask and be rejected. Even my sister-in-law could say no. I don't trust anyone enough to count on them or ask them for favors" (Interview M342, 8/18/2004).

In Villa Israel, fictive kin relationships are neither common nor particularly important. Despite this, some Catholic household heads say that their godparents would help them out in an emergency. One woman, who has no immediate relatives in Villa Israel, said that she "would try to go to the store to buy what I need but, if I couldn't, I would go to my godmother. I wouldn't feel afraid to borrow anything, because I know that I would give it back" (Interview M106, 8/22/2004). Although people do see godparents as possible sources of help in an emergency, few maintain long-standing reciprocal exchange relationships with them or express a high degree of confidence that the godparents would help them out during a crisis.

Businesses

One surprising finding from the field research is the extent to which Villa Israel household heads use business relationships to build reciprocal exchange partnerships. In the literature on urban reciprocity, there is little theoretical discussion of reciprocity among vendors, clients, renters, and employees. The only exception is Peattie's discussion (1970) of monetization of reciprocal exchange relationships. Peattie explained

that, in the shantytown where she conducted research, people paid for favors as a way to avoid the creation and storage of reciprocal obligations. In Villa Israel, people turn the tactic on its head, and use business relationships to build reciprocal ones. When reciprocal exchanges take place under the camouflage of business relationships, people can avoid the stigmatization of neediness and enjoy the benefits of reciprocity.

In Villa Israel, many household heads maintain reciprocal exchange relationships with owners of local corner stores. In exchange for the credit that vendors extend, clients reciprocate with loyalty, information, and payments. One woman, who has several family members in Villa Israel and is a member of the UCE church explained, “I am afraid to borrow and ask for favors from people here. In an emergency, I would only go to the corner store to borrow the things I really need” (Interview M339, 8/22/2004). Another woman said she relies on credit from the corner store because “I know that I can pay them back somehow, but I do not go to other people because I know they would deny me help” (M338, 8/16/2004). Many others said that they only trust the owner of their preferred corner store to help them during a crisis.

Interestingly, household heads’ reliance on corner stores creates its own set of problems for store owners. One store owner said that she avoids giving customers items on credit because, “when you charge them the only thing you earn is enemies, and then they end up going to other people’s stores” (Interview M181, 5/18/2004). Another storeowner said that he frequently gives credit, but only to customers he knows and considers trustworthy (Interview P366, 9/15/2004). The storeowners’ comments illustrate that clients expect to receive loans and gifts from storeowners, and punish the storeowners when they try to force balanced or negative reciprocal exchanges.

Storeowners know that they must be very careful to establish reciprocal relationships only when they have trust with a client.

Among co-workers, employers, employees, landlords, and renters, close reciprocal relationships are also built in Villa Israel. One restaurant owner maintains a close friendship with the owner of a nearby corner store. In a crisis, the restaurant owner said, she "would go to the one and only person I always go to for help (the store owner). She is the only person with whom I have trust" (Interview M99, 9/7/2004). Similarly, household heads that had renters or employees reported that they maintained extensive reciprocal exchange relationships that included food sharing, numerous loans, and help with childcare.

Based on observations and interviews, it appears that household heads prefer to create reciprocal relationships out of business ones for three main reasons. First, business partners have an economic interest in the welfare of reciprocal partners. Second, reciprocal partners do not appear to be needy when exchanges occur under the cover of business relationships. Such relationships are rarely the objects of gossip in the community. Third, people can repay favors with money alone if they choose, and no long-standing social obligation will be created. In this way, a reciprocal relationship can easily be re-converted into a business relationship if things go sour.

Conclusion

In the first half of this chapter, I discussed the three dependent variables that are examined in this study. Drawing on classic anthropological studies of social and reciprocal exchange, I explained how the Laughlin-Brady model predicts that resource scarcity will affect sociability, reciprocity, and community participation. In the second half of the chapter, I examined how two important phenomena—nested cycles and

cultural institutions—affect the Laughlin-Brady hypotheses. I showed that, while the long-term cycle of global capitalism has eroded urban reciprocal exchange systems, Villa Israel household heads do still engage in numerous reciprocal exchanges. I also showed that cultural institutions like religion, neighborhood, family, and business shape reciprocal exchanges in unique ways. In Villa Israel, conflicting value systems, mistrust, and gossip prevent people from creating extensive reciprocal exchange relationships through religion and with neighbors. Instead, people have developed reciprocal exchange relationships with business partners and family members. Now that I have established how and why urban water scarcity is expected to affect sociability, reciprocity, and community participation, I will test the hypothesized relationships in the next chapter.

CHAPTER 7
DATA ANALYSIS

In this section, I test the four hypotheses presented in chapter one. In section one, I use repeated measures analysis of variance (ANOVA) to determine whether household heads engage in more social interactions, economic exchanges, and community participation during the wet season than the dry season. In section two, I develop a multiple regression model to determine whether household heads with more water participate in more social and economic interactions than those with less water. Finally, in the third section, I fit the regression model I developed in section two to 10 datasets, and show how the effect of water availability on sociability changes seasonally. I conclude that water availability did affect sociability, but did not affect reciprocity or participation, in Villa Israel during 2004-2005.

Section 1—Changes in Water, Sociability, Reciprocity, and Participation over Time

A Note on Methods of Analysis

The statistical analyses in this section were performed using repeated measures ANOVA to determine if there are significant differences in mean measures, such as water scarcity and food sharing, over five study periods from April 2004 to January 2005. Since the repeated measures ANOVA procedure analyzes only data with no missing observations, data from 57 of the 76 households surveyed were used in these analyses. For variables that do show a significant difference over the five time periods, I use qualitative data from semi-structured survey interviews, key informant interviews, and participant-observations to explain changes over time. For some measures, the changes

were clearly related to seasonal changes in water availability; for other measures, the qualitative data point to other causal mechanisms.

Before I begin the discussion on temporal change in Villa Israel, it is important to briefly revisit the issue of nested cycles. As I explained in chapter six, multiple nested cycles—ecological, economic, political, and social—act together to shape social and economic interactions in every society. In the data presented here, not all cycles act equally on all measures. My ability to disentangle the influences of rainfall, economic, and political cycles on social and economic interactions depends, to a large extent, on knowledge I gleaned from in-depth interviews and participant-observation. Where possible, I let Villa Israel residents speak for themselves about how these cycles work. Often, however, people are unaware of how nested cycles shape their micro-interactions; in such cases, I rely on my own observation and analyses.

Changes in Water Availability over Time

In this section, I determine the extent to which water availability changes over time in Villa Israel. To do so, I examine three measures of water scarcity: rainfall, the water-based task scale, and normative water use. I chose these three measures because they represent each of the three approaches I used to characterize water scarcity—security to water access, the experience of water scarcity, and household water provision. I begin with a discussion of seasonal rainfall in Villa Israel.

Secure access to water: Rainfall measure

To understand the role that Cochabamba's seasonal rainfall patterns play in creating urban water scarcity, it was essential that 2004-2005 follow a typical wet-to-dry season cycle. The graph below depicts actual seasonal rainfall patterns across the study's six data collection periods. The rainy season lasted from January to March 2004, and

began again in late November 2004. The dry season lasted from March to November 2004.

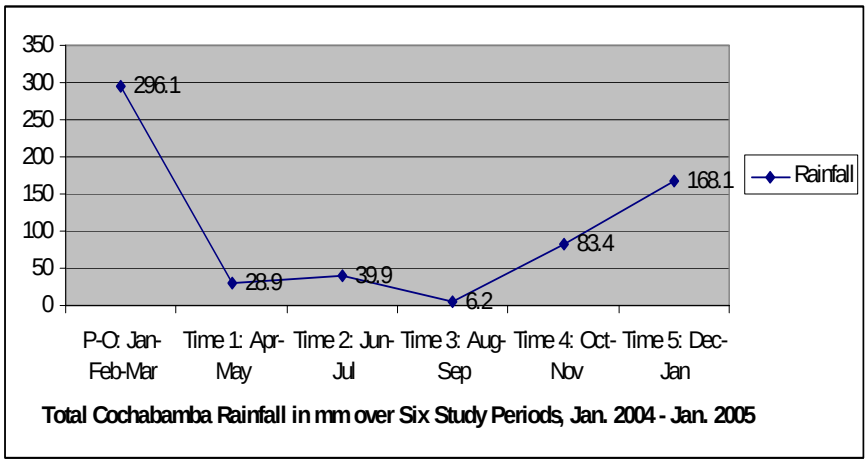

Figure 7-1. Total rainfall in mm across six data collection periods, from January 2004 to January 2005, in Cochabamba, Bolivia. (Rainfall data from SENAMHI 2005).

As I explained in chapter five, rainfall is a proxy measure for changes in water security over time. When it rains, Villa residents have access to two free and unrestricted sources of water—rooftop rainwater collection and the Villa Israel River. In 2004, the last heavy rains fell between March 17 and March 20 (SENAMHI 2005). Soon after, the Villa Israel River went dry. Some households had access to stored rainwater through April and May. The first rains of the new wet season fell between November 16 and November 17, 2004 (SENAMHI 2005). This indicates that Villa Israel residents had access to free and unrestricted water sources before May 2004 and after November 2004; they lacked access to free and unrestricted water sources from June 2004 to October 2004.

While access to two secure water sources disappeared during the dry season, this does not necessarily mean that people in Villa Israel experienced water scarcity once it stopped raining. In Villa Israel, people rely on multiple water sources—market-based water trucks, the community tap stand systems, rainfall collection, and surface water

sources—to obtain the water they need. While rainwater and surface water sources depend entirely on rainfall, the tap stand system and water deliver trucks do not. Using rainfall data alone, then, we cannot determine whether seasonal rainfall patterns actually result in seasonal water scarcity in Villa Israel. To do so, we must examine a direct measure of the experience of water scarcity.

Experience of water scarcity: Water-based task scale

As I explained in chapter five, the experience of water scarcity is multifaceted, and involves feelings, conflicts, and other dimensions. However, the measure that best represents the amount water people have in their homes is the Guttman scale of water-based tasks. The Guttman measure uses five indicators—house cleaning, bathing, doing laundry, cooking, and washing dishes—to determine if a household had enough water to complete common water-based tasks in the last week. A household with a score of 0 had enough water to do all five tasks, while water scarcity prevented a household with a score of 5 from doing all five tasks in the last week. The water-based task scale provides a sensitive measure of the amount of water scarcity households experienced in the last week.

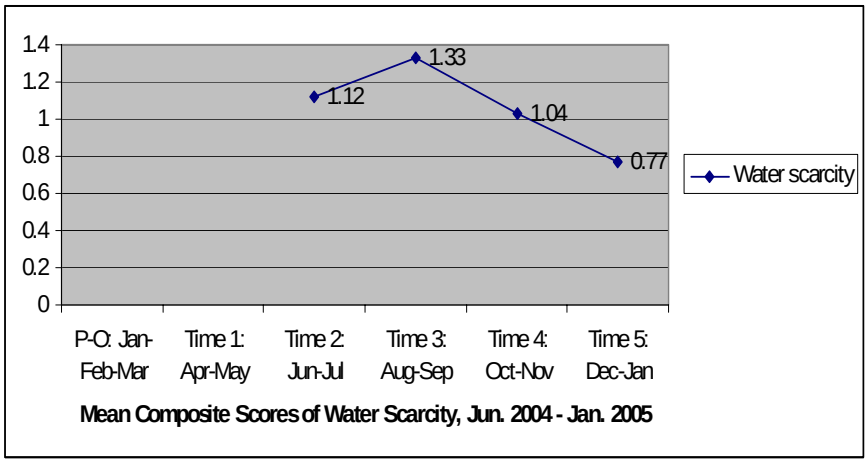

Figure 7-2. Mean composite household scores for Guttman task-based measure of water scarcity over four study periods, from June 2004 to January 2005, in Villa Israel.

Figure 7-2 depicts the mean scores of households over four study periods, from June 2004 to January 2005. A repeated measures ANOVA for the Guttman water-based task scale shows that there are small but fairly significant differences in the means over the four study periods ($F = 2.40$, $p = .08$). The means for June to July 2004 ($m = 1.12$), August to September 2004 ($m= 1.33$), and October to November 2004 ($m = 1.04$) are all between 1 and 2, which indicates that, on average, households struggled to get the water they needed to bathe and do laundry. In December 2004 and January 2005, the mean decreased to 0.77, which indicates that households, on average, had enough water or struggled only to get the water they needed for house cleaning. The data show that the experience of household water scarcity intensified in August and September 2005, at the height of the dry season.

There are only four data points available for the Guttman task-based measure of water scarcity because it took over three months to research, develop, and test the 33 indicators used for the Guttman scales. Even so, the four data points are enough to illustrate that temporal variations in the experience of water scarcity do correspond to seasonal variations in rainfall. In Figure 7-3, mean composite household scores for the task-based measure of water scarcity are plotted against data for total rainfall over the four study periods. Because the scales for the two measures are so different, the line graphs are shown without scales. The graphs clearly demonstrate that, as rainfall decreases between June and October 2004, the household experience of water scarcity increases. Conversely, as rainfall increases between November 2004 and January 2005, the household experience of water scarcity decreases.

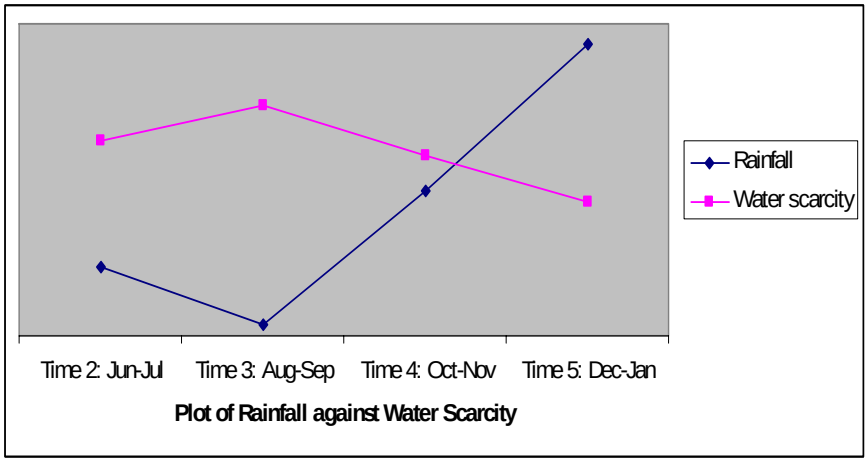

Figure 7-3. Total Cochabamba rainfall is plotted against the task-based water scarcity measure for data collected between June 2004 and January 2005.

The line graphs indicate that household perceptions of water scarcity are linked to seasonal rainfall variations in Villa Israel. While the water delivery trucks and tap stand system clearly do mitigate households' dependence on seasonal water resources, they do not de-link them entirely (as they do in urban centers with municipal water delivery). Instead, rainfall and surface water collection bind households to natural rainfall cycles, causing the experience of water scarcity to fluctuate seasonally in Villa Israel.

Household water provision: Task-based water use estimate

To assess the extent to which households suffered from absolute water scarcity, we obtained estimates of household water use. Here, I examine data for the task-based water use estimate, which was introduced in chapter five. The task-based water use estimate reflects the amount of water household heads perceive that household members normally allocate to 13 tasks. Since the data reflect water use norms, the task-based water use estimate is not a sensitive measure of short-term changes in water availability. Instead, it provides a broad view of household-level efforts to budget and plan for the use of existing water resources.

Figure 7-4 depicts mean estimates of per-person per-day water use in Villa Israel households between April and November 2004. Looking at the mean per-person per-day water use over four study periods, it is clear that household members never came close to using the 50 L of water that are required to meet daily household needs in a low-technology setting. In fact, average household water deficiency ranged from 14.02 L per day (during April and May 2004) to 22.37 L (per day during October and November 2004). Although Villa Israel households suffered from water scarcity throughout 2004, levels of household water use did vary across the four data collection periods.

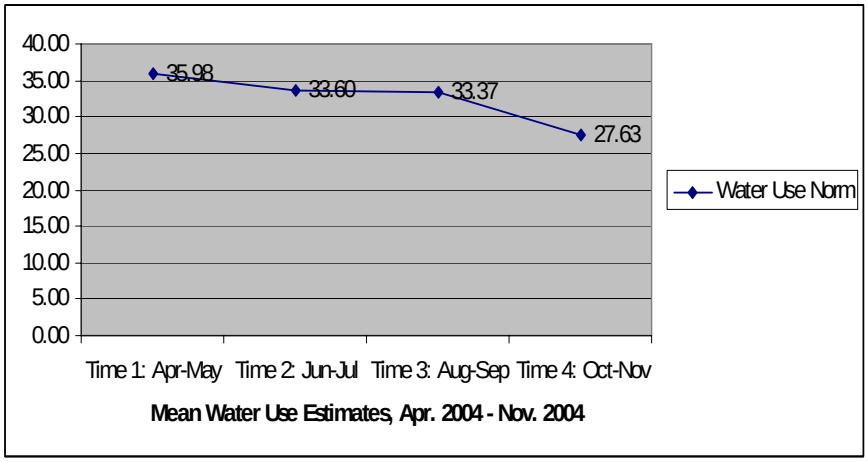

Figure 7-4. Mean estimates of household water use (per person, per day) over four study periods, from April 2004 to November 2004, in Villa Israel.

A repeated measures ANOVA for the water use estimates shows that there are significant differences in the means over the four study periods ($F = 5.38$, $p = .003$). In April and May of 2004, mean household water use was 35.98 L per person per day. As the dry season progressed, mean per-person per-day household water use decreased to 33.60 L in June and July 2004 and 33. 37 L in August and September 2004. Finally, in October and November 2004, mean household water use was at its lowest, 27.63 L per person per day.

Because the research design originally included only four survey cycles, we do not have data for the fifth survey period (in December 2004 and January 2005). When it still had not yet rained in October 2004, I asked the research team and respondents to participate in one extra round of interviews. Everyone agreed, with the stipulation that they would no longer do the despised water self-measure and the task-based estimate exercises in round five. The last cycle of interviews was less onerous for everyone involved, but, as a result, the extent to which household water use changed after the rainy season began in late November remains a mystery.

The data collected for April to September 2004 show that water use dropped as the dry season progressed. It is unsurprising that, as water becomes scarcer, people report using less water. However, there are two aspects of the graph that are unexpected. First, water scarcity worsened considerably from June and July 2004 to August and September 2004, but mean household water use only dropped by 0.23 L during that study period. Second, household heads reported that they decreased household water use by 5.74 L per person per day from August to November 2004. However, the water scarcity measure indicates that the water problem began to improve in October and November 2004. Why would people decrease water use just as the water scarcity problem begins to improve? A plot of water use against the rainfall data, shown in Figure 7-5, illustrates the two problems.

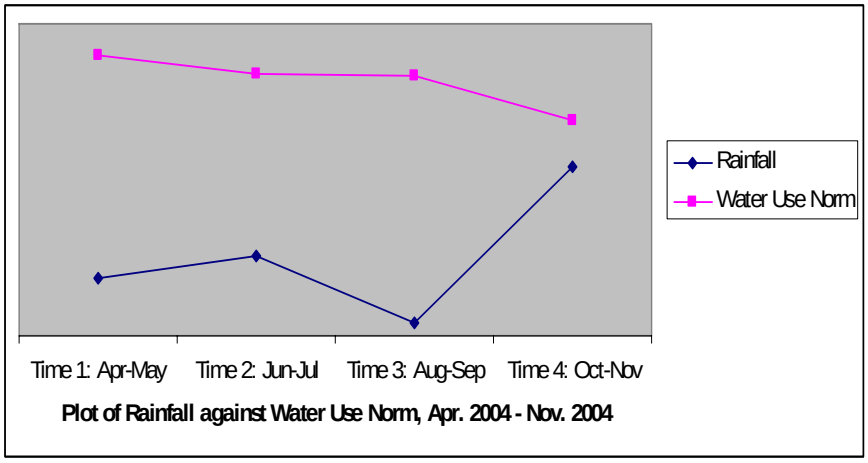

Figure 7-5. Mean Cochabamba rainfall is plotted against the household water use measure for data collected between April 2004 and November 2004.

The two anomalies make sense if changes in normative water use lag behind real changes in water availability. This would explain why normative behaviors at time three seem more appropriate for time two rainfall levels, and normative behaviors at time four seem more appropriate for time three rainfall levels. The data indicate, then, that people's water budgeting behaviors are shaped by past experiences, rather than current or anticipated ones.

Conclusion: Changes in water availability over time

In Villa Israel, the experience of water scarcity is complex, and is shaped by a number of factors including economy, politics, technology, and hydrology. Despite the complexity of water scarcity, it is possible to identify two simple water patterns in Villa Israel. First, the experience of water scarcity is closely related to rainfall patterns. While Villa Israel households use the water delivery truck and tap stand systems all year, rainfall and surface water provide crucial supplements to market-based water purchases. As a result, people have more water (from four sources) when it rains, and less water (from only two sources) when it does not rain. Second, people budget water in response to past experiences of abundance or scarcity. For this reason, people maintain the same

level of water use after they have experienced relatively stable access to water, and they conserve water after they have experienced decreasing access to water.

Piecing together data for rainfall, water scarcity, and water use, we can see how water availability changes over time for residents of Villa Israel. During the wet season, from December to March, water availability is highest. In April and May, the rains end but people can still subsist on stored rainwater. In June and July, rainwater stores begin to run out, and household members begin to conserve water by allocating less water to common household tasks. In August and September, experiences of water scarcity intensify, as rainwater stores have long run out and no rain falls. In October and November, people plan for severe water scarcity and allocate less water to household tasks. In November, the first rains of the wet season begin to relieve water-related stress. In December and January, heavy rains fall again and fewer households experience extreme water scarcity.

In the next section, I examine changes in sociability and reciprocity over time. I also relate those changes to seasonal water availability in Villa Israel.

Changes in Sociability, Reciprocity, and Community Participation over Time

Over ten months of survey research, the research team collected data on seven measures of sociability, reciprocity, and community participation in Villa Israel. In this section, I discuss three measures of sociability (visits, food sharing, and public social interactions), two measures of reciprocity (loans and helping), and two measures of community participation (church attendance and Neighborhood Council attendance). I begin with an analysis of changes in sociability.

Sociability: Changes in food sharing over time

The first measure of sociability discussed here is the number of times Villa Israel residents shared food in the last week. Figure 7-6 depicts the mean number of food sharing events in which household heads participated over five study periods. A repeated measures ANOVA shows that there are significant changes in food sharing across the five study periods ($F = 4.09$, $p = .01$). The changes in food sharing shown here appear

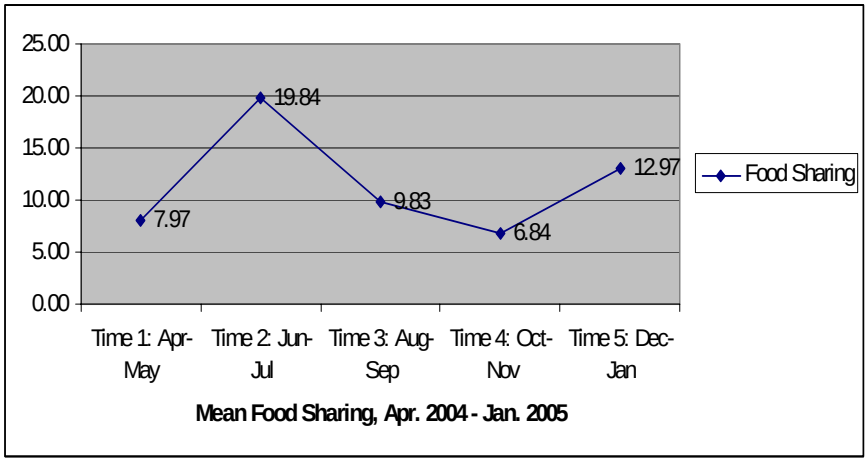

Figure 7-6. Mean numbers of food sharing over five study periods, from April 2004 to January 2005, in Villa Israel.

exactly as predicted by the Laughlin-Brady model. As water scarcity intensifies, between April and July 2004, there is a sharp increase in food sharing. Then, in August and September, as the dry season progresses, food sharing drops off. In August, an evangelical woman recounted what happened when she offered food to one of her neighbors at Villa Israel's Sunday market, "I gave her some of my lunch, on the top of the pot I was eating out of. She did not give me anything in return because she doesn't know how to *invitar comida*. She hides her food as she eats it. You have to teach people how to share food" (Interview M8, 8/13/2004). In July and August, several other women also brought up the topic in interviews, and explained to me that people in Villa Israel

just do not know how to share food properly. Clearly, the dry season change in food sharing habits does not escape people's attention in Villa Israel.

However, the idea that people "just don't know how to share food" is not borne out in the data. Food sharing reaches a low point during the crisis months of October and November, when water, income, and market activity are all scarce. In November, one Villa Israel resident explained how the three factors interrelate, "The market is empty, and no one has any money. There isn't any rain either, so that things can be produced again" (Interview M32, 11/10/2004). In response to this overwhelming scarcity, people avoid maintaining social relationships that might be a draw on scarce economic resources.

In December and January, when resources are abundant again, people resume food sharing activities. The data indicate, then, that people do know how to share food, but they only choose to do so when they are in a stable economic position. In the next section, I explore how and why social interactions increase in December and January.

Sociability: Changes in visiting over time

The second measure of sociability discussed here is the number of visits made and received by household heads in Villa Israel. Below, Figure 7-6 depicts the mean number of visits in which household heads participated over five study periods. A repeated measures ANOVA shows that there are significant changes across the five study periods ($F = 3.23$, $p = .02$).

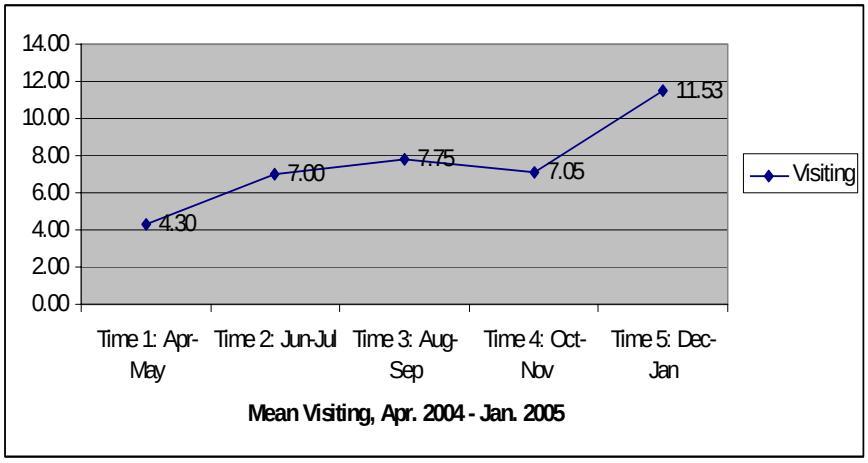

Figure 7-7. Mean number of visits over five study periods, from April 2004 to January 2005, in Villa Israel.

In particular, there are two sizeable increases in visiting—one between April and July 2004 and another between October 2004 and January 2005—across the ten months of survey research. Both increases are hypothesized by the Laughlin-Brady model. As water scarcity begins to worsen between April and July of 2004, people intensify social interactions. Then, as water becomes available during the wet season in December 2004 and January 2005, social interactions increase again.

During the wet season in December and January, however, the increase in visiting is higher than we would predict as a response to changes in water availability alone. That increase in visiting is actually related to rainfall, holiday, and economic cycles that recur each year. As one Villa Israel entrepreneur explained in October 2004, “The economy in Cochabamba is bad now, as it always is at this time of year. But it will pick up again in December, as always.” (Interview M101, 10/19/2004). In December, the onset of the rainy season frees up time and capital that had been spent on the *aguatero*. Two important holidays, Christmas and the New Year, also help stimulate the Cochabamba economy. The sharp increase in visits in December and January, then, reflects the

combined effects of the start of the rainy season, holiday social activity, and the revitalization of the Cochabamba economy.

One unexpected finding here is the small increase in visiting between July and August of 2004. Following the Laughlin-Brady model, we would expect people to visit less as the dry season progresses, from August to November. However, in August and September, the number of visits in which people participate actually increases; visiting only decreased during October and November of 2004. Although the drop in visiting was delayed, people's reasons for withdrawing from visiting relationships did coincide with the hypotheses under study here. For instance, one mother explained that she did not make any social visits in early November because she "did not have any money left over" and visiting always involves some small expenditure (Interview M32, 11/10/2004). Many other respondents said that they did not have time to go and visit people, as they were occupied with numerous economic activities as they tried to make ends meet. As predicted, then, as water scarcity worsened, people intensified income-generating activities and withdrew from social relationships.

Sociability: Changes in public social interactions over time

The third measure of sociability examined here is public social interaction. Figure 7-8 depicts changes in public social interactions over four study periods in Villa Israel. A repeated measures ANOVA shows that there are small but moderately significant changes in public social interactions over the four study periods ($F = 2.72$, $p = .04$).

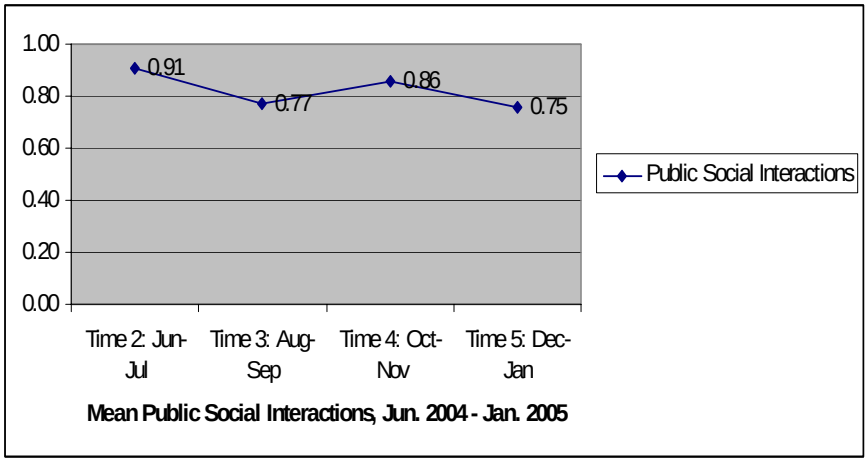

Figure 7-8. Mean number of public social interactions over four study periods, from June 2004 to January 2005, in Villa Israel.

In June and July, public social interactions average .91 interactions per site, and they decrease to .77 in August and September. The spike and drop in interactions do, to this point, follow the changes predicted by the Laughlin-Brady model. However, after October, trends in public social interactions are the opposite of what we expect. In October and November, public social interactions increase, and then they fall again in December and January. After a review of the data from participant-observation and semi-structured survey interviews, I could find no reason for the observed changes in public social interaction.

Unlike the patterns in food sharing and visiting, public social interactions do not appear to follow the trend predicted by the Laughlin-Brady model. Public social interactions involve very little expenditure of time and resources, and so there is probably no reason to reduce them during the dry season. Instead, some variable other than water scarcity must drive change in public social interactions, and that variable was outside of the scope of this study.

Reciprocity: Changes in loans over time

A repeated measures ANOVA showed no significant difference in loans (F = 1.89, p = .13) over the five study periods.

Reciprocity: Changes in helping over time

A repeated measures ANOVA showed no significant difference in helping (F = 1.82, p = .14) over the five study periods.

Participation: Changes in church attendance over time

A repeated measures ANOVA showed no significant difference in church attendance (F = 1.79, p = .13) over the five study periods.

Participation: Changes in neighborhood council meeting attendance over time

The last measure examined here is attendance at Neighborhood Council Meetings. Figure 7-9 depicts changes in Neighborhood Council meeting attendance over five study periods in Villa Israel. A repeated measures ANOVA shows that there are very significant changes in public social interactions over the four study periods (F = 6.59, p = .006).

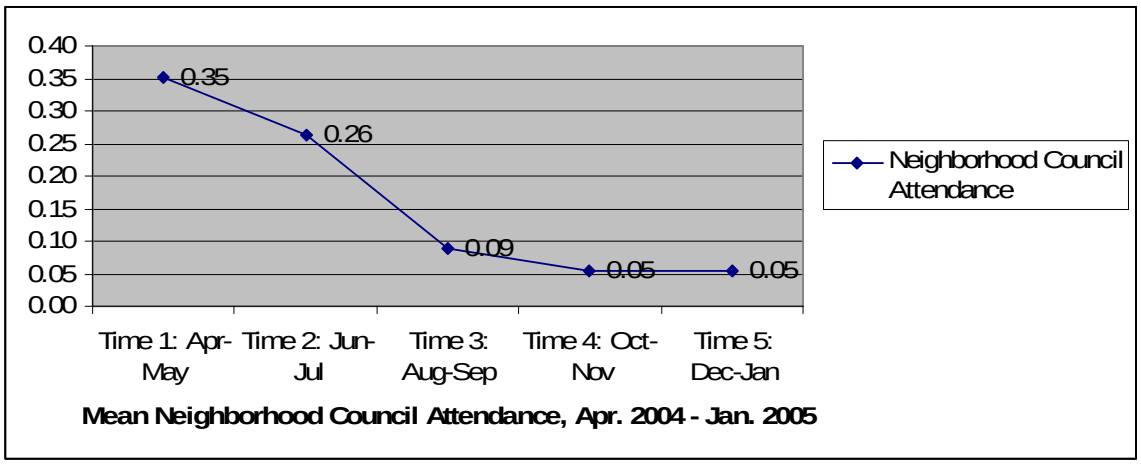

Figure 7-9. Mean number of public social interactions over four study periods, from June 2004 to January 2005, in Villa Israel.

As the graph shows, changes in Neighborhood Council meeting attendance do not follow the pattern predicted by the Laughlin-Brady model. Instead, meeting attendance decreased consistently throughout the study period.

A crisis in the leadership in the Neighborhood Council, which unfolded during 2004, caused the drop-off in meeting attendance that year. In April and May of 2004, meeting attendance and participation was relatively high. Then, news of several serious embezzlement scandals involving the Neighborhood Council hit the community. In June, there was also a public fistfight between the Council leader and a Council board member. All of these events shook community members' trust in the leadership of the Neighborhood Council. In June, several board members resigned from the Neighborhood Council in protest of the current leader. However, community members voted to give the leader one last chance to right the wrongs of the past. In late August, the leader finally resigned, and was replaced in an emergency election. After August, people said that the change in leadership was an improvement, but few showed any interest in attending meetings. As a result, attendance at Neighborhood Council meetings dropped off considerably during the last four months of the study period. This drop appears to have had little or nothing to do with increasing water scarcity.

Conclusion: Changes in sociability, reciprocity, and participation over time

In this section, I presented the results of repeated measures ANOVAs for data on water availability, social interactions, economic exchanges, and community participation. The data showed that there were significant changes in water availability and social interactions over the 10-month study period. There were no significant changes in economic exchanges and community participation over the 10-month study period. Clearly, it is important to ask why the hypothesized effects appear only in social

interactions, and not for economic or participatory behaviors. To understand how and why people disengage in patterned ways, we must first understand why people engage in each kind of interaction. Social interactions, economic exchanges, and community participation fulfill different needs in the life of a Villa Israel resident.

People engage in social interactions for two reasons. First, visiting and food sharing are fun. People participate in social interactions to pass the time, gossip, and joke. Second, social interactions provide an important foundation for the initiation of later economic exchanges. While social interactions also occur between people who already have economic relationships, they are initiated more frequently, occur between less trustworthy partners, and can broken off more easily than economic relationships. In contrast, reciprocal economic relationships allow each partner to draw on the other's goods, labor, and social capital. As a result, economic relationships are normally only established between partners with a long social history, high trust, and a strong interest in maintaining the relationship. To preserve economic relationships, people avoid refusing requests and making requests that will be refused. Like economic exchanges, church participation occurs as part of a very strong commitment to religion and to a religious community. People who stop attending church are targets of gossip and criticism in the community. Participation in the Neighborhood Council is required and enforced with a small fine, but is also widely shirked by Villa Israel household heads.

Severe short-term scarcity, it seems, impacts low-trust, low-commitment relationships first. Since social relationships are not instrumental to people's survival, they break them most easily. Additionally, people also appear to cut off social interactions that act as gateways to economic interaction. People who are engaged in

reciprocal relationships avoid social interactions with existing and potential economic partners, so they will not be put in a position to refuse requests when times are tough. People who are actively engaged in reciprocal economic exchanges and church attendance, however, continue these interactions. This is because disengaging from economic and religious commitments would invite censure and damage one's long-term economic and social security. Severe short-term scarcity, then, does not appear to prompt a withdrawal from interactions within high-trust, high-commitment relationships.

While ecological and economic scarcity did cause household heads to withdraw from social interactions, the 2004 dry season was not severe enough to prompt a withdrawal from economic exchanges and church participation. Had it not begun to rain, however, it seems likely that the social and economic impacts of water scarcity would have increased during November and December.

Section 2—Explaining Social Interactions across Households

In chapter one, I hypothesized that household heads with more water will participate in more social interactions and economic exchanges than those with less water. Here, I test those relationships by building a multiple regression model for each of the dependent variables.

Identifying Independent Variables

To analyze trends over the entire 10 months of field research, I took the mean of the data collected for each variable over the five data periods. I then identified six potential independent variables: (1) self-administered direct measure of water use, (2) task-based water use estimate, (3) overall estimate of weekly water use, (4) task-based Guttman scale of water scarcity, (5) water storage capacity, and (6) household economic well-being. As I explained in chapter five, all of these variables were designed to capture

some aspect of the water scarcity concept. Variables 1, 2, and 3 were designed to measure water availability. Variable 4 was designed to measure experiences of water scarcity. Variable 5 was designed to measure water security. Variable 6 was designed to measure access to water markets. While other measures (such as distance from the cistern route and Guttman scaling of water conflicts) were also designed to capture unique elements of the water scarcity concept, those measures were exploratory, and are too noisy for use in a regression analyses.

In Table 7-1 and Figure 7-10, I show the results of a principal components analysis of the six variables under study here (with no rotation). I also performed the principal components analysis with varimax and equamax rotations, and the factor loadings were the same. In factor one, three variables load high: Water Norm (.95), Water Use (.86), and Water Estimate (.86). Factor one clearly represents water provision. In factor two, the Guttman measure of water scarcity loads high (.76), while the economic well-being measure loads low (-.77). Factor two, then, represents water scarcity loaded against economic well-being. Factor three represents water security, and only the water storage capacity variable loads high (.98). The factor loadings support the argument I made in chapter five that water scarcity has three aspects: water provision, the experience of water scarcity, and water security. These three aspects, in addition to the measure of economic well-being that opposes water scarcity on component three, will be used to predict social interactions in the multiple regression models developed here. While I could have used the individual factor loadings as independent variables in the regression model, I have chosen to use the raw data for three reasons. First, as I explained earlier in this chapter,

Table 7-1. Factor loadings for six potential predictors of social interactions, for summaries of data collected over five interview periods.

Component loadings	1	2	3
Water Norm	0.95	0.18	-0.08
Water Use	0.86	0.36	0.00
Water Estimate	0.86	0.13	0.05
Econ. Well-being	0.37	-0.77	0.23
Guttman Water Scar.	-0.40	0.76	0.12
Water Storage Cap.	0.00	0.09	0.98
Percent of Total Variance Explained	44.51 %	22.35 %	17.35 %

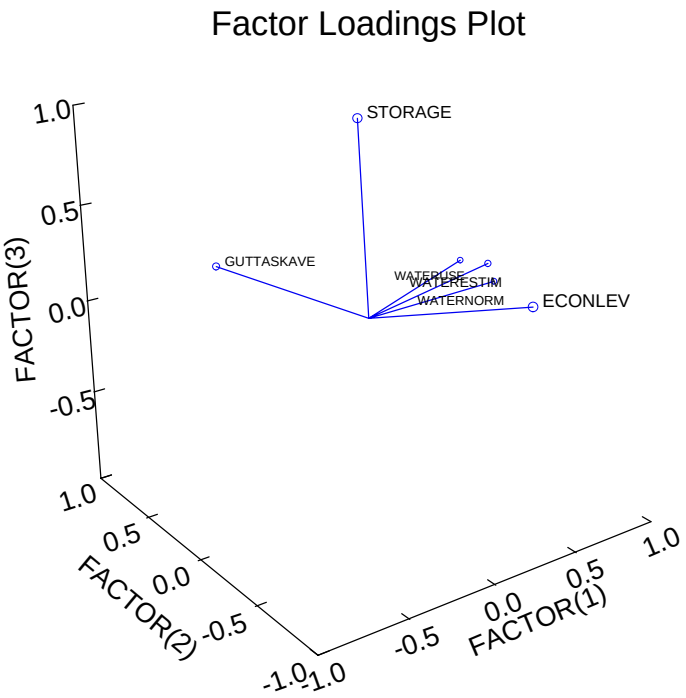

Figure 7-10. A plot depicting factor loadings for three factors. Factor one represents water provision, factor two represents economic well-being against water scarcity, and factor three represents water security.

I do not have data on water norms and water use for time period five. Without period five data, it would be impossible to fit a regression model using factor loadings to the dataset for time period five. Second, as I explained in chapter five, the three water provision measures are highly correlated, so it is unlikely that using a summary measure would

significantly improve predictive power over using one of the three variables. As a result, I have chosen to use the water estimate variable, for which I have complete data, to represent the water provision factor in the model here. Third, I have worked throughout this study to create clear and simple analyses that have high explanatory power. As I argued in chapter five, doing so helps researchers who lack the time and funding I had in Villa Israel to reproduce the methods in other contexts. By testing the effects of four simple variables—water estimate, storage capacity, water scarcity, and economic well-being—I facilitate cultural anthropologists' ability to reproduce the methods of data collection and analysis in other ethnographic contexts.

Building the Regression Model

Using the four independent variables identified here, I fit a regression model to the summary data to predict two measures of sociability (visiting and food sharing). It is appropriate to question the value of using a regression model to predict two closely related dependent variables, like visiting and food sharing (Pearson correlation = .67, p = .000). Both measures were actually designed to operationalize the same concept—sociability—so it is unsurprising that they are so highly correlated. However, as similar as the two measures are, there are two important differences between them. Visiting is a high-commitment social activity with no resource exchange required, while food sharing is a low-commitment social activity in which resource exchange must occur. The implications of these two conceptual differences will be explored in the section that follows this one.

The independent variables had no significant effect on the other four dependent variables (loans, helping, church attendance, and Neighborhood Council meeting

attendance). The results of the first two models are presented in Table 7-2; the results of the remaining four models are contained in the appendix.

Table 7-2. Regression models predict two kinds of social interactions, using four independent variables. Data are means for five data periods.

Dep. Variables	N	Data source	R-sq	P	Indep. Variables	Coeff.	P
Visiting	72	Means (Apr 2004-Jan 2005)	0.13	0.05	Water storage	0.21	0.07
					Water estimate	0.24	0.05
					Gutt. W. Scarcity	0.10	0.46
					Econ. Well-being	0.12	0.39
Food Sharing	72	Means (Apr 2004-Jan 2005)	0.09	0.16	Water storage	0.26	0.03
					Water estimate	0.11	0.38
					Gutt. W. Scarcity	-0.12	0.36
					Econ. Well-being	-0.02	0.91

The model accounts for a modest and significant amount of the variation in visiting. It is not significantly associated with food sharing. Looking at the independent variables, it is clear that there are some problems. Water storage is the only independent variable that is significantly associated with both dependent variables. Water estimate is significantly associated with visiting, but not with food sharing. The Guttman water scarcity and economic well-being measures are not significantly associated with either of the dependent variables.

I argue that two of the independent variables, Guttman water scarcity and economic well-being, should be removed from the model. While it is important to avoid data-driven model building, there are legitimate methodological reasons to exclude these two variables. As I explained in chapters three and five, Guttman water scarcity and economic well-being are both ordinal-level measures that were designed during the field research.

The assignment of scores on the economic well-being measure was done cooperatively by the research team after the research was conducted, so there are no inter-rater reliability scores to test the reliability of the scoring. The Guttman water scarcity scale is an experimental measure that has never been tested before. The removal of the two measures from the model is warranted because the measures are not reliably coded, well-defined, or extensively tested. As a result, they are probably too noisy to contribute meaningfully to the analyses here. I stress, however, that future studies should attempt to collect better data on economic well-being and further develop Guttman scales of water scarcity so that these variables can be included in regression models.

Understanding the Regression Model

Once the Guttman water scarcity and economic well-being measures are eliminated, the resulting multiple regression models account for a modest but significant amount of variation in both visiting and food sharing. Since there is neither a statistical nor a conceptual association between the two independent variables (Pearson correlation = .03, p = .77), the inclusion of an interaction variable would be inappropriate for this model. The parameters for models predicting visiting and food sharing appear in Table 7-3 below.

The independent variables still had no significant effect on the other four dependent variables (loans, helping, church attendance, and Neighborhood Council meeting attendance). The results of the remaining four models are contained in the appendix.

The model accounts for 12 percent of the variance in visiting behaviors (p = .01). Both water storage and water estimate variables have a weak positive association with visiting. The food sharing model accounts for 8 percent of variation in food sharing (p =

.06). While there is a significant association between storage capacity and food sharing, the water estimate is not significantly associated with food sharing.

Table 7-3. Regression models predict two kinds of social interactions, using two measures of water availability. Data are means for five data periods.

Dependent Variable	N	Data source	R-sq	P	Independent Variables	Coeff.	P
Visiting	72	Means (Apr 2004-Jan 2005)	0.12	0.01	Water storage	0.23	0.05
					Water estim.	0.25	0.03
Food Sharing	72	Means (Apr 2004-Jan 2005)	0.08	0.06	Water storage	0.25	0.04
					Water estim.	0.12	0.29

The water storage variable is a better predictor of both social interaction variables. When household heads can better budget water use, they engage in more social interactions. People who constantly live with the threat that water will run out, however, avoid and are excluded from social interactions. This is probably because people with little water security (1) are too stressed out to really enjoy social interactions and (2) want to avoid getting entangled in economic obligations that they can not fulfill. People who are better able to budget their water use are probably more able to enjoy themselves and less wary of incurring economic obligations.

The water estimate variable is only significantly associated with visiting, not food sharing. Household heads who believe that they have more water engage in more visiting than household heads who believe they have less water. As with the water storage variable, people who have more water are more able to have fun and more willing to incur economic obligations. This explains why they are less avoidant of social situations. The question remains, however, why is the water estimate associated with only visiting, and not food sharing?

The explanation is that visiting behaviors are more sensitive to changes in water scarcity than food sharing. There are two reasons for this. First, visits occur inside people's houses, so it gives people the opportunity to assess one another's water provision and storage situation. In contrast, much food sharing occurs in the street, and so it does not make anyone vulnerable to predatory water borrowing or gossip about water poverty. Second, visiting is a much more intimate behavior that food sharing. Once someone has entered another person's home, it is easy for one person to obligate the other to do a favor. Food sharing, however, is much more casual, and can easily be cut short or disengaged from without giving offense.

In the next section, I explore the use of regression models to examine how these two variables predict social interaction when water is available and when it is not available.

Section 3—Explaining Household Social Interactions over Time

The Laughlin-Brady model predicts that sociability and reciprocity will only be affected when resources are scarce. If the resource supply is abundant, then, there should be no correlation between resource provision and sociability. To test this using the water data, I tested the regression models using 10 datasets (from five study periods) to predict visiting and food sharing. The model only fits three of the datasets—for the data collected during the height of the 2004 dray season. Table 7-4 shows the results for the three regression models.

The independent variables are not associated with variance on the dependent variables in the other 27 models, with one exception. The regression model accounts for 11 percent of the variance in "helping" behavior in the period two dataset ($p = .03$). However, since this one finding is not explained by theory and does not fit the overall

pattern in the data, I do not consider it to be significant. The appendix contains the results of the other seven regression models for visiting and food sharing, and the 20 regression models fitting the data to the remaining four dependent variables.

Table 7-4. Regression models predict visiting and food sharing for two study periods: June—July 2004 and August—September 2004.

Dependent Variable	N	Data source	R-sq	P	Independent Variables	Coeff.	P
Visiting	65	Jun 2004 -Jul 2004	0.11	0.02	Water storage	0.33	0.01
					Water estim.	0.07	0.54
Visiting	60	Aug 2004 -Sep 2004	0.23	0.001	Water storage	0.27	0.03
					Water estim.	0.38	0.002
Food Sharing	60	Aug 2004 -Sep 2004	0.14	0.01	Water storage	0.33	0.01
					Water estim.	0.18	0.16

Together, water storage capacity and the water use estimate account for a moderate amount of the variation in visiting and food sharing during the dry season. In June and July, the model explains 11 percent of the variance in visiting ($p = .02$). In August and September, the model explains 23 percent of the variance in visiting ($p = .001$). In August and September, the model explains 14 percent of the variation in food sharing ($p = .01$). In each of the models, water storage yielded a positive, significant correlation to social interactions. The water use estimate yielded a positive, significant correlation with visiting only during August and September. In that model, water estimate had the strongest and most significant correlation of any predictor used in the three models. During the other study periods and for food sharing, the water estimate did not account for any variation in the dependent variable.

Using the models, we can identify several important trends in the data. First, water availability is only significantly associated with social interaction during the height of the

dry season. Second, household heads began to cut back on visiting early in the dry season (in June and July), but they did not reduce food sharing until later in the dry season (in August and September). Third, household heads with less water storage capacity were affected earlier and reduced both kinds of social interactions, while people who believed they had less water were affected later in the dry season and reduced only visiting behaviors, and not food sharing. Fourth, when the water estimate emerges as a significant predictor of social interaction, it exerts a stronger and more significant effect than the storage capacity variable.

Looking at the three regression models, the mechanisms that mediate social responses to water scarcity become clear. During the rainy season, water availability has no effect on social interactions. As the dry season sets in, household heads cut back on social visits. As the dry season advances, they also cut back on food sharing. Household heads with less storage capacity are initially more responsive to the onset of the dry season than are household heads with less water, because they are more conscientious about budgeting social and economic expenditures. However, when water scarcity becomes severe, people who believe that they have less water cut back on social interactions more drastically than do people with less storage space.

Based on these findings, I would predict that, had the dry season been worse: (1) people with less water would cut back on food sharing; (2) then, people with less storage capacity would reduce economic exchanges; and (3) finally, people with less water would reduce economic exchanges.

Data Analysis Conclusions

In this chapter, I examined the effects of urban water scarcity on social interactions, economic exchanges, and community participation. In the first section, I examined

changes in water provision and scarcity over time in Villa Israel. Using repeated measures ANOVAs, I identified the two dependent variables that changed in response to water scarcity in Villa Israel—visiting and food sharing. In the second section, I created a multiple regression model that tests the effects of water availability on social interactions for the Villa Israel data. I explained how and why two measures of water availability (water storage and water estimate) predict two measures of sociability (visiting and food sharing).

Finally, in the third section, I tested the fit of the regression models for the data from each of the five study periods. I showed that water scarcity affects sociability only during the height of the dry season. During the wet season and transitory periods, water availability variables are not correlated with measures of sociability, reciprocity, and community participation. I also showed that water storage capacity affects sociability earlier in the dry season, but that the water estimate has a stronger effect once dry season water scarcity intensifies. I conclude that the 2004 dry season in Villa Israel was not severe enough to cause effects on reciprocity or community participation. I hypothesize, however, that under more severe water scarcity conditions, sociability, reciprocity, and community participation would continue to change as predicted by the Laughlin-Brady model.

CHAPTER 8
CONCLUSIONS

In this last chapter, I discuss the study's results and their implications for theory, practice, and future research. In the first section, I summarize the research agenda, methods, and findings. In the second section, I discuss the study's contributions to theory and practice. In the third section, I explore the implications for future research in cultural anthropology.

Section 1—Summary of Findings

This research examines the effects of urban water scarcity on reciprocity and sociability. Following Laughlin and Brady's 1978 model of human adaptation to resource scarcity, I hypothesized that four effects could be observed in Villa Israel: (1) household heads would participate in more social interactions during the wet season than during the dry season, (2) household heads would participate in more reciprocal economic exchanges during the wet season than during the dry season, (3) household heads with more water would participate in more social interactions than those with less water, (4) household heads with more water would participate in more reciprocal economic exchanges than those with less water.

To test these hypotheses, I developed measures of water scarcity, sociability, and reciprocity that were appropriate to the ethnographic context of Cochabamba, Bolivia. Measures of water scarcity were designed to function in an urban context where water comes from multiple sources, including a market-based system, a politicized community system, and seasonal rainfall-based sources. I designed three approaches to measuring

water scarcity: water provision, water security, and the experience of water scarcity. Each of the approaches contributes unique information about the emics and etics of water scarcity.

Measures of reciprocity and sociability were designed to capture the complex social landscape of a Bolivian shantytown, including the heterogeneity of origins, religion, ethnicity, household composition, and economic well-being in the research population. I designed three measures of sociability, two measures of reciprocity, and two measures of community participation. Each of the measures represents emic categories of sociability, reciprocity, and participation, but they also operationalize the concepts in clear, reproducible ways that contribute to our etic understanding of the topic.

After four months of participant-observation, data were collected over 10 months, in five rounds of survey research and direct observation. The results of repeated measures ANOVAs show that participation in two kinds of social interactions (visiting and food sharing) changed over time. Participation in public social interactions, reciprocal exchanges, and community meetings did not change over time. A multiple regression model showed that two measures of water availability (water storage capacity and water use estimate) had a moderate, positive association with social interactions. The other measures were not significantly correlated with the dependent variables. However, by fitting the regression model to datasets from 5 study periods, it became clear that water scarcity only affected visiting and food sharing during the dry season; there were no effects during the rainy and transition seasons.

The findings indicate that the Laughlin-Brady model does accurately predict the effects of urban water scarcity, to a point. As the dry season progresses, household heads

engage in fewer social interactions. People with less water and less ability to budget water use engage in fewer social interactions. Changes in reciprocity and community participation did not occur as predicted. Economic and religious relationships are much more valuable than social ones, and water scarcity was not severe enough to motivate people to break valuable ties. Participation in the Neighborhood Council changed in response to cycles other than seasonal water scarcity. I conclude that seasonal water scarcity in Villa Israel was not severe enough to cause all the effects hypothesized by the Laughlin-Brady model during 2004-2005.

This research described changes in water scarcity, sociability, reciprocity, and community participation during a typical seasonal cycle in Villa Israel. As a result, the findings should be helpful in drawing conclusions about survival tactics in water-scarce urban areas during a typical dry season. I do believe, however, that during an atypical year with more severe or prolonged water scarcity, we could observe the effects on reciprocity and community participation predicted by the Laughlin-Brady model.

Section 2—Contributions to Theory and Practice

Theoretical Contributions to Anthropology

In this section, I examine the study's contributions to anthropological theory. First, I discuss urban water scarcity and the survival strategies of the urban poor. Then, I discuss human adaptations to resource scarcity. Finally, I discuss the findings in view of the larger project of theory-building in cultural anthropology.

Urbanism, Poverty, and Water Scarcity

In this study, I argue that the emergence of urban water scarcity can best be explained using a political ecological approach. In chapter one, I explained that a center/periphery urban structure, characterized by the inequitable distribution of

municipal services to outlying residents, developed in many Latin American cities. In chapter five, I showed that such an urban structure exists in Cochabamba, Bolivia and has caused a serious water scarcity problem to develop among residents of the city's south side. I explained that historical factors, including Bolivia's national economic crises, the hydrological characteristics of the Cochabamba Valley, political decisions of Cochabamba policymakers, and the settlement patterns of highland migrants, have all contributed to the exclusion of the urban poor from Cochabamba's municipal water system. I concluded that, to understand the emergence of urban water scarcity in local contexts, it is necessary to examine hydrological, social, political, and economic factors.

I also argued that water scarcity is a complex concept that should be studied using etic and emic approaches. First, measures of water provision help us assess the severity of unmet biophysical needs for water. Second, measures of water security help us understand how ecological, technological, and infrastructural factors shape water scarcity. Third, measures of the experience of water scarcity help us understand how culture mediates the ways in which water scarcity is felt and understood in local contexts. Using all of these approaches helps us create a more complete picture of the causes, distribution, and effects of water scarcity within and across cultures.

Urban Reciprocity

Another important phenomenon under study here is decline of reciprocal exchange systems. As I showed in chapter six, economic conditions in the 1960s and 1970s supported the creation of reciprocal networks. After the 1980s, economic crises and neoliberal restructuring undermined reciprocal exchange relationships. My research on urban reciprocity in Villa Israel indicates that new systems of belief and behavior have begun to develop in response to new economic conditions.

First, I found that there is a strong prohibition on economic interdependence among neighbors in Villa Israel, which is enforced with gossiping and public embarrassment. Second, I found that, while household heads avoid creating reciprocal exchange relationships with neighbors, they maintain extensive reciprocal exchange relationships with family members and business partners (like landlords, renters, storeowners, and clients). Third, I found that reciprocal exchanges are not distributed equally over all community members. Catholic exchanges systems, which are built around an unsustainable and stigmatized *fiesta* system, are in decline. In contrast, evangelicals are actively involved in reciprocal exchanges, which are built around an accumulation-oriented value system rather than a redistributive one. Together, these findings indicate that new values and reciprocal exchange structures have emerged to replace the old ones, and they are more compatible with the new economic system than the old values and reciprocal exchange structures.

Human Adaptations to Resource Scarcity

This study's main focus is on testing the applicability of the Laughlin-Brady model for urban water scarcity. The results show that the Laughlin-Brady model does accurately predict the effects of water scarcity on sociability in Villa Israel. This is particularly significant because is it indicates that, however complex the societies and scarcity phenomena we study, we can still disentangle the effects of ecological and economic cycles on social and cultural phenomena. It also provides further evidence that material changes in the ecology and economy are the primary drivers of changes in human belief and behavior.

In this study, I used both ideographic and nomothetic theories to explain the effects of urban water scarcity on reciprocity and sociability in Villa Israel. Ideographic theories

advance case-specific explanations, while nomothetic theories advance universal explanations that apply to many cases (Bernard 2002: 77-83). By using both kinds of theory, I showed that each one has much to contribute to our understanding of how and why people respond to resource scarcity. First, I used ideographic (local and regional) theories to examine urban water scarcity, sociability, and reciprocity in Villa Israel. Then, I used a nomothetic theory of culture change to explain why water scarcity affects sociability in Villa Israel.

As I explained in chapter one, ecological anthropologists have spent decades embroiled in debates to determine the extent to which changes in the resource base cause changes in human belief and behavior. Following the work of political ecologists, I have argued here that the relationship between resource scarcity and human behavior is strong, but not mechanistic. Changes in the availability of ecological and economic resources are the primary drivers of culture change. However, the cultural, political, and psychological dynamics that create and mediate human perception of resource scarcity also shape the ways—collective and individual—that people respond.

Interdisciplinary Contributions

The research was designed to contribute to two interdisciplinary research areas: environmental sustainability and human well-being. In this section, I examine how the research findings advance interdisciplinary research in each of these study areas.

The research was designed to examine human-environment interactions in a water-scarce urban environment. This study made several contributions to this research area. First, the study contains an in-depth ethnographic description of life in a water-scarce urban area. The ethnographic description shows how extractive technologies and distributive systems shape human water use. Second, it details the political ecology of

urban water scarcity in Cochabamba, Bolivia. The political ecological analysis demonstrates how power, politics, and economics shape access to natural resources in developing cities. Third, it presents a three-pronged approach to understanding the urban water scarcity concept. The analysis of water provision, water security, and water scarcity experience illustrate that "urban water scarcity" is a complex concept that contains elements of biophysical need, infrastructural adequacy, and culturally-mediated perception. Fourth, the research presents twelve reproducible ways to measure the urban water scarcity concept. By presenting the definition, operationalization, and descriptive statistics for each measure, the study facilitates scientific research on the human aspects of urban water scarcity. Fifth, the study demonstrates the utility of nested cycles (as in nested seasonal and economic cycles) and transformation (as in the transformation of reciprocal relations through new social constructions like Latin American evangelism) in explaining the human responses to changes in the resource base. In doing so, the study shows how theories of social-ecological systems can help explain cycles of human behavior. Together, these findings reveal new information about the workings of human systems of water distribution and consumption, and point to future avenues for research on human-environment interactions around water, as well as to programs for ameliorating problems of urban water scarcity.

In addition to its focus on environment, the research was designed to examine how water scarcity affects human well-being, particularly at the family, community, and cultural levels. The study contributed to this research area in several ways. First, the study identified the people responsible for the acquisition and distribution of important household resources, including water. The research revealed that child-headed

households are most vulnerable to water scarcity, and that dual-headed households were most successful in acquiring and distributing the resources they need. Second, the study examined water allocation across thirteen household tasks. It showed that people suffering from water scarcity cut back first on hygienic activities, and then on water consumption. Third, the study showed that water provision and budgeting affect household heads' ability to participate in social interactions, which act as a gateway to reciprocal economic exchanges. Over the long-term, this may affect household heads' ability to participate in reciprocal favors and exchanges. Fourth, it showed that the local water distribution system provides unequal access to water resources for community residents. This explains why many Villa Israel residents do not benefit from the water the system provides. Fifth, the politicization of community-level water systems also causes people to avoid participating in the maintenance and extension of local water systems. As a result, the infrastructure has fallen into disrepair with extensive water leaks and at least one non-functional tap stand. Sixth, over time, serious tensions have developed around the water issue at the community level. As a result, the Water Committee is defunct, community members refuse to fund solutions that the Neighborhood Council pursues, and the creation of community-oriented solutions to water problems has been inhibited. Together, these findings reveal new information regarding how urban water scarcity affects family and communities, and point to future avenues for research about the cultural aspects of water scarcity.

Drawing on ethnographic, observational, and survey data, the study makes contributions to two areas of interdisciplinary research. First, it examines hydrologic aspects of human-environment interactions. It shows how human systems of water

extraction and distribution are created and maintained in developing cities. It also shows that the survival of the most vulnerable populations is closely tied to natural hydrologic systems, because vulnerable populations are marginalized from municipal water systems. Second, the study examined the effects of urban water scarcity on one vulnerable population, residents of Villa Israel. It shows that, although households vary in terms if their ability to access water resources, the entire community is affected by the stresses, politics, and conflicts that develop around urban water scarcity.

Ending Urban Water Scarcity: Six Recommendations

As I mentioned in chapter three, this research project was conceived and executed with the help of Susana Southerwood and Abraham Aruquipa, two hydrologic engineers from the water-delivery NGO Water for People. While in the field, I was conscious of the need to generate applied findings that would help real-world practitioners like Susana and Abraham with their work to end urban water scarcity. While practitioners are certainly capable of drawing their own conclusions from the findings presented here, I hope to facilitate the process by pointing to six suggestions for improving water delivery and water relief projects.

First, while water scarcity is a serious problem for people all year, water relief projects are urgently needed for residents of water-scarce communities during the dry season. Between the months of June and October, many families are in need of better access to water, cheaper water, and more water. Any kind of relief project that could distribute or facilitate the distribution of water during the dry season would be enormously helpful to residents of communities like Villa Israel (Recommendation 1). Water relief projects would probably prevent hunger, disease, and hygienic problems during the dry season. If water relief projects are implemented, they should target the

neediest households first. Relatively affluent household heads can be incredibly savvy about appropriating food, materials, jobs, and money that are meant for the poorest households. To avoid this, relief projects should distribute relief to households in the following order: child-headed households, households headed by elderly women, households headed by single mothers, households headed by out-of-work men, and renters (Recommendation 2). The qualifications of project participants can be easily verified by checking with the owners of nearby corner stores.

The most serious obstacles to the implementation of community-based water projects appear to be (1) political corruption that targets development projects and (2) power struggles over access to and control of resources. It is extremely important for practitioners to do everything they can to prevent local corruption and power struggles (Recommendation 3), because such incidents live on in communities members' memories and undermine their willingness to participate in community projects for years. However, corruption and power struggles are complex problems, and the solutions lie far beyond the scope of this study. Even when nothing can be done about local corruption and power struggles, practitioners can improve water distribution by working with water delivery truck operators.

Currently, water delivery trucks provide the most reliable, accessible, and affordable water access for most community members—and everyone uses them. However, water delivery service could be improved in two ways. First, people who live far away from main roads cannot get reliable access to the trucks. By negotiating for a fixed route that includes back roads, even just one day a week, NGOs could significantly improve access to water sources for families in outlying areas (Recommendation 4).

Second, while most families can afford to buy the water they need from the water delivery truck, some families simply cannot. By implementing a system of vouchers, subsidies, or graded pricing, water provision levels could be improved significantly for the most vulnerable members of water-scarce neighborhoods (Recommendation 5). While it is true that water delivery trucks are independent profit-oriented operators, they are also accustomed to negotiating over the price and distribution of water. NGOs command a considerable amount of power and capital across the developing world, and could do much to make water markets physically and economically accessible for all community members. Projects that focus on water delivery trucks could probably do more to improve water distribution than any other kind of project in water-scarce urban communities like Villa Israel.

Finally, this study shows that, over the course of the dry season, household water storage capacity does more to improve household well-being than any other kind of water infrastructure. Having more water storage capacity allows people to negotiate for bulk water discounts and to budget their water use more effectively. This indicates that water-oriented NGOs should consider building water storage capacity instead of or in addition to making improvements to water distribution infrastructure (Recommendation 6). The importance of water storage capacity, of course, is related to household dependence on water markets, the reliability of those water markets, and the availability of a functioning local water distribution system. In Villa Israel, however, conditions would be ideal for a pilot program and further study of the proposition that water storage capacity is the best infrastructure for protecting families from water scarcity.

Section 3—Looking Ahead in Cultural Anthropology

Moving Forward: Anthropological Research on Urban Water Scarcity

As I explained in chapter one, social scientists have only recently begun to focus their attention on urban water scarcity. Because the area of inquiry is so new, it presents many opportunities for anthropologists to contribute. In this section, I briefly examine three potential areas for future research on urban water scarcity.

First, anthropologists should do much more to understand urban water scarcity. To begin, we must determine where and when urban water scarcity emerges around the world. To build a cultural anthropology of urban water scarcity, we must examine both material and cultural mechanisms that shape urban water scarcity, including water distribution systems, water extraction technologies, and socio-economic systems. We also need to test the efficacy of the three approaches to understanding water scarcity presented here, and develop better measures as our understanding of the phenomenon deepens.

Second, I asserted that dry season water scarcity in Villa Israel was not severe enough to all cause all the effects predicted by the Laughlin-Brady model. In the future, we should determine whether very severe water scarcity affects sociability, reciprocity, and community participation as predicted by the Laughlin-Brady model, or not. It is, of course, very risky to plan a field research study around seasonal urban water scarcity, since the seasonal rainfall cycles are generally unpredictable. However, by doing comparative research in communities with different levels of water scarcity, we can also determine the effects of severe water scarcity on the dependent variables. In such studies, it will also be important to determine how the relative importance of different aspects of water scarcity (like water security, water provision, and market efficiency) change as dry season unfolds.

Third, we should use cross-cultural research to determine how the socio-economic effects of urban water scarcity are expressed in different cultural systems. In particular, the study should be reproduced in societies with different economic bases, social structures (such as family and religion), and kinds of reciprocal exchange systems. This will help us understand how culture mediates the effect of resource changes on human belief and behavior. It will also help show that materialist explanations of culture change (Steward 1959, Carneiro 1970, Rappaport 1974, Harris 1979) are not mechanistic, but rather make full use of culture in developing explanations for social phenomena.

Cultural Anthropology's Future: Collaboration, Method, and Theory

Collaboration

As I explained in chapter one, natural scientists have become increasingly interested in collaborating with social scientists to understand social-ecological systems. Such collaborations have enormous potential to yield influential theory and practical applications. Generally, natural scientists are interested in social scientists' ability to explain how human beliefs, perception, and behavior affect (and are affected by) the natural resource base. This is the kind of contribution that any social scientist can make to an interdisciplinary collaboration. However, anthropologists also have unique knowledge that no other discipline can offer, including knowledge of human biophysical and cultural adaptations, human manipulation of the natural and constructed environments, the historical depth of human experience, and a comparative, evolutionary perspective.

Anthropologists are in a unique position to contribute to studies of human-environment interactions, then, because they offer more sophisticated analyses of the human-environment nexus than any other social science discipline. Ecological anthropologists laid the theoretical foundations of ecological anthropology (Steward

1959, Carneiro 1970, Rappaport 1974), created influential integrative theories (Wolf 1969, Vayda and McCay 1975, Harris 1979), embraced political ecology (Durham 1979, Schmink 1982, Stonich 1989, 1993), and continue to innovate in their use of social-ecological and new ecological theory (van der Leeuw and Redman 2002, Abel and Stepp 2003). To remain at the forefront of innovative interdisciplinary collaborations, however, cultural anthropologists maintain the attention to methodological rigor that our colleagues in biological anthropology and archeology have.

Method

To remain in dialogue with other disciplines, cultural anthropologists must use scientific methods. At a minimum, we should continue to produce rigorous ethnographic work, make plain our sampling and data collection methods, use reproducible methods, explicate causal links, and test hypotheses relationships with statistical analyses. We must also be clear about whether our arguments are based on reliable data, exploratory evidence, or conjecture.

Over the last two decades, cultural anthropologists have continued the discipline's tradition of creating innovative research methods. The anthropological tool kit contains many new items, including consensus analysis (Romney et al. 1986), personal network analysis (Bernard et al. 1990, McCarty and Wutich 2005), economic experimentation (Henrich et al. 2004), and ecological experimentation (Casagrande et al. in press). Methodological innovation is particularly important in cultural anthropology because anthropologists are often positioned to observe the emergence of new social phenomena and structures before anyone else. Ethnography gives us knowledge of these new cultural constructions, but methods give us the ability to report on those findings in concise, scientific ways.

Theory

For the past 25 years, there has been something of a paradigmatic shift in anthropological research, from scientific model-building to humanistic interpretivism. Scientific model-building uses reproducible methods to test hypotheses and make falsifiable contributions to knowledge. In contrast, humanistic interpretive research identifies new discourses, challenges dominant narratives, encourages reflexivity, and promotes engagement with the power and politics. Both are focused on understanding cross-cultural changes in human belief and behavior, and both make important contributions to the development of anthropology as a discipline.

However, when humanistic interpretivism goes unchecked by scientific contributions, these strengths can become weaknesses. In cultural anthropology, for instance, scant evidence has occasionally been used to posit grandiose theories of cross-cultural change. Conversely, ethnographic research can become so particularistic that it is disengaged from the effort to create cross-cultural theories. Both trends are undesirable because they undermine the quality of research produced, prevent anthropologists from influencing interdisciplinary collaborations and social policy, and detract from the strength and growth of the discipline.

By balancing critical, discourse-oriented research with scientific, data-based research, anthropology has the potential to grow and improve. Anthropological theory is at it most powerful when humanistic and scientific approaches are used to complement each other. For instance, cultural anthropologists' ability to put themselves in unusual ethnographic contexts, identify new discourses, and analyze their idiomatic implications is one of the discipline's great contributions to social science. But we must also

determine the extent to which new discourses and behaviors are global, regional, or local. Once we do, we can explain how and why they develop as they do.

In my work here, I operationalized Ennis-McMillan's bodily distress concept, and determined the extent to which it can be applied to water scarcity in Villa Israel. I determined that, while Villa Israel residents do not express concern about water scarcity using the idiom of bodily distress, emotion and conflict are important aspects of the water scarcity experience. Like Ennis-McMillan, I analyzed the political, ecological, and economic aspects that shape urban water scarcity. Combining our work, a cultural anthropology of urban water scarcity that is interpretive, scientific, cross-cultural, and explanatory begins to emerge. For interpretivists and scientists to build an integrated cultural anthropology, we must read each other's work and use it in the field. While combining approaches is not as common as it ought to be, it is very important for the future development of cultural anthropology.

To my way of thinking, the biggest challenge for scholars of my generation is to bridge the gap between humanism and science that developed during the 1980s and 1990s. For scientists, the challenge is to find novel ways of operationalizing and studying the questions humanists raise. For humanists, the challenge is to understand how discourses can be operationalized and explained by mid-range and nomothetic theories of cross-cultural change. If young scholars can find ways to cross sub-disciplinary boundaries, we will facilitate future collaborations, preserve the strengths of cultural anthropology, and create research that influences the way policymakers build our world.

APPENDIX
REGRESSION MODELS

Regression Models with Four Independent Variables, with Data for Means from Five Study Periods

Table A-1. Regression model predicts loans using four independent variables. Data are means for five data periods.

Dep Var: ITEM N: 72 Multiple R: 0.239 Squared multiple R: 0.057

Adjusted squared multiple R: 0.001 Standard error of estimate: 3.444

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.204	1.863	0	.	3.329	0.001
WATERESTIM	0.034	0.033	0.126	0.928	1.02	0.311
STORAGE	0	0	0.047	0.975	0.391	0.697
ECONLEV	-1.096	0.591	-0.257	0.733	-1.855	0.068
GUTTASKAVE	-0.188	0.458	-0.056	0.761	-0.411	0.683
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	48.233	4	12.058	1.017	0.405	
Residual	794.546	67	11.859			

Table A-2. Regression model predicts helping using four independent variables. Data are means for five data periods.

Dep Var: HELP N: 72 Multiple R: 0.169 Squared multiple R: 0.029

Adjusted squared multiple R: 0.000 Standard error of estimate: 6.500

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.42	3.517	0	.	1.825	0.072
WATERESTIM	0.016	0.063	0.033	0.928	0.262	0.794
STORAGE	0	0	0.16	0.975	1.311	0.194
ECONLEV	-0.427	1.116	-0.054	0.733	-0.382	0.703
GUTTASKAVE	-0.496	0.865	-0.079	0.761	-0.573	0.568
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	83.413	4	20.853	0.494	0.74	
Residual	2830.867	67	42.252			

Table A-3. Regression model predicts participation in Neighborhood Council meetings using four independent variables. Data are means for five data periods.

Dep Var: JV N: 71 Multiple R: 0.286 Squared multiple R: 0.082

Adjusted squared multiple R: 0.026 Standard error of estimate: 0.205

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.159	0.113	0	.	1.416	0.162
WATERESTIM	-0.004	0.002	-0.236	0.932	-1.93	0.058
STORAGE	0	0	0.034	0.977	0.285	0.777
ECONLEV	0.031	0.035	0.122	0.736	0.886	0.379
GUTTASKAVE	-0.029	0.027	-0.144	0.759	-1.06	0.293
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.248	4	0.062	1.471	0.221	
Residual	2.785	66	0.042			

Table A-4. Regression model predicts participation in church meetings using four independent variables. Data are means for five data periods.

Dep Var: IG N: 72 Multiple R: 0.102 Squared multiple R: 0.010

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.795

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.452	0.43	0	.	1.05	0.298
WATERESTIM	0.005	0.008	0.082	0.928	0.653	0.516
STORAGE	0	0	0.062	0.975	0.505	0.615
ECONLEV	-0.028	0.136	-0.029	0.733	-0.206	0.837
GUTTASKAVE						
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.442	4	0.11	0.175	0.951	
Residual	42.374	67	0.632			

Regression Models with Two Independent Models, with Data for Means from Five Study Periods

Table A-5. Regression model predicts loans using two independent variables. Data are means for five data periods.

Dep Var: ITEM N: 72 Multiple R: 0.074 Squared multiple R: 0.005

Adjusted squared multiple R: 0.000 Standard error of estimate: 3.485

Effect	Coefficient	Std Error	Std Coef	Tolerance	T	P(2 Tail)
CONSTANT	3.47	0.815	0	.	4.258	0
WATERESTIM	0.018	0.032	0.068	0.999	0.57	0.571
STORAGE	0	0	0.025	0.999	0.207	0.837
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	4.566	2	2.283	0.188	0.829	
Residual	838.213	69	12.148			

Table A-5. Regression model predicts helping using two independent variables. Data are means for five data periods.

Dep Var: HELP N: 72 Multiple R: 0.154 Squared multiple R: 0.024

Adjusted squared multiple R: 0.000 Standard error of estimate: 6.422

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4.841	1.502	0	.	3.224	0.002
WATERESTIM	0.016	0.06	0.033	0.999	0.273	0.786
STORAGE	0	0	0.149	0.999	1.252	0.215
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	68.751	2	34.376	0.834	0.439	
Residual	2845.529	69	41.24			

Table A-6. Regression model predicts participation in Neighborhood Council meetings using two independent variables. Data are means for five data periods.

Dep Var: JV N: 71 Multiple R: 0.182 Squared multiple R: 0.033

Adjusted squared multiple R: 0.005 Standard error of estimate: 0.208

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.196	0.05	0	.	3.952	0
WATERESTIM	-0.003	0.002	-0.18	0.999	-1.509	0.136
STORAGE	0	0	0.028	0.999	0.239	0.812
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.1	2	0.05	1.16	0.32	
Residual	2.933	68	0.043			

Table A-7. Regression model predicts participation in church meetings using two independent variables. Data are means for five data periods.

Dep Var: IG N: 72 Multiple R: 0.098 Squared multiple R: 0.010

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.784

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.387	0.183	0	.	2.11	0.038
WATERESTIM	0.005	0.007	0.075	0.999	0.625	0.534
STORAGE	0	0	0.06	0.999	0.502	0.617
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.408	2	0.204	0.332	0.718	
Residual	42.408	69	0.615			

Regression Models with Two Independent Models, with Data from Five Study Periods

Table A-8. Regression model predicts food sharing using two independent variables. Data were coded from interviews conducted during study period 1 (April-May 2004).

Dep Var: FOOD1 N: 68 Multiple R: 0.189 Squared multiple R: 0.036

Adjusted squared multiple R: 0.006 Standard error of estimate: 11.121

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.311	2.1	0	.	3.006	0.004
STORAGE	0.001	0	0.191	0.981	1.55	0.126
ESTIM1	-0.006	0.064	-0.012	0.981	-0.101	0.92
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	298.508	2	149.254	1.207	0.306	
Residual	8038.713	65	123.673			

Table A-9. Regression model predicts visiting using two independent variables. Data were coded from interviews conducted during study period 1 (April-May 2004).

Dep Var: VISIT1 N: 68 Multiple R: 0.122 Squared multiple R: 0.015

Adjusted squared multiple R: 0.000 Standard error of estimate: 5.258

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	3.585	0.993	0	.	3.611	0.001
STORAGE	0	0	0.018	0.981	0.147	0.884
ESTIM1	0.029	0.03	0.118	0.981	0.952	0.345
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	27.223	2	13.611	0.492	0.613	
Residual	1796.895	65	27.645			

Table A-10. Regression model predicts loans using two independent variables. Data were coded from interviews conducted during study period 1 (April-May 2004).

Dep Var: LOAN1 N: 68 Multiple R: 0.134 Squared multiple R: 0.018

Adjusted squared multiple R: 0.000 Standard error of estimate: 3.520

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.937	0.665	0	.	4.419	0
STORAGE	0	0	0.125	0.981	1.009	0.317
ESTIM1	-0.011	0.02	-0.067	0.981	-0.541	0.59
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	14.658	2	7.329	0.592	0.556	
Residual	805.342	65	12.39			

Table A-11. Regression model predicts helping using two independent variables. Data were coded from interviews conducted during study period 1 (April-May 2004).

Dep Var: HELP1 N: 68 Multiple R: 0.141 Squared multiple R: 0.020

Adjusted squared multiple R: 0.000 Standard error of estimate: 5.442

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	3.5	1.028	0	.	3.406	0.001
STORAGE	0	0	0.142	0.981	1.144	0.257
ESTIM1	-0.002	0.031	-0.007	0.981	-0.057	0.955
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	39.058	2	19.529	0.659	0.521	
Residual	1924.942	65	29.614			

Table A-12. Regression model predicts participation in Neighborhood Council meetings using two independent variables. Data were coded from interviews conducted during study period 1 (April-May 2004).

Dep Var: JV1 N: 66 Multiple R: 0.176 Squared multiple R: 0.031

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.655

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.194	0.126	0	.	1.539	0.129
STORAGE	0	0	0.164	0.983	1.308	0.196
ESTIM1	0.001	0.004	0.048	0.983	0.383	0.703
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.87	2	0.435	1.012	0.369	
Residual	27.069	63	0.43			

Table A-13. Regression model predicts participation in church meetings using two independent variables. Data were coded from interviews conducted during study period 1 (April-May 2004).

Dep Var: IG1 N: 67 Multiple R: 0.212 Squared multiple R: 0.045

Adjusted squared multiple R: 0.015 Standard error of estimate: 1.307

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.36	0.248	0	.	1.448	0.153
STORAGE	0	0	0.129	0.981	1.043	0.301
ESTIM1	0.009	0.008	0.152	0.981	1.23	0.223
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	5.134	2	2.567	1.503	0.23	
Residual	109.284	64	1.708			

Table A-14. Regression model predicts food sharing using two independent variables. Data were coded from interviews conducted during study period 2 (June-July 2004).

Dep Var: FOOD2 N: 65 Multiple R: 0.069 Squared multiple R: 0.005

Adjusted squared multiple R: 0.000 Standard error of estimate: 28.820

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	18.127	5.967	0	.	3.038	0.003
STORAGE	0.001	0.001	0.066	0.997	0.518	0.606
ESTIM2	-0.037	0.189	-0.025	0.997	-0.194	0.847
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	246.205	2	123.102	0.148	0.863	
Residual	51496.349	62	830.586			

Table A-15. Regression model predicts loans using two independent variables. Data were coded from interviews conducted during study period 2 (June-July 2004).

Dep Var: LOAN2 N: 65 Multiple R: 0.024 Squared multiple R: 0.001

Adjusted squared multiple R: 0.000 Standard error of estimate: 5.682

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4.923	1.176	0	.	4.185	0
STORAGE	0	0	0.004	0.997	0.032	0.975
ESTIM2	-0.007	0.037	-0.024	0.997	-0.189	0.851
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	1.17	2	0.585	0.018	0.982	
Residual	2001.815	62	32.287			

Table A-16. Regression model predicts helping using two independent variables. Data were coded from interviews conducted during study period 2 (June-July 2004).

Dep Var: HELP2 N: 65 Multiple R: 0.324 Squared multiple R: 0.105

Adjusted squared multiple R: 0.076 Standard error of estimate: 9.174

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.89	1.899	0	.	1.521	0.133
STORAGE	0.001	0	0.304	0.997	2.529	0.014
ESTIM2	0.048	0.06	0.096	0.997	0.799	0.427
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	611.583	2	305.791	3.633	0.032	
Residual	5218.356	62	84.167			

Table A-17. Regression model predicts participation in Neighborhood Council meetings using two independent variables. Data were coded from interviews conducted during study period 2 (June-July 2004).

Dep Var: JV2 N: 64 Multiple R: 0.207 Squared multiple R: 0.043

Adjusted squared multiple R: 0.012 Standard error of estimate: 0.440

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.152	0.092	0	.	1.653	0.103
STORAGE	0	0	0.207	0.997	1.647	0.105
ESTIM2	-0.001	0.003	-0.028	0.997	-0.223	0.824
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.53	2	0.265	1.367	0.263	
Residual	11.829	61	0.194			

Table A-18. Regression model predicts participation in church meetings using two independent variables. Data were coded from interviews conducted during study period 2 (June-July 2004).

Dep Var: IG2 N: 64 Multiple R: 0.134 Squared multiple R: 0.018

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.755

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.295	0.158	0	.	1.87	0.066
STORAGE	0	0	0.12	0.997	0.942	0.35
ESTIM2	0.002	0.005	0.054	0.997	0.425	0.673
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.634	2	0.317	0.556	0.577	
Residual	34.803	61	0.571			

Table A-19. Regression model predicts loans using two independent variables. Data were coded from interviews conducted during study period 3 (August-September 2004).

Dep Var: LOAN3 N: 60 Multiple R: 0.146 Squared multiple R: 0.021

Adjusted squared multiple R: 0.000 Standard error of estimate: 4.980

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.477	1.123	0	.	2.206	0.031
STORAGE	0	0	0.11	0.998	0.835	0.407
ESTIM3	0.028	0.039	0.092	0.998	0.7	0.487
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	30.947	2	15.474	0.624	0.539	
Residual	1413.786	57	24.803			

Table A-20. Regression model predicts helping using two independent variables. Data were coded from interviews conducted during study period 3 (August-September 2004).

Dep Var: HELP3 N: 60 Multiple R: 0.266 Squared multiple R: 0.071

Adjusted squared multiple R: 0.038 Standard error of estimate: 10.133

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.846	2.284	0	.	1.246	0.218
STORAGE	0.001	0	0.204	0.998	1.597	0.116
ESTIM3	0.101	0.08	0.161	0.998	1.259	0.213
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	446.01	2	223.005	2.172	0.123	
Residual	5852.723	57	102.679			

Table A-21. Regression model predicts participation in Neighborhood Council meetings using two independent variables. Data were coded from interviews conducted during study period 3 (August-September 2004).

Dep Var: JV3 N: 58 Multiple R: 0.118 Squared multiple R: 0.014

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.311

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.066	0.072	0	.	0.91	0.367
STORAGE	0	0	0.111	0.999	0.831	0.409
ESTIM3	0.001	0.002	0.034	0.999	0.255	0.8
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.074	2	0.037	0.386	0.682	
Residual	5.305	55	0.096			

Table A-22. Regression model predicts participation in church meetings using two independent variables. Data were coded from interviews conducted during study period 3 (August-September 2004).

Dep Var: IG3 N: 58 Multiple R: 0.225 Squared multiple R: 0.051

Adjusted squared multiple R: 0.016 Standard error of estimate: 0.966

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.727	0.224	0	.	3.245	0.002
STORAGE	0	0	-0.131	0.999	-0.999	0.322
ESTIM3	-0.01	0.008	-0.178	0.999	-1.355	0.181
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	2.738	2	1.369	1.467	0.239	
Residual	51.33	55	0.933			

Table A-23. Regression model predicts food sharing using two independent variables. Data were coded from interviews conducted during study period 4 (October-November 2004).

Dep Var: FOOD4 N: 62 Multiple R: 0.047 Squared multiple R: 0.002

Adjusted squared multiple R: 0.000 Standard error of estimate: 14.353

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	8.12	3.316	0	.	2.449	0.017
STORAGE	0	0.001	0.029	0.968	0.217	0.829
ESTIM4	-0.027	0.113	-0.032	0.968	-0.243	0.809
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	26.594	2	13.297	0.065	0.938	
Residual	12154.373	59	206.006			

Table A-24. Regression model predicts visiting using two independent variables. Data were coded from interviews conducted during study period 4 (October-November 2004).

Dep Var: VISIT4 N: 62 Multiple R: 0.128 Squared multiple R: 0.016

Adjusted squared multiple R: 0.000 Standard error of estimate: 9.606

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	5.418	2.219	0	.	2.442	0.018
STORAGE	0	0	0.1	0.968	0.761	0.449
ESTIM4	0.057	0.076	0.099	0.968	0.756	0.453
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	90.025	2	45.012	0.488	0.616	
Residual	5444.249	59	92.275			

Table A-25. Regression model predicts loans using two independent variables. Data were coded from interviews conducted during study period 4 (October-November 2004).

Dep Var: LOAN4 N: 62 Multiple R: 0.102 Squared multiple R: 0.010

Adjusted squared multiple R: 0.000 Standard error of estimate: 5.817

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	3.88	1.344	0	.	2.887	0.005
STORAGE	0	0	-0.062	0.968	-0.475	0.637
ESTIM4	0.024	0.046	0.07	0.968	0.529	0.599
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	20.807	2	10.404	0.307	0.737	
Residual	1996.612	59	33.841			

Table A-26. Regression model predicts helping using two independent variables. Data were coded from interviews conducted during study period 4 (October-November 2004).

Dep Var: HELP4 N: 62 Multiple R: 0.093 Squared multiple R: 0.009

Adjusted squared multiple R: 0.000 Standard error of estimate: 8.278

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.778	1.912	0	.	3.544	0.001
STORAGE	0	0	0.001	0.968	0.006	0.995
ESTIM4	-0.046	0.065	-0.093	0.968	-0.704	0.484
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	35.22	2	17.61	0.257	0.774	
Residual	4042.989	59	68.525			

Table A-27. Regression model predicts participation in Neighborhood Council meetings using two independent variables. Data were coded from interviews conducted during study period 4 (October-November 2004).

Dep Var: JV4 N: 58 Multiple R: 0.177 Squared multiple R: 0.031

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.256

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.114	0.06	0	.	1.879	0.066
STORAGE	0	0	-0.179	0.968	-1.33	0.189
ESTIM4	-0.001	0.002	-0.041	0.968	-0.302	0.763
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.116	2	0.058	0.887	0.418	
Residual	3.608	55	0.066			

Table A-28. Regression model predicts participation in church meetings using two independent variables. Data were coded from interviews conducted during study period 4 (October-November 2004).

Dep Var: IG4 N: 58 Multiple R: 0.131 Squared multiple R: 0.017

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.950

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.321	0.224	0	.	1.431	0.158
STORAGE	0	0	0.104	0.968	0.764	0.448
ESTIM4	0.006	0.008	0.101	0.968	0.747	0.458
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.873	2	0.437	0.484	0.619	
Residual	49.627	55	0.902			

Table A-29. Regression model predicts food sharing using two independent variables. Data were coded from interviews conducted during study period 5 (December 2004-January 2005).

Dep Var: FOOD5 N: 59 Multiple R: 0.178 Squared multiple R: 0.032

Adjusted squared multiple R: 0.000 Standard error of estimate: 17.176

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	11.55	3.876	0	.	2.98	0.004
STORAGE	0.001	0.001	0.16	0.99	1.208	0.232
ESTIM5	-0.069	0.141	-0.065	0.99	-0.491	0.625
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	542.182	2	271.091	0.919	0.405	
Residual	16521.377	56	295.025			

Table A-30. Regression model predicts visiting using two independent variables. Data were coded from interviews conducted during study period 5 (December 2004-January 2005).

Dep Var: VISIT5 N: 59 Multiple R: 0.230 Squared multiple R: 0.053

Adjusted squared multiple R: 0.019 Standard error of estimate: 16.383

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	9.256	3.697	0	.	2.503	0.015
STORAGE	0.001	0.001	0.225	0.99	1.72	0.091
ESTIM5	-0.032	0.134	-0.032	0.99	-0.242	0.81
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	840.353	2	420.176	1.565	0.218	
Residual	15031.308	56	268.416			

Table A-31. Regression model predicts loans using two independent variables. Data were coded from interviews conducted during study period 5 (December 2004-January 2005).

Dep Var: LOAN5 N: 59 Multiple R: 0.049 Squared multiple R: 0.002

Adjusted squared multiple R: 0.000 Standard error of estimate: 7.760

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4.91	1.751	0	.	2.803	0.007
STORAGE	0	0	0.024	0.99	0.181	0.857
ESTIM5	-0.019	0.063	-0.04	0.99	-0.295	0.769
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	7.954	2	3.977	0.066	0.936	
Residual	3372.555	56	60.224			

Table A-32. Regression model predicts helping using two independent variables. Data were coded from interviews conducted during study period 5 (December 2004-January 2005).

Dep Var: HELP5 N: 59 Multiple R: 0.070 Squared multiple R: 0.005

Adjusted squared multiple R: 0.000 Standard error of estimate: 8.604

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7.052	1.942	0	.	3.632	0.001
STORAGE	0	0	0.037	0.99	0.274	0.785
ESTIM5	-0.029	0.07	-0.056	0.99	-0.419	0.677
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	20.438	2	10.219	0.138	0.871	
Residual	4145.223	56	74.022			

Table A-33. Regression model predicts participation in Neighborhood Council meetings using two independent variables. Data were coded from interviews conducted during study period 5 (December 2004-January 2005).

Dep Var: JV5 N: 57 Multiple R: 0.103 Squared multiple R: 0.011

Adjusted squared multiple R: 0.000 Standard error of estimate: 0.261

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.047	0.06	0	.	0.781	0.438
STORAGE	0	0	0.103	0.989	0.757	0.452
ESTIM5	0	0.002	0.016	0.989	0.121	0.904
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	0.039	2	0.02	0.288	0.751	
Residual	3.68	54	0.068			

Table A-34. Regression model predicts participation in church meetings using two independent variables. Data were coded from interviews conducted during study period 5 (December 2004-January 2005).

Dep Var: IG5 N: 57 Multiple R: 0.197 Squared multiple R: 0.039

Adjusted squared multiple R: 0.003 Standard error of estimate: 0.994

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.821	0.228	0	.	3.609	0.001
STORAGE	0	0	-0.193	0.989	-1.437	0.156
ESTIM5	-0.004	0.008	-0.064	0.989	-0.479	0.634
Analysis of Variance						
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P	
Regression	2.149	2	1.074	1.087	0.344	
Residual	53.36	54	0.988			

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