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Funded Research Proposal to the National Science Foundation  
Dissertation Development Grant Competition  
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**Title: The Effects of Water Scarcity on Reciprocity and Sociability in Bolivia**

Statement of the Problem

Reports on the state of freshwater reserves warn that severe local shortages are imminent, and predict that violent conflicts will emerge in water-scarce regions (Ohlsson 1995, Elhance 1999). Water scarcity has been shown to cause civil conflict, particularly when accompanied by high population density, poverty, and income inequality (Homer-Dixon 1994, 1996, Hauge and Ellingsen 1998). Urban migrant communities, where ethnic, religious, and class differences can exacerbate tensions, and community-wide patterns of adaptation to environmental scarcities are not well-formed, may be particularly vulnerable to water conflicts (Moench 2002). To better understand how conflicts develop in water-scarce regions, research is needed on the social and economic factors that mediate cooperation and conflict (Ronfeldt 1997). I propose to do an in-depth study of Villa Israel, a barrio of Cochabamba, Bolivia, where conflict over water is an established part of life. Every winter, seasonal water shortages threaten the lives of the people of Villa Israel, forcing them to make choices in how they use their economic and social resources.

One factor that mitigates the incidence and intensity of conflicts is the existence of cooperative ties within a community (Ross 1993). In marginal urban settings, poverty and mutual assistance foster social support networks (Low 1996) that strengthen community ties. However, Laughlin and Brady's model (1978) of adaptation to environmental stress predicts that, in times of severe resource scarcity, individuals will withdraw from the generalized reciprocal exchange relationships and social relationships that characterize urban social support networks. The proposed research in Villa Israel will test the Laughlin and Brady model to determine if severe water scarcity erodes reciprocal exchange and social relationships.

Research Objectives

The overall objective is to understand how severe water scarcity affects reciprocal exchange relationships and social relationships in a marginal urban setting. The five specific objectives are:

1. to document the incidence of water scarcity in the research community. This involves the development and testing of a scale to assess water consumption, as well as conducting interviews to document variation of water use in a sample of households.
2. to determine how water scarcity affects the frequency and quality of reciprocal exchanges between households. This involves documenting the reciprocal exchanges that a sample of households engages in over a nine-month period.

3. to determine how water scarcity affects the frequency and quality of social interactions between households. This involves documenting the social interactions that a sample of households engages in over a nine-month period.
4. to determine if community norms exist for determining the order in which households withdraw from reciprocal exchange relationships. This involves testing how economic interactions change under a variety of hypothetical conditions in an experimental game.
5. to determine if households withdraw from reciprocal exchange and social relationships in the order established by community norms.

### Literature Review

The existence and quality of intracommunity ties has long been recognized as a factor that determines how conflicts evolve over scarce resources and other threats (Simmel 1904 [1955], Coser 1956, Mack 1965). The degree of connectedness and the presence of ties that cross social segments are both elements of social structure that inhibit conflict development (Gluckman in Ross 1993, LeVine and Campbell 1972). Although early conflict theorists called for empirical research to investigate when and in what order social ties are broken (Coleman 1957), such studies have been conducted in only a few geographic regions and on a few environmental scarcities.

Laughlin and Brady's (1978) model of adaptation describes how economic and social interactions fluctuate with seasonal patterns of resource scarcity. They hypothesize that, during times of widespread (but non-lethal) deprivation, households will increase generalized reciprocal exchanges and social interactions. When resource scarcity becomes more severe, households will shift to balanced or negative reciprocal exchanges and will withdraw from social relationships. Dirks (1980) demonstrated that, whether famines are seasonal or unpredictable, societies pass from an initial stage of alarm (characterized by intensified sharing and sociability) to resistance (characterized by economic and social withdrawal into households and kin groups) to exhaustion (in which kin-based alliances to find food disintegrate) as scarcity worsens. Laughlin and Brady's model was validated by a series of African famine case studies (Laughlin 1974, Cashdan 1985, Corbett 1988, Walker 1989).

Similar to the survival tactics documented in rural African households, urban Andean households engage in frequent reciprocal exchanges to guard against privation. For the purposes of this research, the social support networks of impoverished urban communities are considered to be characteristic of the first stage of response to deprivation. The anthropological literature on Andean survival strategies indicates that people form mutual support relationships based on five major kinds of ties: kin, *compadrazgo*, *paisano*, work, and church.

One of the most powerful cooperative strategies that urban migrants use to survive is to form kin-based groups (Halebsky 1995). In the Andes, the basic units for such groups are

nuclear and extended households (Lobo 1995 [1982]). Beyond the household, ties with extended families and fictive kin constitute the heart of Andean support networks. In Lima, groups of siblings and cousins migrated together from the highlands. These siblings formed powerful core groups, which they later augmented with marriage alliances (Lobo 1995 [1982]). Familial support is also enhanced with *compadrazgo* ties, in which ceremonial parents establish relationships for mutual aid with their fictive children (Isbell 1985 [1978]). In addition, *paisanos*, or people who came from the same highland district, are relied upon to help and defend each other in urban settlements (Lobo 1995 [1982]). Similarly, in Mexico City, kinship, *compadrazgo*, and informal social networks provided services, goods, and information that were crucial to the survival of residents of a shantytown (Lomnitz 1977).

Andean communities also tend to have strong traditions of mutual support founded on work-based solidarity (Buechler and Buechler 1971). In urban settlements, such ties of mutual support may be formed around cooperative welfare projects (McFarren 1992), union membership or shared professions (Nash 1993 [1979]), and camaraderie established while women do housework or work in markets (Weismantel 2001).

Churches provide another setting in which mutual support relationships are formed (Krause et al. 2001). Regardless of the denomination, parishioners generally belong to church organizations that provide assistance to needy community members, and form informal assistance networks among themselves. One particularly important form of reciprocity is the obligation to provide goods and labor to kin and fictive kin during Catholic festivals (Isbell 1985 [1978]). Protestants, lacking a system of festival-based reciprocity, form informal social support networks to provide goods and services to churchgoers (cf. Stewart-Gambino and Wilson 1997).

While the adaptive elements of Latin American urban support networks have been extensively documented, the effects of severe resource scarcity on urban networks remain unexplored. Lomnitz (1978) suggested that extreme deprivation would likely cause decrement of generalized reciprocal exchanges and social interactions in urban areas. Still, no empirical research has tested the effects of drought or severe water scarcity on urban support ties.

### Hypotheses

Assuming that all households engage in exchange and social relationships, and that the amount of water available to the households varies, I propose ten hypotheses:

H1. Generalized reciprocal exchanges will occur more frequently in the wet season than in the dry season.

H2. Social interactions will occur more frequently in the wet season than in the dry season.

H3. During the dry season, households with more water will engage in more generalized reciprocal exchanges than will households with less water.

H4. During the dry season, households with more water will engage in generalized reciprocal exchange relationships with more households than will households with less water.

H5. During the dry season, households with more water will engage in more social interactions than will households with less water.

H6. During the dry season, households with more water will engage in social relationships with more households than will households with less water.

H7. People will trust partners to reciprocate under experimental conditions most if they believe partners are kin, followed by *compadres*, then *paisanos*, then co-workers, and finally co-parishioners.

H8. People will reciprocate under experimental conditions most if they believe partners are kin, followed by *compadres*, then *paisanos*, then co-workers, and finally co-parishioners.

H9. During the dry season, households will withdraw from generalized reciprocal exchange relationships in the order predicted by the experimental game.

H10. During the dry season, households will withdraw from social relationships in the order predicted by the experimental game.

### **Research Plan**

The research will proceed in two phases. During the first phase, I will select a 60-household purposive sample, create and test interview protocols, choose key informants, and train a research assistant. The first phase will lay the groundwork for the second, so that I will be prepared to complete a baseline assessment of exchange and social interactions before the dry season begins in May. During the second phase, I will conduct in-depth interviews with key informants and four ethnographic interviews with each household in the sample. At the end of the second phase, I will conduct a series of experimental economic games to determine the norms of trust and reciprocity in the community.

The research design has several strengths. First, ethnographic study will yield data with high internal validity about how responses to water scarcity evolve over the wet-to-dry cycle (Kirk and Miller 1986). Second, the household interviews allow me to document change by collecting repeated measurements of household characteristics over time. Third, interviews with key informants allow me to collect information with more time depth than would be available with only the household interviews. Fourth, the experimental game allows me to determine how certain ties affect trust and reciprocity, controlling for other factors like history. Finally, the use of three forms of data collection – household interviews, interviews with key informants, and an experimental game – will

enable me to check the results of each method against the other, facilitating identification of sample biases, hoax answers, or other data problems.

### Research Schedule

Phase 1:	
Review household census data, choose purposive sample Train research assistant Translate household interview protocol	January-February
Create water scale – preliminary research and testing Choose key informants Pre-test household interview protocol	February-March
Phase 2:	
Conduct semi-structured household interviews Conduct interviews with key informants	April-November (4 two-month cycles)
Investment Game	November-December
Transcribe narratives Convert narrative data into profile matrices Record data in Excel format	Ongoing (February-December)

### Research Site: Villa Israel, Cochabamba, Bolivia

Cochabamba is a large Bolivian city located in a semi-arid zone, made famous in 2000 by protests and riots over water delivery that received international attention. There, a rapid increase in water demand caused by urban growth, groundwater scarcity, and topography that drains water away from the city have intensified pressures on the municipal water distribution system (Laurie and Marvin 1999). Lacking the capital to extend water services to its growing periphery, Cochabamba contains a large population of marginal urban residents that lack access to the municipal water system.

Villa Israel, a neighborhood on the outskirts of Cochabamba, is an impoverished community of 565 migrant families. The population contains people of Quechua and Aymara origin, and members of four different Catholic and Protestant churches. Currently, Villa Israel has no municipal water or sanitation services. Most households buy drinking water from a 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). Households may purchase between 20 and 40 liters of low-cost, untreated drinking water a day through thirteen public faucets controlled by the Unión Cristiana Evangélica, a Protestant church (Trujillo 2002). During the wet season, households also collect rainfall and water from canal beds used to drain sewage and wastewater. The ability of a household to acquire sufficient water depends on its per capita income and its exchange relationships with other households. Throughout the year, all households lack sufficient water for daily sanitation tasks in Villa Israel. As the

winter dry season progresses, the impacts of water scarcity become increasingly severe. For example, between April and July of 2002, fourteen children under the age of one died from water-related illnesses (Trujillo 2002).

### Data collection

***Sampling and choosing key informants*** Using the Unión Cristiana Evangélica census of Villa Israel as a sample frame, I will select a purposive sample of 60 households. Households will be selected to maximize variation on the following variables: number of members, ethnicity, religious affiliation, head of household's profession, and geographic location of the house (distance from water sources). Although choosing a purposive sample renders generalization from the study impossible, the purposive sample will enable me to choose households that maximize variation on the independent variables (Bernard 2002). A sample of 60 is small enough so that, with the help of a research assistant, I can do rigorous, in-depth study of the sample, and I also have enough observations to do inferential statistics to test the hypotheses.

Upon entering the field, I will also begin to look for key informants through word-of-mouth recommendations. I will attempt to find key informants using an a priori analytic framework (Johnson 1990), that is, based on the characteristics that will give informants access to different experiences in the community (ethnicity, religion, profession, age, and gender). Having several key informants will allow me to check their recollections and assessments of norms against each other.

***Measurement of water availability*** To determine when the wet and dry seasons begin and end (independent variables H1-2), I will consult published records of precipitation in Cochabamba for 2004. To determine the amount of water available to each household at each interview time (independent variable H4-6), I will use a Guttman scale. Attempts to physically measure the volume of water acquired by the household from all sources may result in serious measurement errors. Instead, I will develop a Guttman scale of water use (Guttman 1950). First, I will elicit free lists of water uses from adult women and prepare a list of, say, the 20 most commonly listed items (the exact number will be determined by examining the data, of course, for repetitions of items.). Next, I will determine which tasks appear be part of a common water use domain. To do this, I will ask 20 women to indicate which of the tasks on the streamlined list (e.g., drinking, washing windows, bathing, watering plants, and cooking) each household member has completed in the last day and in the last week. I will then create two scales (for weekly and daily use), calculating the coefficient of reproducibility (CR – the statistic that summarizes errors in the scale), for each. If the CR is greater than .85, I will consider water use to scale sufficiently (Bernard 2002). I will then use the modal household water use to represent overall water availability in the household. If water use does not scale, I will collect measures of the volume of water acquired by each household from all sources at the time of each interview, and will also ask the person responsible for collecting water to assess how much water was collected that day.

**Household interviews** To determine the number of reciprocal exchanges (dependent variable H1,3), the number of reciprocal exchange relationships (dependent variable H4), the number of social visits (dependent variable H2,5), and the number of social relationships (dependent variable H6) that each household has engaged in during the week preceding each interview as well as the order in which households withdraw from those relationships (dependent variables H9-10), I will conduct one interview every two months with each of the 60 households in the purposive sample. The interview will be conducted primarily with the adult responsible for housekeeping, but I will verify responses with other household members during the interview. Each household will be allocated 4 to 8 hours per meeting for interviewing and observation. Because residents of marginal Cochabamban neighborhoods tend to mistrust and avoid researchers with structured survey protocols (Goldstein 2002), I will conduct informal, semi-structured interviews with household members. With respondents' permission, I will record interviews using a digital sound recorder. I will take detailed field notes and observations using Spradley's method for note-taking (1980). In interviews with key informants, I will also supplement field notes with digital sound recording whenever possible.

For the semi-structured interviews, I will modify the interview protocol from Stack's classic study of urban survival strategies (1970) for use in the Andes (see appendix). To do so, I will translate the protocol with a bilingual Spanish-speaker, and pre-test the protocol with households outside the sample. The protocol includes questions about daily life, the acquisition of goods, finances, and leisure time. The advantages of using a modified version of the Stack protocol are that it has been pre-tested for research on urban survival strategies, it is flexible enough to accommodate Andean social structure, and successful replication of Stack's results will enhance the external validity of previous findings about how urban support systems function. In interviews with key informants, I will expand on the household interview protocol, and will probe for anecdotes about times when ties have been broken or when people have come into conflict over water.

**Experimental game** Following anthropologists who have modified experimental economic methods to study economic behaviors in 15 small-scale societies (Henrich et al. 2001), I will use an investment game (Berg et al. 1995) to discover the social norms that determine when and with whom households trust (dependent variable H7) and reciprocate (dependent variable H8). I will set up the games using Barr's investment game protocol and script, as she made modifications to the original protocol to facilitate its use in developing nations (2001). The game is an anonymous, one-time economic interaction between two people that uses real money. The player A is given a sum equal to one day's labor (about US \$3), and the option to keep the money or send some of it to the player B. If the money is sent to player B, it triples and player B determines how much of the money should be returned to player A. The amount of money offered by player A indicates how much A trusts B, and the amount B returns to A is a measure of reciprocation (Berg et al. 1995). By informing players A and B that the anonymous opposing player shares kin, *compadrazgo*, *paisano*, work, or religious affiliation, the experiment can be manipulated to test the strength of trust and reciprocity for each tie. I will conduct 60 repetitions of each interaction for each scenario, totaling 360 repetitions.

### Data analysis

***Data entry and coding*** Interviews will be transcribed by the field assistant as they are conducted. Data from the interviews will be used to construct an ordinal measure of water use (H4-6) and four interval-level dependent variables: the number of generalized reciprocal exchanges that occurred in the last week (H1,3), the number of households with which the respondents exchanged in the last week (H4), the number of social visits that occurred in the last week (H2,5), the number of households with which the respondents visited in the last week (H6). The amount of offers (H7) and counter-offers (H8) made during the investment game will be recorded in Bolivianos. Quantitative data for households will be entered directly into Excel spreadsheets.

***Inferential statistics*** I will use t-tests to compare mean numbers of exchange and social interactions for the wet and dry season (H1, H2), and ANOVA to determine if levels of household water availability are associated with differences in mean levels of exchange and interaction (H3-H6). Analysis of variance tests will also be used to if different social ties are associated with differences in mean monetary measures of trust and reciprocity (H7, H8). I will use repeated measures ANOVA to test hypotheses 9 and 10.

***Analysis of ethnographic data*** Field notes and transcribed narratives that include anecdotes about tie breaking and water conflicts will be coded to indicate if the case supports or disproves any of the hypotheses. I will examine each case to better understand the dynamics of tie breakage and water conflicts.

### Preliminary Studies

In summer 2002, I traveled to Bolivia to conduct preliminary fieldwork and establish relationships with institutions that support this study. I interviewed project coordinators in USAID, CARE, the Peace Corps, and Bolivian NGOs to learn about how communities adapt to conditions of water scarcity. After the interviews, I determined that Villa Israel would be an ideal site to test the research question.

In Cochabamba, I became associated with three organizations that are working on local water problems. The first, The Democracy Center, is a Cochabamba-based organization that works to strengthen the advocacy efforts of community groups. The second organization, Water for People, is an international NGO that helps communities in Cochabamba that lack adequate water delivery install wells, hand pumps, and sanitation systems. The third is the Unión Cristiana Evangélica church, which manages the distribution of water through tap stands in Villa Israel.

Each of these organizations has provided me with valuable information about the water situation, introductions to key community leaders in Cochabamba and Villa Israel, and has pledged to support me during the year-long data collection project. Since my return, I have stayed in frequent contact with representatives of the three organizations, and continue to receive data and consult with them on logistics of conducting research and living in Villa Israel. During summer of 2003, I will return to Villa Israel to introduce myself formally to community members, hire a research assistant from the sociology

department at the Universidad Mayor de San Simón, and finalize living arrangements for the following January.

### Research Competence of the Student

Over six years of coursework, I have acquired a solid four-field education in anthropology that enables me to understand the cultural, biological, historical, and symbolic aspects of water scarcity and conflict. My preparation for this research includes coursework in the following subjects: research design and cognitive research methods with Dr. H. Russell Bernard, economic anthropology and studies of race and ethnicity with Dr. Anthony Oliver-Smith, political ecology and development in the tropics with Dr. Marianne Schmink, and anthropological theory with Dr. Maxine Margolis. During spring 2003, I will take a fourth course in statistics, as well as a course in hydrology. I supplemented graduate coursework with an intensive six-week language course in Oaxaca, Mexico during the summer of 2000, in which I polished the Spanish skills I acquired studying and working in South Florida between 1992 and 1996.

While assisting Drs. H. Russell Bernard and Christopher McCarty in research projects between 1997 and 2002, I honed my skills in sampling, questionnaire design, data collection and data analysis. Under Dr. Bernard's direction, I have conducted ethnographic interviews, transcribed narratives, and done text analysis, social network analysis, and multivariate analyses. I currently manage data collection and analysis for the Survey Research Center at the UF Bureau of Economic and Business Research under the supervision of Dr. McCarty. My responsibilities include overseeing a four-survey evaluation of health care in the state of Florida, which involves 300 interviewers and 13,500 interviews. After five years of practice and hands-on instruction in ethnographic and survey research methods, I have become an experienced and capable researcher.

I have also conducted three independent research projects in cities and marginal urban areas. Two of these projects took place in Mexico and Bolivia, where I honed my ability to do research in Spanish. In 2001, I conducted a study on the effects of social support networks on child feeding decisions with the Mexican Social Security Institute in Oaxaca. In 2002, I traveled to Bolivia to conduct preliminary fieldwork and establish relationships with institutions that support my work. When I return to Bolivia in January 2004, I will have the experience, knowledge, and local support to successfully conduct the proposed research.

### Significance of Proposed Research

This research will contribute to two areas of social science inquiry: urban anthropology and environment-conflict theory. The research will be the first study to examine if and how urban social support relationships are transformed by severe water scarcity. Understanding how reciprocal exchange and social ties are strained during periods of severe deprivation will contribute to efforts to understand the dynamics involved in conflict over environmental resources.

Through in-depth study of one case, the research will produce data with high internal validity. This is particularly important because the research examines the *process* of

withdrawal from reciprocal exchange and social relationships. In using Stack's ethnographic interview protocol and Berg et al.'s experimental investment game, the proposed research replicates well-known research, and facilitates future replications to establish the external validity of the findings.

In addition to its theoretical contributions, the study has practical applications for those seeking to anticipate and manage coming conflicts over scarce freshwater. In many Latin American cities, the arrival of new immigrants strains the ability of the local government to provide municipal services to all city residents (Gilbert 1998). By determining when and how social ties become vulnerable during periods of severe water scarcity, the research will point to possible avenues for conflict prevention in marginal urban communities. In Cochabamba, I will disseminate my findings to three local NGOs (The Democracy Center, Water for People, and the Unión Cristiana Evangélica church) and will suggest ways in which the research can be of use in future water delivery projects.

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## **B. PERSONNEL**

### Half-time Undergraduate Student Research Assistant (46 weeks) \$2020

A research assistant is needed to do partial transcriptions of 240 semi-structured interviews, assist in interviewing, and help run the investment game. The research assistant's salary was calculated at \$2.20 an hour, 20 hours a week, for 46 weeks. Because the student will be hired from the sociology department from the local university (*Universidad Mayor de San Simón*), and will be offered an internship opportunity with intensive methods training, this will likely be a sufficient wage to attract a dedicated research assistant.

## **E2. TRAVEL (Foreign)**

### American Airlines round-trip ticket \$650

Economy seating. Transportation from Miami (the least expensive airport in Florida for travel to Latin America) to Cochabamba. Because of the amount of luggage the Co-PI will be traveling with, she will need to fly directly to Cochabamba.

### Living expenses for Co-PI (12 months) \$6200

Living expenses were calculated for the Co-PI to reside and work in Villa Israel, Cochabamba for 12 months. The requested amount is 46% of the State Department estimate for the cost of living in Cochabamba, and totals about 85% of an average factory worker's salary in Bolivia. Because she will be living in a working class neighborhood, \$6200 will be sufficient for the Co-PI to subsist at a standard of living similar to that of the other community members.

### Transportation \$200

Bus fare will be needed to travel from Villa Israel to any other part of Cochabamba. Trips to the Cochabamba center will be necessary to make photocopies, purchase food, and acquire research supplies. The transportation budget also includes funds for occasional taxi rides to and from the airport, to carry large loads, and in the evening when buses stop running to Villa Israel.

## **G1. OTHER DIRECT COSTS (Materials and Supplies)**

### Pre-owned laptop computer \$600

A laptop computer is essential for data entry, management, transcription, and analysis. The \$600 estimate is for a bottom-of-the-line pre-owned laptop with the capacity to run Excel, A-3000, and SYSTAT.

### Digital sound recorder \$70

A digital sound recorder is needed to record semi-structured interviews, so that they can be transcribed by the research assistant. The \$70 estimate is for a new, low-end digital recorder on sale.

A-3000 transcription kit \$100

The transcription kit will speed the transcription work of the research assistant, so that he or she will also be able to participate in the data collection. The A-3000 transcription kit includes software, a headset, and a foot pedal.

**G6. OTHER DIRECT COSTS (other)**

Investment game \$2160

The investment game must be played with a substantial starting bid (Berg et al. 1995). A common measure of an appropriate starting bid is one day's wages. In Bolivia, the average day's wage for a factory worker is \$3.50; the Co-PI will set the starting bid at \$3. The estimate of \$2160 assumes that half of the players will send nothing (so that the cost of the interaction is \$3) and half of the players send the full amount (so that the cost of the interaction is \$9).

**TOTAL EXPENSES \$12,000**